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PART 1 GENERAL

1.01 PROJECT
A. Project Name: 18069_95 SW 5th Ave Development
B. Owner's Name: Palm Beach County.
C. Architect's Name: Song + Associates, Inc..
D. The Project consists of the construction of a new two-story CMU and precast joist and beams with poured floor slab shell structure. Housing 3 future tenant space build out areas. Along with covered parking garage tenant common areas.

1.02 CONTRACT DESCRIPTION
A. Contract Type: A single prime contract based on a Stipulated Price as described in Document 00 52 00 - Agreement Form.

1.03 OWNER OCCUPANCY
A. Owner intends to occupy the Project upon Substantial Completion.
B. Cooperate with Owner to minimize conflict and to facilitate Owner's operations.
C. Schedule the Work to accommodate Owner occupancy.

1.04 CONTRACTOR USE OF SITE
A. Construction Operations: Limited to areas noted on Drawings.
   1. Locate and conduct construction activities in ways that will limit disturbance to site.
B. Provide access to and from site as required by law and by Owner:
   1. Emergency Building Exits During Construction: Keep all exits required by code open during construction period; provide temporary exit signs if exit routes are temporarily altered.
   2. Do not obstruct roadways, sidewalks, or other public ways without permit.
C. Existing building spaces may not be used for storage.
D. Time Restrictions:
   1. Limit conduct of especially noisy exterior work to hours as agreed to with Palm Beach County.
   2. Limit conduct of hours as agreed to with Palm Beach County.

PART 2 PRODUCTS - NOT USED
PART 3 EXECUTION - NOT USED

END OF SECTION 01 10 00
SECTION 01 20 00
PRICE AND PAYMENT PROCEDURES

PART 1 GENERAL

1.01 SECTION INCLUDES
A. Procedures for preparation and submittal of applications for progress payments.
B. Documentation of changes in Contract Sum and Contract Time.
C. Change procedures.
D. Correlation of Contractor submittals based on changes.
E. Procedures for preparation and submittal of application for final payment.

1.02 SCHEDULE OF VALUES
A. Use Schedule of Values Form: As agreed upon in Owner-Contractor Agreement.
B. Electronic media printout including equivalent information will be considered in lieu of standard form specified; submit draft to Architect for approval.
C. Forms filled out by hand will not be accepted.
D. Submit Schedule of Values in duplicate within 15 days after date established in Notice to Proceed.
E. Format: Utilize the Table of Contents of this Project Manual. Identify each line item with number and title of the specification section. Identify site mobilization.
F. Include separately from each line item, a direct proportional amount of Contractor's overhead and profit.
G. Revise schedule to list approved Change Orders, with each Application For Payment.

1.03 APPLICATIONS FOR PROGRESS PAYMENTS
A. Payment Period: Submit at intervals stipulated in the Agreement.
B. Electronic media printout including equivalent information will be considered in lieu of standard form specified; submit sample to Architect for approval.
C. Forms filled out by hand will not be accepted.
D. For each item, provide a column for listing each of the following:
   1. Item Number.
   2. Description of work.
   4. Previous Applications.
   5. Work in Place and Stored Materials under this Application.
   6. Authorized Change Orders.
   7. Total Completed and Stored to Date of Application.
   8. Percentage of Completion.
  10. Retainage.
E. Execute certification by signature of authorized officer.
F. Use data from approved Schedule of Values. Provide dollar value in each column for each line item for portion of work performed and for stored products.
G. List each authorized Change Order as a separate line item, listing Change Order number and dollar amount as for an original item of work.
H. Submit one electronic and three hard-copies of each Application for Payment.
I. Include the following with the application:
   1. Transmittal letter as specified for submittals in Section 01 30 00.
   2. Construction progress schedule, revised and current as specified in Section 01 30 00.
   3. Current construction photographs specified in Section 01 30 00.
4. Partial release of liens from major subcontractors and vendors.
5. Affidavits attesting to off-site stored products.

J. When Owner or Architect requires substantiating information, submit data justifying dollar amounts in question. Provide one copy of data with cover letter for each copy of submittal. Show application number and date, and line item by number and description.

1.04 MODIFICATION PROCEDURES

A. For minor changes not involving an adjustment to the Contract Sum or Contract Time, Architect will issue instructions directly to Contractor.

B. For other required changes, Architect will issue a document signed by Owner instructing Contractor to proceed with the change, for subsequent inclusion in a Change Order.
   1. The document will describe the required changes and will designate method of determining any change in Contract Sum or Contract Time.
   2. Promptly execute the change.

C. For changes for which advance pricing is desired, Architect will issue a document that includes a detailed description of a proposed change with supplementary or revised drawings and specifications, a change in Contract Time for executing the change with a stipulation of any overtime work required and the period of time during which the requested price will be considered valid. Contractor shall prepare and submit a fixed price quotation within 7 days.

D. Contractor may propose a change by submitting a request for change to Architect, describing the proposed change and its full effect on the work, with a statement describing the reason for the change, and the effect on the Contract Sum and Contract Time with full documentation. Document any requested substitutions in accordance with Section 01 6000.

E. Computation of Change in Contract Amount: As specified in the Agreement and Conditions of the Contract.
   1. For change requested by Owner or Architect for work falling under a fixed price contract, the amount will be based on Contractor's price quotation.
   2. For change requested by Contractor, the amount will be based on the Contractor's request for a Change Order as approved by Owner and Architect.

F. Substantiation of Costs: Provide full information required for evaluation.
   1. On request, provide the following data:
      a. Quantities of products, labor, and equipment.
      b. Taxes, insurance, and bonds.
      c. Overhead and profit.
      d. Justification for any change in Contract Time.
      e. Credit for deletions from Contract, similarly documented.
   2. Support each claim for additional costs with additional information:
      a. Origin and date of claim.
      b. Dates and times work was performed, and by whom.
      c. Time records and wage rates paid.
      d. Invoices and receipts for products, equipment, and subcontracts, similarly documented.
   3. For Time and Material work, submit itemized account and supporting data after completion of change, within time limits indicated in the Conditions of the Contract.

G. Execution of Change Orders: Architect will issue Change Orders for signatures of parties as provided in the Conditions of the Contract.

H. After execution of Change Order, promptly revise Schedule of Values and Application for Payment forms to record each authorized Change Order as a separate line item and adjust the Contract Sum.

I. Promptly revise progress schedules to reflect any change in Contract Time, revise sub-schedules to adjust times for other items of work affected by the change, and resubmit.

J. Promptly enter changes in Project Record Documents.
1.05 APPLICATION FOR FINAL PAYMENT
   A. Prepare Application for Final Payment as specified for progress payments, identifying total
      adjusted Contract Sum, previous payments, and sum remaining due.
   B. Application for Final Payment will not be considered until the following have been
      accomplished:
      1. All closeout procedures specified in Section 01 70 00.

PART 2 PRODUCTS - NOT USED
PART 3 EXECUTION - NOT USED

END OF SECTION 01 20 00
SECTION 01 25 00
SUBSTITUTION PROCEDURES

PART 1  GENERAL
1.01  SECTION INCLUDES
A. Procedural requirements for proposed substitutions.

1.02  DEFINITIONS
A. Substitutions: Changes from Contract Documents requirements proposed by Contractor to materials, products, assemblies, and equipment.
   1. Substitutions for Cause: Proposed due to changed Project circumstances beyond Contractor's control.
      a. Unavailability.
      b. Regulatory changes.
   2. Substitutions for Convenience: Proposed due to possibility of offering substantial advantage to the Project.
      a. Substitution requests offering advantages solely to the Contractor will not be considered.

1.03  REFERENCE STANDARDS
A. CSI/CSC Form 1.5C - Substitution Request (During the Bidding/Negotiating Stage) Current Edition.

PART 2  PRODUCTS - NOT USED

PART 3  EXECUTION
3.01  GENERAL REQUIREMENTS
A. A Substitution Request for products, assemblies, materials, and equipment constitutes a representation that the submitter:
   1. Has investigated proposed product and determined that it meets or exceeds the quality level of the specified product, equipment, assembly, or system.
   2. Agrees to provide the same warranty for the substitution as for the specified product.
   3. Agrees to provide same or equivalent maintenance service and source of replacement parts, as applicable.
   4. Agrees to coordinate installation and make changes to other work that may be required for the work to be complete, with no additional cost to Owner.
   5. Waives claims for additional costs or time extension that may subsequently become apparent.
   6. Agrees to reimburse Owner and Architect for review or redesign services associated with re-approval by authorities.
B. A Substitution Request for specified installer constitutes a representation that the submitter:
   1. Has acted in good faith to obtain services of specified installer, but was unable to come to commercial, or other terms.
C. Document each request with complete data substantiating compliance of proposed substitution with Contract Documents. Burden of proof is on proposer.
   1. Note explicitly any non-compliant characteristics.
D. Content: Include information necessary for tracking the status of each Substitution Request, and information necessary to provide an actionable response.
   1. No specific form is required. Contractor's Substitution Request documentation must include the following:
      a. Project Information:
         1) Official project name and number, and any additional required identifiers established in Contract Documents.
2) Owner's, Architect's, and Contractor's names.

b. Substitution Request Information:
   1) Discrete and consecutive Substitution Request number, and descriptive subject/title.
   2) Indication of whether the substitution is for cause or convenience.
   3) Issue date.
   4) Reference to particular Contract Document(s) specification section number, title, and article/paragraph(s).
   5) Description of Substitution.
   6) Reason why the specified item cannot be provided.
   7) Differences between proposed substitution and specified item.
   8) Description of how proposed substitution affects other parts of work.

c. Attached Comparative Data: Provide point-by-point, side-by-side comparison addressing essential attributes specified, as appropriate and relevant for the item:
   1) Physical characteristics.
   2) In-service performance.
   3) Expected durability.
   4) Visual effect.
   5) Warranties.
   6) Other salient features and requirements.
   7) Include, as appropriate or requested, the following types of documentation:
      (a) Product Data:
      (b) Samples.
      (c) Certificates, test, reports or similar qualification data.
      (d) Drawings, when required to show impact on adjacent construction elements.

d. Impact of Substitution:
   1) Savings to Owner for accepting substitution.
   2) Change to Contract Time due to accepting substitution.

E. Limit each request to a single proposed substitution item.
   1. Submit an electronic document, combining the request form with supporting data into single document.

3.02 SUBSTITUTION PROCEDURES DURING PROCUREMENT

A. Submittal Time Restrictions:

3.03 SUBSTITUTION PROCEDURES DURING CONSTRUCTION

A. Architect will consider requests for substitutions only within 15 days after date of Agreement.

B. Submit request for Substitution for Cause within 14 days of discovery of need for substitution, but not later than 14 days prior to time required for review and approval by Architect, in order to stay on approved project schedule.

C. Submit request for Substitution for Convenience immediately upon discovery of its potential advantage to the project, but not later than 14 days prior to time required for review and approval by Architect, in order to stay on approved project schedule.

   1. In addition to meeting general documentation requirements, document how the requested substitution benefits the Owner through cost savings, time savings, greater energy conservation, or in other specific ways.

   2. Document means of coordinating of substitution item with other portions of the work, including work by affected subcontractors.

   3. Bear the costs engendered by proposed substitution of:
      a. Owner's compensation to the Architect for any required redesign, time spent processing and evaluating the request.
      b. Other construction by Owner.
      c. Other unanticipated project considerations.
D. Substitutions will not be considered under one or more of the following circumstances:
   1. When they are indicated or implied on shop drawing or product data submittals, without having received prior approval.
   2. Without a separate written request.
   3. When acceptance will require revisions to Contract Documents.

3.04 RESOLUTION
   A. Architect may request additional information and documentation prior to rendering a decision. Provide this data in an expeditious manner.
   B. Architect will notify Contractor in writing of decision to accept or reject request.
      1. Architect's decision following review of proposed substitution will be noted on the submitted form.

3.05 ACCEPTANCE
   A. Accepted substitutions change the work of the Project. They will be documented and incorporated into work of the project by Change Order, Construction Change Directive, Architectural Supplementary Instructions, or similar instruments provided for in the Conditions of the Contract.

3.06 CLOSEOUT ACTIVITIES
   A. See Section 01 78 00 - Closeout Submittals, for closeout submittals.
   B. Include completed Substitution Request Forms as part of the Project record. Include both approved and rejected Requests.

END OF SECTION 01 25 00
SECTION 01 30 00
ADMINISTRATIVE REQUIREMENTS

PART 1 GENERAL

1.01 SECTION INCLUDES
A. General administrative requirements.
B. Electronic document submittal service.
C. Preconstruction meeting.
D. Site mobilization meeting.
E. Progress meetings.
F. Construction progress schedule.
G. Contractor's daily reports.
H. Progress photographs.
I. Coordination drawings.
J. Submittals for review, information, and project closeout.
K. Number of copies of submittals.
L. Requests for Interpretation (RFI) procedures.
M. Submittal procedures.

1.02 RELATED REQUIREMENTS
A. Section 01 60 00 - Product Requirements: General product requirements.

1.03 REFERENCE STANDARDS
C. CSI/CSC Form 12.1A - Submittal Transmittal Current Edition.

1.04 GENERAL ADMINISTRATIVE REQUIREMENTS
A. Comply with requirements of Section 01 70 00 - Execution and Closeout Requirements for coordination of execution of administrative tasks with timing of construction activities.
B. Make the following types of submittals to Architect:
   1. Requests for Interpretation (RFI).
   2. Requests for substitution.
   3. Shop drawings, product data, and samples.
   4. Test and inspection reports.
   5. Design data.
   6. Manufacturer's instructions and field reports.
   7. Applications for payment and change order requests.
   8. Progress schedules.
   9. Coordination drawings.
   10. Correction Punch List and Final Correction Punch List for Substantial Completion.
   11. Closeout submittals.

PART 2 PRODUCTS - NOT USED

PART 3 EXECUTION

3.01 ELECTRONIC DOCUMENT SUBMITTAL SERVICE
A. All documents transmitted for purposes of administration of the contract are to be in electronic (PDF, MS Word, or MS Excel) format, as appropriate to the document, and transmitted via an Internet-based submittal service that receives, logs and stores documents, provides electronic
stamping and signatures, and notifies addressees via email.
1. Besides submittals for review, information, and closeout, this procedure applies to Requests for Interpretation (RFIs), progress documentation, contract modification documents (e.g. supplementary instructions, change proposals, change orders), applications for payment, field reports and meeting minutes, Contractor's correction punchlist, and any other document any participant wishes to make part of the project record.
2. Contractor and Architect are required to use this service.
3. It is Contractor's responsibility to submit documents in allowable format.
4. Subcontractors, suppliers, and Architect's consultants will be permitted to use the service at no extra charge.
5. Users of the service need an email address, internet access, and PDF review software that includes ability to mark up and apply electronic stamps (such as Adobe Acrobat, www.adobe.com, or Bluebeam PDF Revu, www.bluebeam.com), unless such software capability is provided by the service provider.
6. Paper document transmittals will not be reviewed; emailed electronic documents will not be reviewed.
7. All other specified submittal and document transmission procedures apply, except that electronic document requirements do not apply to samples or color selection charts.

B. Submittal Service: The selected service is:
1. As agreed upon between Owner and Contractor.

C. Training: One, one-hour, web-based training session will be arranged for all participants, with representatives of Architect and Contractor participating; further training is the responsibility of the user of the service.

D. Project Closeout: Architect will determine when to terminate the service for the project and is responsible for obtaining archive copies of files for Owner.

3.02 PRECONSTRUCTION MEETING
A. Schedule meeting after Notice of Award.
B. Attendance Required:
1. Owner.
3. Contractor.

C. Agenda:
1. Execution of Owner-Contractor Agreement.
2. Submission of executed bonds and insurance certificates.
4. Submission of list of subcontractors, list of products, schedule of values, and progress schedule.
5. Submission of initial Submittal schedule.
7. Procedures and processing of field decisions, submittals, substitutions, applications for payments, proposal request, Change Orders, and Contract closeout procedures.
8. Scheduling.

D. Record minutes and distribute copies within two days after meeting to participants, with two copies to Architect, Owner, participants, and those affected by decisions made.

E. Record minutes and distribute PFD copies within two days after meeting to Architect, Owner, participants, and those affected by decisions made.

3.03 SITE MOBILIZATION MEETING
A. Schedule meeting at the Project site prior to Contractor occupancy.
B. Attendance Required:
1. Contractor.
2. Owner.
3. Architect.
4. Contractor's superintendent.
5. Major subcontractors.

C. Agenda:
1. Use of premises by Owner and Contractor.
2. Owner's requirements.
3. Construction facilities and controls provided by Owner.
4. Temporary utilities provided by Owner.
5. Survey and building layout.
7. Schedules.
8. Application for payment procedures.
9. Procedures for testing.
11. Requirements for start-up of equipment.
12. Inspection and acceptance of equipment put into service during construction period.

D. Record minutes and distribute copies within two days after meeting to participants, with two copies to Architect, Owner, participants, and those affected by decisions made.

3.04 PROGRESS MEETINGS
A. Schedule and administer meetings throughout progress of the work at maximum bi-monthly intervals.
B. Make arrangements for meetings, prepare agenda with copies for participants, preside at meetings.
C. Attendance Required:
1. Contractor.
2. Owner.
3. Architect.
4. Contractor's superintendent.
5. Major subcontractors.
D. Agenda:
1. Review minutes of previous meetings.
2. Review of work progress.
3. Field observations, problems, and decisions.
4. Identification of problems that impede, or will impede, planned progress.
5. Review of submittals schedule and status of submittals.
7. Review of off-site fabrication and delivery schedules.
8. Maintenance of progress schedule.
9. Corrective measures to regain projected schedules.
10. Planned progress during succeeding work period.
11. Coordination of projected progress.
12. Maintenance of quality and work standards.
13. Effect of proposed changes on progress schedule and coordination.
14. Other business relating to work.
E. Record minutes and distribute copies within two days after meeting to participants, with two copies to Architect, Owner, participants, and those affected by decisions made.

3.05 CONSTRUCTION PROGRESS SCHEDULE - SEE SECTION 01 32 16
A. Within 10 days after date established in Notice to Proceed, submit preliminary schedule defining planned operations for the first 60 days of work, with a general outline for remainder of work.
B. If preliminary schedule requires revision after review, submit revised schedule within 10 days.
C. Within 20 days after review of preliminary schedule, submit draft of proposed complete schedule for review.
   1. Include written certification that major contractors have reviewed and accepted proposed schedule.

D. Within 10 days after joint review, submit complete schedule.

E. Submit updated schedule with each Application for Payment.

3.06 DAILY CONSTRUCTION REPORTS

A. Include only factual information. Do not include personal remarks or opinions regarding operations and/or personnel.

B. Prepare a daily construction report recording the following information concerning events at Project site and project progress:
   1. Date.
   2. High and low temperatures, and general weather conditions.
   3. List of subcontractors at Project site.
   4. List of separate contractors at Project site.
   5. Approximate count of personnel at Project site.
      a. Include a breakdown for supervisors, laborers, journeymen, equipment operators, and helpers.
   6. Major equipment at Project site.
   7. Material deliveries.
   8. Safety, environmental, or industrial relations incidents.
   9. Meetings and significant decisions.
   10. Unusual events (submit a separate special report).
   11. Stoppages, delays, shortages, and losses. Include comparison between scheduled work activities (in Contractor's most recently updated and published schedule) and actual activities. Explain differences, if any. Note days or periods when no work was in progress and explain the reasons why.
   12. Directives and requests of Authority(s) Having Jurisdiction (AHJ).
   13. Testing and/or inspections performed.
   14. Signature of Contractor's authorized representative.

3.07 PROGRESS PHOTOGRAPHS

A. Submit photographs with each application for payment, taken not more than 3 days prior to submission of application for payment.

B. Photography Type: Digital; electronic files.

C. Provide photographs of site and construction throughout progress of work produced by an experienced photographer, acceptable to Architect.

D. In addition to periodic, recurring views, take photographs of each of the following events:
   1. Completion of site clearing.
   2. Excavations in progress.
   3. Foundations in progress and upon completion.
   4. Structural framing in progress and upon completion.
   5. Enclosure of building, upon completion.
   6. Final completion, minimum of ten (10) photos.

E. Take photographs as evidence of existing project conditions as follows:
   1. Interior views: 8 minimum.
   2. Exterior views: 8 minimum.

F. Views:
   1. Provide non-aerial photographs from four cardinal views at each specified time, until date of Substantial Completion.
   2. Consult with Architect for instructions on views required.
   3. Provide factual presentation.
4. Provide correct exposure and focus, high resolution and sharpness, maximum depth of field, and minimum distortion.
5. Point of View Sketch: Provide sketch identifying point of view of each photograph.

G. Digital Photographs: 24 bit color, minimum resolution of 1024 by 768, in JPG format; provide files unaltered by photo editing software.
   1. Delivery Medium: Via email.
   2. File Naming: Include project identification, date and time of view, and view identification.
   3. Point of View Sketch: Include digital copy of point of view sketch with each electronic submittal; include point of view identification in each photo file name.
   4. PDF File: Assemble all photos into printable pages in PDF format, with 2 to 3 photos per page, each photo labeled with file name; one PDF file per submittal.

3.08 REQUESTS FOR INTERPRETATION (RFI)

A. Definition: A request seeking one of the following:
   1. An interpretation, amplification, or clarification of some requirement of Contract Documents arising from inability to determine from them the exact material, process, or system to be installed; or when the elements of construction are required to occupy the same space (interference); or when an item of work is described differently at more than one place in Contract Documents.
   2. A resolution to an issue which has arisen due to field conditions and affects design intent.

B. Whenever possible, request clarifications at the next appropriate project progress meeting, with response entered into meeting minutes, rendering unnecessary the issuance of a formal RFI.

C. Preparation: Prepare an RFI immediately upon discovery of a need for interpretation of Contract Documents. Failure to submit a RFI in a timely manner is not a legitimate cause for claiming additional costs or delays in execution of the work.
   1. Prepare a separate RFI for each specific item.
      a. Review, coordinate, and comment on requests originating with subcontractors and/or materials suppliers.
      b. Do not forward requests which solely require internal coordination between subcontractors.
   2. Prepare in a format and with content acceptable to Owner.
      a. Use AIA G716 - Request for Information.
      b. Use CSI/CSC Form 13.2A - Request for Interpretation.
   3. Combine RFI and its attachments into a single electronic file. PDF format is preferred.

D. Reason for the RFI: Prior to initiation of an RFI, carefully study all Contract Documents to confirm that information sufficient for their interpretation is definitely not included.
   1. Include in each request Contractor's signature attesting to good faith effort to determine from Contract Documents information requiring interpretation.
   2. Unacceptable Uses for RFIs: Do not use RFIs to request the following:
      a. Approval of submittals (use procedures specified elsewhere in this section).
      b. Approval of substitutions (see Section - 01 60 00 - Product Requirements)
      d. Different methods of performing work than those indicated in the Contract Drawings and Specifications (comply with provisions of the Conditions of the Contract).
   3. Improper RFIs: Requests not prepared in compliance with requirements of this section, and/or missing key information required to render an actionable response. They will be returned without a response, with an explanatory notation.
   4. Frivolous RFIs: Requests regarding information that is clearly indicated on, or reasonably inferable from, Contract Documents, with no additional input required to clarify the question. They will be returned without a response, with an explanatory notation.
      a. The Owner reserves the right to assess the Contractor for the costs (on time-and-materials basis) incurred by the Architect, and any of its consultants, due to processing of such RFIs.
E. Content: Include identifiers necessary for tracking the status of each RFI, and information necessary to provide an actionable response.
1. Official Project name and number, and any additional required identifiers established in Contract Documents.
2. Owner's, Architect's, and Contractor's names.
3. Discrete and consecutive RFI number, and descriptive subject/title.
4. Issue date, and requested reply date.
5. Reference to particular Contract Document(s) requiring additional information/interpretation. Identify pertinent drawing and detail number and/or specification section number, title, and paragraph(s).
6. Annotations: Field dimensions and/or description of conditions which have engendered the request.
7. Contractor's suggested resolution: A written and/or a graphic solution, to scale, is required in cases where clarification of coordination issues is involved, for example; routing, clearances, and/or specific locations of work shown diagrammatically in Contract Documents. If applicable, state the likely impact of the suggested resolution on Contract Time or the Contract Sum.

F. Attachments: Include sketches, coordination drawings, descriptions, photos, submittals, and other information necessary to substantiate the reason for the request.

G. RFI Log: Prepare and maintain a tabular log of RFIs for the duration of the project.
1. Indicate current status of every RFI. Update log promptly and on a regular basis.
2. Note dates of when each request is made, and when a response is received.
3. Highlight items requiring priority or expedited response.
4. Highlight items for which a timely response has not been received to date.
5. Identify and include improper or frivolous RFIs.

H. Review Time: Architect will respond and return RFIs to Contractor within seven calendar days of receipt. For the purpose of establishing the start of the mandated response period, RFIs received after 12:00 noon will be considered as having been received on the following regular working day.
1. Response period may be shortened or lengthened for specific items, subject to mutual agreement, and recorded in a timely manner in progress meeting minutes.

I. Responses: Content of answered RFIs will not constitute in any manner a directive or authorization to perform extra work or delay the project. If in Contractor's belief it is likely to lead to a change to Contract Sum or Contract Time, promptly issue a notice to this effect, and follow up with an appropriate Change Order request to Owner.
1. Response may include a request for additional information, in which case the original RFI will be deemed as having been answered, and an amended one is to be issued forthwith. Identify the amended RFI with an R suffix to the original number.
2. Do not extend applicability of a response to specific item to encompass other similar conditions, unless specifically so noted in the response.
3. Upon receipt of a response, promptly review and distribute it to all affected parties, and update the RFI Log.
4. Notify Architect within seven calendar days if an additional or corrected response is required by submitting an amended version of the original RFI, identified as specified above.

### 3.09 SUBMITTAL SCHEDULE

A. Submit to Architect for review a schedule for submittals in tabular format.
1. Submit at the same time as the preliminary schedule specified in Section - 01 32 16 - Construction Progress Schedule.
2. Coordinate with Contractor's construction schedule and schedule of values.
3. Format schedule to allow tracking of status of submittals throughout duration of construction.
4. Arrange information to include scheduled date for initial submittal, specification number and title, submittal category (for review or for information), description of item of work covered, and role and name of subcontractor.

5. Account for time required for preparation, review, manufacturing, fabrication and delivery when establishing submittal delivery and review deadline dates.
   a. For assemblies, equipment, systems comprised of multiple components and/or requiring detailed coordination with other work, allow for additional time to make corrections or revisions to initial submittals, and time for their review.

3.10 SUBMITTALS FOR REVIEW

A. When the following are specified in individual sections, submit them for review:
   1. Product data.
   2. Shop drawings.
   3. Samples for selection.
   4. Samples for verification.

B. Submit to Architect for review for the limited purpose of checking for compliance with information given and the design concept expressed in Contract Documents.

C. Samples will be reviewed for aesthetic, color, or finish selection.

D. After review, provide copies and distribute in accordance with SUBMITTAL PROCEDURES article below and for record documents purposes described in Section 01 78 00 - Closeout Submittals.

3.11 SUBMITTALS FOR INFORMATION

A. When the following are specified in individual sections, submit them for information:
   1. Design data.
   2. Certificates.
   3. Test reports.
   4. Inspection reports.
   5. Manufacturer's instructions.
   6. Manufacturer's field reports.
   7. Other types indicated.

B. Submit for Architect's knowledge as contract administrator or for Owner.

3.12 SUBMITTALS FOR PROJECT CLOSEOUT

A. Submit Correction Punch List for Substantial Completion.

B. Submit Final Correction Punch List for Substantial Completion.

C. When the following are specified in individual sections, submit them at project closeout in compliance with requirements of Section 01 78 00 - Closeout Submittals:
   1. Project record documents.
   2. Operation and maintenance data.
   3. Warranties.
   5. Other types as indicated.

D. Submit for Owner's benefit during and after project completion.

3.13 NUMBER OF COPIES OF SUBMITTALS

A. Electronic Documents: Submit one electronic copy in PDF format; an electronically-marked up file will be returned. Create PDFs at native size and right-side up; illegible files will be rejected.

B. Samples: Submit the number specified in individual specification sections; one of which will be retained by Architect.
   1. After review, produce duplicates.
   2. Retained samples will not be returned to Contractor unless specifically so stated.

3.14 SUBMITTAL PROCEDURES
A. General Requirements:
   1. Use a single transmittal for related items.
   2. Submit separate packages of submittals for review and submittals for information, when included in the same specification section.
   3. Transmit using approved form.
   4. Sequentially identify each item. For revised submittals use original number and a sequential numerical suffix.
   5. Identify: Project; Contractor; subcontractor or supplier; pertinent drawing and detail number; and specification section number and article/paragraph, as appropriate on each copy.
   6. Apply Contractor's stamp, signed or initialed certifying that review, approval, verification of products required, field dimensions, adjacent construction work, and coordination of information is in accordance with the requirements of the work and Contract Documents.
      a. Submittals from sources other than the Contractor, or without Contractor's stamp will not be acknowledged, reviewed, or returned.
   7. Deliver each submittal on date noted in submittal schedule, unless an earlier date has been agreed to by all affected parties, and is of the benefit to the project.
      b. Deliver physical samples to Architect at business address.
   8. Schedule submittals to expedite the Project, and coordinate submission of related items.
      a. For each submittal for review, allow 15 days excluding delivery time to and from the Contractor.
      b. For sequential reviews involving Architect's consultants, Owner, or another affected party, allow an additional 7 days.
      c. For sequential reviews involving approval from authorities having jurisdiction (AHJ), in addition to Architect's approval, allow an additional 30 days.
   9. Identify variations from Contract Documents and product or system limitations that may be detrimental to successful performance of the completed work.
   10. Provide space for Contractor and Architect review stamps.
   11. When revised for resubmission, identify all changes made since previous submission.
   12. Distribute reviewed submittals. Instruct parties to promptly report inability to comply with requirements.
   13. Incomplete submittals will not be reviewed, unless they are partial submittals for distinct portion(s) of the work, and have received prior approval for their use.
   14. Submittals not requested will not be recognized or processed.

B. Product Data Procedures:
   1. Submit only information required by individual specification sections.
   2. Collect required information into a single submittal.
   3. Submit concurrently with related shop drawing submittal.
   4. Do not submit (Material) Safety Data Sheets for materials or products.

C. Shop Drawing Procedures:
   1. Prepare accurate, drawn-to-scale, original shop drawing documentation by interpreting Contract Documents and coordinating related work.
   2. Do not reproduce Contract Documents to create shop drawings.
   3. Generic, non-project-specific information submitted as shop drawings do not meet the requirements for shop drawings.

D. Samples Procedures:
   1. Transmit related items together as single package.
   2. Identify each item to allow review for applicability in relation to shop drawings showing installation locations.

3.15 SUBMITTAL REVIEW
A. Submittals for Review: Architect will review each submittal, and approve, or take other appropriate action.

B. Submittals for Information: Architect will acknowledge receipt and review. See below for actions to be taken.

C. Architect's actions will be reflected by marking each returned submittal using virtual stamp on electronic submittals.
   1. Notations may be made directly on submitted items and/or listed on appended Submittal Review cover sheet.

D. Architect's and consultants' actions on items submitted for review:
   1. Authorizing purchasing, fabrication, delivery, and installation:
      a. "No Exceptions Taken", or language with same legal meaning.
      b. "Reviewed as noted", or language with same legal meaning.
         1) At Contractor's option, submit corrected item, with review notations acknowledged and incorporated.
   2. Not Authorizing fabrication, delivery, and installation:
      a. "Revise and Resubmit".
         1) Resubmit revised item, with review notations acknowledged and incorporated.
         2) Non-responsive resubmittals may be rejected.
      b. "Rejected".
         1) Submit item complying with requirements of Contract Documents.

E. Architect's and consultants' actions on items submitted for information:
   1. Items for which no action was taken:
      a. "Received" - to notify the Contractor that the submittal has been received for record only.
   2. Items for which action was taken:
      a. "Reviewed" - no further action is required from Contractor.

END OF SECTION 01 30 00
SECTION 01 32 16
CONSTRUCTION PROGRESS SCHEDULE

PART 1  GENERAL
1.01  SECTION INCLUDES
   A. Preliminary schedule.
   B. Construction progress schedule, bar chart type.

1.02  RELATED SECTIONS
   A. Section 01 10 00 - Summary: Work sequence.

1.03  SUBMITTALS
   A. Within 10 days after date established in Notice to Proceed, submit preliminary schedule.
   B. If preliminary schedule requires revision after review, submit revised schedule within 10 days.
   C. Within 20 days after review of preliminary schedule, submit draft of proposed complete schedule for review.
      1. Include written certification that major contractors have reviewed and accepted proposed schedule.
   D. Within 10 days after joint review, submit complete schedule.
   E. Submit updated schedule with each Application for Payment.
   F. Submit in PDF format.

1.04  QUALITY ASSURANCE
   A. Scheduler: Contractor's personnel or specialist Consultant specializing in CPM scheduling with one years minimum experience in scheduling construction work of a complexity comparable to this Project, and having use of computer facilities capable of delivering a detailed graphic printout within 48 hours of request.

1.05  SCHEDULE FORMAT
   A. Listings: In chronological order according to the start date for each activity. Identify each activity with the applicable specification section number.
   B. Scale and Spacing: To allow for notations and revisions.

PART 2  PRODUCTS - NOT USED

PART 3  EXECUTION
3.01  PRELIMINARY SCHEDULE
   A. Prepare preliminary schedule in the form of a horizontal bar chart.

3.02  CONTENT
   A. Show complete sequence of construction by activity, with dates for beginning and completion of each element of construction.
   B. Identify each item by specification section number.
   C. Identify work of separate stages and other logically grouped activities.
   D. Provide sub-schedules to define critical portions of the entire schedule.
   E. Include conferences and meetings in schedule.
   F. Show accumulated percentage of completion of each item, and total percentage of Work completed, as of the first day of each month.
   G. Indicate delivery dates for owner-furnished products.
   H. Coordinate content with schedule of values specified in Section 01 20 00 - Price and Payment Procedures.
   I. Provide legend for symbols and abbreviations used.
3.03 BAR CHARTS
   A. Include a separate bar for each major portion of Work or operation.
   B. Identify the first work day of each week.

3.04 REVIEW AND EVALUATION OF SCHEDULE
   A. Participate in joint review and evaluation of schedule with Owner and Architect at each
      submittal.
   B. Evaluate project status to determine work behind schedule and work ahead of schedule.
   C. After review, revise as necessary as result of review, and resubmit within 10 days.

3.05 UPDATING SCHEDULE
   A. Maintain schedules to record actual start and finish dates of completed activities.
   B. Indicate progress of each activity to date of revision, with projected completion date of each
      activity.
   C. Annotate diagrams to graphically depict current status of Work.
   D. Identify activities modified since previous submittal, major changes in Work, and other
      identifiable changes.
   E. Indicate changes required to maintain Date of Substantial Completion.
   F. Submit reports required to support recommended changes.
   G. Provide narrative report to define problem areas, anticipated delays, and impact on the
      schedule. Report corrective action taken or proposed and its effect.

3.06 DISTRIBUTION OF SCHEDULE
   A. Distribute copies of updated schedules to Contractor's project site file, to subcontractors,
      suppliers, Architect, Owner, and other concerned parties.
   B. Instruct recipients to promptly report, in writing, problems anticipated by projections indicated in
      schedules.

END OF SECTION 01 32 16
SECTION 01 40 00
QUALITY REQUIREMENTS

PART 1  GENERAL

1.01  SECTION INCLUDES

A. Submittals.
B. Quality assurance.
C. References and standards.
D. Testing and inspection agencies and services.
E. Contractor's construction-related professional design services.
F. Contractor's design-related professional design services.
G. Control of installation.
H. Mock-ups.
I. Tolerances.
J. Manufacturers' field services.
K. Defect Assessment.

1.02  REFERENCE STANDARDS


1.03  DEFINITIONS

A. Contractor's Professional Design Services: Design of some aspect or portion of the project by party other than the design professional of record. Provide these services as part of the Contract for Construction.

1. Design Services Types Required:
   a. Construction-Related: Services Contractor needs to provide in order to carry out the Contractor's sole responsibilities for construction means, methods, techniques, sequences, and procedures.
   b. Design-Related: Design services explicitly required to be performed by another design professional due to highly-technical and/or specialized nature of a portion of the project. Services primarily involve engineering analysis, calculations, and design, and are not intended to alter the aesthetic aspects of the design.

B. Design Data: Design-related, signed and sealed drawings, calculations, specifications, certifications, shop drawings and other submittals provided by Contractor, and prepared directly by, or under direct supervision of, appropriately licensed design professional.

1.04  CONTRACTOR'S CONSTRUCTION-RELATED PROFESSIONAL DESIGN SERVICES
A. Coordination: Contractor's professional design services are subject to requirements of project's Conditions for Construction Contract.

B. Provide such engineering design services as may be necessary to plan and safely conduct certain construction operations, pertaining to, but not limited to the following:
   1. Temporary sheeting, shoring, or supports.
   2. Temporary scaffolding.
   3. Temporary bracing.
   4. Temporary foundation underpinning.
   5. Temporary stairs or steps required for construction access only.
   6. Temporary hoist(s) and rigging.

1.05 CONTRACTOR'S DESIGN-RELATED PROFESSIONAL DESIGN SERVICES

A. Coordination: Contractor's professional design services are subject to requirements of project's Conditions for Construction Contract.

B. Base design on performance and/or design criteria indicated in individual specification sections.
   1. Submit a Request for Interpretation to Architect if the criteria indicated are not sufficient to perform required design services.

C. Scope of Contractor's Professional Design Services: Provide for the following items of work:
   1. Structural Design of Reinforcement Splices: As described in Section 03 01 00 - Maintenance of Concrete.
   2. Structural Design of Formwork: As described in Section 03 10 00 - Concrete Forming and Accessories.
   3. Structural Calculations and Design: As described in Section 03 41 00 - Precast Structural Concrete.
   4. Concrete Mix and Structural Design: As described in Section 03 45 00 - Precast Architectural Concrete.
   5. Concrete Mix and Structural Design: As described in Section 03 47 13 - Tilt-Up Concrete.
   6. Structural Design of Steel Connections: As described in Section 05 12 00 - Structural Steel Framing.
   7. Structural Design of Steel Connections: As described in Section 05 21 00 - Steel Joist Framing.
   8. Structural Design of Steel Decking: As described in Section 05 31 00 - Steel Decking.
   9. Structural Design of Stairs: As described in Section 05 51 00 - Metal Stairs.
  10. Structural Design of Railings: As described in Section 05 52 13 - Pipe and Tube Railings.
  11. Structural Design: Include physical characteristics, engineering calculations, and resulting dimensional limitations as described in Section 08 43 13 - Aluminum-Framed Storefronts.
  12. Structural Design: Include calculations for resisting wind loads, anchor locations, loads at points of attachment to building structure, physical characteristics, resulting dimensional limitations as described in Section 08 44 13 - Glazed Aluminum Curtain Walls.
  15. Structural Design of Foundation: As described in Section 10 75 00 - Flagpoles.
  16. Sprinkler Layout: Coordinate with ceiling installation, detailed pipe layout, and hydraulic calculations as described in Section 21 13 00 - Fire-Suppression Sprinkler Systems.

1.06 SUBMITTALS

A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.

B. Designer's Qualification Statement: Submit for Architect's knowledge as contract administrator, or for Owner's information.
   1. Include information for each individual professional responsible for producing, or supervising production of, design-related professional services provided by Contractor.
      a. Full name.
b. Professional licensure information.
c. Statement addressing extent and depth of experience specifically relevant to design of items assigned to Contractor.

C. Design Data: Submit for Architect's knowledge as contract administrator for the limited purpose of assessing compliance with information given and the design concept expressed in the Contract Documents, or for Owner's information.
   1. Include calculations that have been used to demonstrate compliance to performance and regulatory criteria provided, and to determine design solutions.
   2. Include required product data and shop drawings.
   3. Include a statement or certification attesting that design data complies with criteria indicated, such as building codes, loads, functional, and similar engineering requirements.
   4. Include signature and seal of design professional responsible for allocated design services on calculations and drawings.

D. Test Reports: After each test/inspection, promptly submit two copies of report to Architect and to Contractor.
   1. Include:
      a. Date issued.
      b. Project title and number.
      c. Name of inspector.
      d. Date and time of sampling or inspection.
      e. Identification of product and specifications section.
      f. Location in the Project.
      g. Type of test/inspection.
      h. Date of test/inspection.
      i. Results of test/inspection.
      j. Compliance with Contract Documents.
      k. When requested by Architect, provide interpretation of results.
   2. Test report submittals are for Architect's knowledge as contract administrator for the limited purpose of assessing compliance with information given and the design concept expressed in the Contract Documents, or for Owner's information.

E. Certificates: When specified in individual specification sections, submit certification by the manufacturer and Contractor or installation/application subcontractor to Architect, in quantities specified for Product Data.
   1. Indicate material or product complies with or exceeds specified requirements. Submit supporting reference data, affidavits, and certifications as appropriate.

F. Manufacturer's Instructions: When specified in individual specification sections, submit printed instructions for delivery, storage, assembly, installation, start-up, adjusting, and finishing, for the Owner's information. Indicate special procedures, perimeter conditions requiring special attention, and special environmental criteria required for application or installation.

G. Manufacturer's Field Reports: Submit reports for Architect's benefit as contract administrator or for Owner.
   1. Submit for information for the limited purpose of assessing compliance with information given and the design concept expressed in the Contract Documents.

H. Erection Drawings: Submit drawings for Architect's benefit as contract administrator or for Owner.
   1. Submit for information for the limited purpose of assessing compliance with information given and the design concept expressed in the Contract Documents.

1.07 QUALITY ASSURANCE

A. Testing Agency Qualifications:
   1. Prior to start of work, submit agency name, address, and telephone number, and names of full time registered Engineer and responsible officer.

B. Designer Qualifications: Where professional engineering design services and design data submittals are specifically required of Contractor by Contract Documents, provide services of a
Professional Engineer experienced in design of this type of work and licensed in Florida.

1.08 REFERENCES AND STANDARDS
A. For products and workmanship specified by reference to a document or documents not included in the Project Manual, also referred to as reference standards, comply with requirements of the standard, except when more rigid requirements are specified or are required by applicable codes.
B. Comply with reference standard of date of issue current on date of Contract Documents, except where a specific date is established by applicable code.
C. Obtain copies of standards where required by product specification sections.
D. Maintain copy at project site during submittals, planning, and progress of the specific work, until Substantial Completion.
E. Should specified reference standards conflict with Contract Documents, request clarification from Architect before proceeding.
F. Neither the contractual relationships, duties, or responsibilities of the parties in Contract nor those of Architect shall be altered from Contract Documents by mention or inference otherwise in any reference document.

1.09 TESTING AND INSPECTION AGENCIES AND SERVICES
A. Contractor shall employ and pay for services of an independent testing agency to perform other specified testing.
B. As indicated in individual specification sections, Owner or Contractor shall employ and pay for services of an independent testing agency to perform other specified testing.
C. Employment of agency in no way relieves Contractor of obligation to perform Work in accordance with requirements of Contract Documents.
D. Contractor Employed Agency:
   2. Laboratory Qualifications: Accredited by IAS according to IAS AC89.
   3. Laboratory: Authorized to operate in Florida.
   4. Laboratory Staff: Maintain a full time registered Engineer on staff to review services.
   5. Testing Equipment: Calibrated at reasonable intervals either by NIST or using an NIST established Measurement Assurance Program, under a laboratory measurement quality assurance program.

PART 2 PRODUCTS - NOT USED
PART 3 EXECUTION
3.01 CONTROL OF INSTALLATION
A. Monitor quality control over suppliers, manufacturers, products, services, site conditions, and workmanship, to produce work of specified quality.
B. Comply with manufacturers' instructions, including each step in sequence.
C. Should manufacturers' instructions conflict with Contract Documents, request clarification from Architect before proceeding.
D. Comply with specified standards as minimum quality for the work except where more stringent tolerances, codes, or specified requirements indicate higher standards or more precise workmanship.
E. Have work performed by persons qualified to produce required and specified quality.
F. Verify that field measurements are as indicated on shop drawings or as instructed by the manufacturer.
G. Secure products in place with positive anchorage devices designed and sized to withstand stresses, vibration, physical distortion, and disfigurement.
3.02 MOCK-UPS

A. Before installing portions of the Work where mock-ups are required, construct mock-ups in location and size indicated for each form of construction and finish required to comply with the following requirements, using materials indicated for the completed Work. The purpose of mock-up is to demonstrate the proposed range of aesthetic effects and workmanship.

B. Accepted mock-ups establish the standard of quality the Architect will use to judge the Work.

C. Integrated Exterior Mock-ups: Construct integrated exterior mock-up as indicated on drawings. Coordinate installation of exterior envelope materials and products as required in individual Specification Sections. Provide adequate supporting structure for mock-up materials as necessary.

D. Tests shall be performed under provisions identified in this section and identified in the respective product specification sections.

E. Assemble and erect specified items with specified attachment and anchorage devices, flashings, seals, and finishes.

F. Obtain Architect's approval of mock-ups before starting work, fabrication, or construction.
   1. Architect will issue written comments within seven (7) working days of initial review and each subsequent follow up review of each mock-up.
   2. Make corrections as necessary until Architect's approval is issued.

G. Architect will use accepted mock-ups as a comparison standard for the remaining Work.

H. Where mock-up has been accepted by Architect and is specified in product specification sections to be removed, protect mock-up throughout construction, remove mock-up and clear area when directed to do so by Architect.

I. Where possible salvage and recycle the demolished mock-up materials.

3.03 TOLERANCES

A. Monitor fabrication and installation tolerance control of products to produce acceptable Work. Do not permit tolerances to accumulate.

B. Comply with manufacturers' tolerances. Should manufacturers' tolerances conflict with Contract Documents, request clarification from Architect before proceeding.

C. Adjust products to appropriate dimensions; position before securing products in place.

3.04 TESTING AND INSPECTION

A. Testing Agency Duties:
   1. Test samples of mixes submitted by Contractor.
   3. Perform specified sampling and testing of products in accordance with specified standards.
   4. Ascertain compliance of materials and mixes with requirements of Contract Documents.
   5. Promptly notify Architect and Contractor of observed irregularities or non-compliance of Work or products.
   6. Perform additional tests and inspections required by Architect.
   7. Submit reports of all tests/inspections specified.

B. Limits on Testing/Inspection Agency Authority:
   1. Agency may not release, revoke, alter, or enlarge on requirements of Contract Documents.
   2. Agency may not approve or accept any portion of the Work.
   3. Agency may not assume any duties of Contractor.
   4. Agency has no authority to stop the Work.

C. Contractor Responsibilities:
   1. Deliver to agency at designated location, adequate samples of materials proposed to be used that require testing, along with proposed mix designs.
2. Cooperate with laboratory personnel, and provide access to the Work and to manufacturers' facilities.

3. Provide incidental labor and facilities:
   a. To provide access to Work to be tested/inspected.
   b. To obtain and handle samples at the site or at source of Products to be tested/inspected.
   c. To facilitate tests/inspections.
   d. To provide storage and curing of test samples.

4. Notify Architect and laboratory 24 hours prior to expected time for operations requiring testing/inspection services.

5. Employ services of an independent qualified testing laboratory and pay for additional samples, tests, and inspections required by Contractor beyond specified requirements.

6. Arrange with Owner's agency and pay for additional samples, tests, and inspections required by Contractor beyond specified requirements.

D. Re-testing required because of non-compliance with specified requirements shall be performed by the same agency on instructions by Architect.

E. Re-testing required because of non-compliance with specified requirements shall be paid for by Contractor.

3.05 MANUFACTURERS' FIELD SERVICES

A. When specified in individual specification sections, require material or product suppliers or manufacturers to provide qualified staff personnel to observe site conditions, conditions of surfaces and installation, quality of workmanship, start-up of equipment, test, adjust, and balance equipment as applicable, and to initiate instructions when necessary.

B. Report observations and site decisions or instructions given to applicators or installers that are supplemental or contrary to manufacturers' written instructions.

3.06 DEFECT ASSESSMENT

A. Replace Work or portions of the Work not complying with specified requirements.

B. If, in the opinion of Owner, it is not practical to remove and replace the work, Owner will direct an appropriate remedy or adjust payment.

END OF SECTION 01 40 00
SECTION 01 50 00
TEMPORARY FACILITIES AND CONTROLS

PART 1  GENERAL

1.01  SECTION INCLUDES
A. Dewatering
B. Temporary utilities.
C. Temporary telecommunications services.
D. Temporary sanitary facilities.
E. Temporary Controls: Barriers, enclosures, and fencing.
F. Security requirements.
G. Vehicular access and parking.
H. Waste removal facilities and services.
I. Project identification sign.
J. Field offices.

1.02  DEWATERING
A. Provide temporary means and methods for dewatering all temporary facilities and controls.
B. Maintain temporary facilities in operable condition.

1.03  TEMPORARY UTILITIES
A. Provide and pay for all electrical power, lighting, water, heating and cooling, and ventilation required for construction purposes.
B. Existing facilities may not be used.
C. New permanent facilities may be used.
D. Use trigger-operated nozzles for water hoses, to avoid waste of water.

1.04  TELECOMMUNICATIONS SERVICES
A. Provide, maintain, and pay for telecommunications services to field office at time of project mobilization.
B. Telecommunications services shall include:
   1. Windows-based personal computer dedicated to project telecommunications, with necessary software and laser printer.
   2. Internet Connections: Minimum of one; DSL modem or faster.
   3. Email: Account/address reserved for project use.

1.05  TEMPORARY SANITARY FACILITIES
A. Provide and maintain required facilities and enclosures. Provide at time of project mobilization.
B. Maintain daily in clean and sanitary condition.

1.06  BARRIERS
A. Provide barriers to prevent unauthorized entry to construction areas, to prevent access to areas that could be hazardous to workers or the public, to allow for owner's use of site and to protect existing facilities and adjacent properties from damage from construction operations and demolition.
B. Provide barricades and covered walkways required by governing authorities for public rights-of-way and for public access to existing building.
C. Provide protection for plants designated to remain. Replace damaged plants.
D. Protect non-owned vehicular traffic, stored materials, site, and structures from damage.

1.07  FENCING
A. Construction: Commercial grade chain link fence.
B. Provide 6 foot high fence around construction site; equip with vehicular and pedestrian gates with locks.

1.08 EXTERIOR ENCLOSURES
A. Provide temporary weather tight closure of exterior openings to accommodate acceptable working conditions and protection for Products, to allow for temporary heating and maintenance of required ambient temperatures identified in individual specification sections, and to prevent entry of unauthorized persons. Provide access doors with self-closing hardware and locks.

1.09 SECURITY
A. Provide security and facilities to protect Work, existing facilities, and Owner's operations from unauthorized entry, vandalism, or theft.

1.10 VEHICULAR ACCESS AND PARKING
A. Coordinate access and haul routes with governing authorities and Owner.
B. Provide and maintain access to fire hydrants, free of obstructions.
C. Provide means of removing mud from vehicle wheels before entering streets.
D. Designated existing on-site roads may be used for construction traffic.
E. Provide temporary parking areas to accommodate construction personnel. When site space is not adequate, provide additional off-site parking.
F. Do not allow vehicle parking on existing pavement.
G. Designate one parking space for Owner and Architect use.

1.11 WASTE REMOVAL
A. Provide waste removal facilities and services as required to maintain the site in clean and orderly condition.
B. Provide containers with lids. Remove trash from site periodically.
C. If materials to be recycled or re-used on the project must be stored on-site, provide suitable non-combustible containers; locate containers holding flammable material outside the structure unless otherwise approved by the authorities having jurisdiction.
D. Open free-fall chutes are not permitted. Terminate closed chutes into appropriate containers with lids.

1.12 PROJECT IDENTIFICATION
A. Provide project identification sign of design and construction indicated on drawings.
B. Erect on site at location established by Architect.
C. No other signs are allowed without Owner permission except those required by law.

1.13 FIELD OFFICES
A. Office: Weathertight, with lighting, electrical outlets, heating, cooling equipment, and equipped with sturdy furniture, drawing rack, and drawing display table.
B. Provide space for Project meetings, with table and chairs to accommodate 8 persons.
C. Locate offices a minimum distance of 30 feet from existing and new structures.

1.14 REMOVAL OF UTILITIES, FACILITIES, AND CONTROLS
A. Remove temporary utilities, equipment, facilities, materials, prior to Date of Substantial Completion inspection.
B. Remove underground installations to a minimum depth of 2 feet. Grade site as indicated.
C. Clean and repair damage caused by installation or use of temporary work.
D. Restore existing facilities used during construction to original condition.
E. Restore new permanent facilities used during construction to specified condition.
PART 2 PRODUCTS - NOT USED
PART 3 EXECUTION - NOT USED

END OF SECTION 01 50 00
SECTION 01 60 00
PRODUCT REQUIREMENTS

PART 1  GENERAL

1.01 SECTION INCLUDES
A. Transportation, handling, storage and protection.
B. Product option requirements.
C. Substitution limitations.
D. Maintenance materials, including extra materials, spare parts, tools, and software.

1.02 RELATED REQUIREMENTS
A. Section 01 25 00 - Substitution Procedures: Substitutions made during procurement and/or construction phases.
B. Section 01 61 16 - Volatile Organic Compound (VOC) Content Restrictions: Requirements for VOC-restricted product categories.
C. Section 01 74 19 - Construction Waste Management and Disposal: Waste disposal requirements potentially affecting product selection, packaging and substitutions.

1.03 SUBMITTALS
A. Product Data Submittals: Submit manufacturer's standard published data. Mark each copy to identify applicable products, models, options, and other data. Supplement manufacturers’ standard data to provide information specific to this Project.
B. Shop Drawing Submittals: Prepared specifically for this Project; indicate utility and electrical characteristics, utility connection requirements, and location of utility outlets for service for functional equipment and appliances.
C. Sample Submittals: Illustrate functional and aesthetic characteristics of the product, with integral parts and attachment devices. Coordinate sample submittals for interfacing work.
   1. For selection from standard finishes, submit samples of the full range of the manufacturer's standard colors, textures, and patterns.

PART 2  PRODUCTS

2.01 NEW PRODUCTS
A. Provide new products unless specifically required or permitted by Contract Documents.
B. Use of products having any of the following characteristics is not permitted:
   1. Made outside the United States, its territories, Canada, or Mexico.
   2. Made using or containing CFC's or HCFC's.
   3. Made of wood from newly cut old growth timber.
   4. Containing lead, cadmium, or asbestos.
C. Where other criteria are met, Contractor shall give preference to products that:
   1. If used on interior, have lower emissions, as defined in Section 01 61 16.
   2. If wet-applied, have lower VOC content, as defined in Section 01 61 16.
   3. Are extracted, harvested, and/or manufactured closer to the location of the project.
   4. Have longer documented life span under normal use.
   5. Result in less construction waste. See Section 01 74 19.
   6. Are made of vegetable materials that are rapidly renewable.
   7. Are made of recycled materials.
   8. If made of wood, are made of sustainably harvested wood, wood chips, or wood fiber.
   9. If bio-based, other than wood, are or are made of Sustainable Agriculture Network certified products.

2.02 PRODUCT OPTIONS
A. Products Specified by Reference Standards or by Description Only: Use any product meeting those standards or description.
B. Products Specified by Naming One or More Manufacturers: Use a product of one of the manufacturers named and meeting specifications, no options or substitutions allowed.

C. Products Specified by Naming One or More Manufacturers with a Provision for Substitutions: Submit a request for substitution for any manufacturer not named.

2.03 MAINTENANCE MATERIALS

A. Furnish extra materials, spare parts, tools, and software of types and in quantities specified in individual specification sections.

B. Deliver to Project site; obtain receipt prior to final payment.

PART 3 EXECUTION

3.01 SUBSTITUTION LIMITATIONS

A. See Section 01 25 00 - Substitution Procedures.

3.02 TRANSPORTATION AND HANDLING

A. Package products for shipment in manner to prevent damage; for equipment, package to avoid loss of factory calibration.

B. If special precautions are required, attach instructions prominently and legibly on outside of packaging.

C. Coordinate schedule of product delivery to designated prepared areas in order to minimize site storage time and potential damage to stored materials.

D. Transport and handle products in accordance with manufacturer's instructions.

E. Transport materials in covered trucks to prevent contamination of product and littering of surrounding areas.

F. Promptly inspect shipments to ensure that products comply with requirements, quantities are correct, and products are undamaged.

G. Provide equipment and personnel to handle products by methods to prevent soiling, disfigurement, or damage, and to minimize handling.

H. Arrange for the return of packing materials, such as wood pallets, where economically feasible.

3.03 STORAGE AND PROTECTION

A. Designate receiving/storage areas for incoming products so that they are delivered according to installation schedule and placed convenient to work area in order to minimize waste due to excessive materials handling and misapplication. See Section 01 74 19.

1. Structural Loading Limitations: Handle and store products and materials so as not to exceed static and dynamic load-bearing capacities of project floor and roof areas.

B. Store and protect products in accordance with manufacturers' instructions.

C. Store with seals and labels intact and legible.

D. Arrange storage of materials and products to allow for visual inspection for the purpose of determination of quantities, amounts, and unit counts.

E. Store sensitive products in weathertight, climate-controlled enclosures in an environment favorable to product.

F. For exterior storage of fabricated products, place on sloped supports above ground.

G. Provide off-site storage and protection when site does not permit on-site storage or protection.

H. Protect products from damage or deterioration due to construction operations, weather, precipitation, humidity, temperature, sunlight and ultraviolet light, dirt, dust, and other contaminants.

I. Comply with manufacturer's warranty conditions, if any.

J. Do not store products directly on the ground.
K. Cover products subject to deterioration with impervious sheet covering. Provide ventilation to prevent condensation and degradation of products.

L. Store loose granular materials on solid flat surfaces in a well-drained area. Prevent mixing with foreign matter.

M. Prevent contact with material that may cause corrosion, discoloration, or staining.

N. Provide equipment and personnel to store products by methods to prevent soiling, disfigurement, or damage.

O. Arrange storage of products to permit access for inspection. Periodically inspect to verify products are undamaged and are maintained in acceptable condition.

END OF SECTION 01 60 00
SECTION 01 61 16
VOLATILE ORGANIC COMPOUND (VOC) CONTENT RESTRICTIONS

PART 1 GENERAL

1.01 SECTION INCLUDES
A. Requirements for Indoor-Emissions-Restricted products.
B. Requirements for VOC-Content-Restricted products.

1.02 RELATED REQUIREMENTS
A. Section 01 30 00 - Administrative Requirements: Submittal procedures.

1.03 DEFINITIONS
A. Indoor-Emissions-Restricted Products: All products in the following product categories, whether specified or not:
   1. Interior paints and coatings applied on site.
   2. Interior adhesives and sealants applied on site, including flooring adhesives.
   3. Flooring.
   5. Products making up wall and ceiling assemblies.
   6. Thermal and acoustical insulation.
B. VOC-Content-Restricted Products: All products in the following product categories, whether specified or not:
   1. Interior paints and coatings applied on site.
   2. Interior adhesives and sealants applied on site, including flooring adhesives.
C. Interior of Building: Anywhere inside the exterior weather barrier.
D. Adhesives: All gunnable, trowelable, liquid-applied, and aerosol adhesives, whether specified or not; including flooring adhesives, resilient base adhesives, and pipe jointing adhesives.
E. Sealants: All gunnable, trowelable, and liquid-applied joint sealants and sealant primers, whether specified or not; including firestopping sealants and duct joint sealers.
F. Inherently Non-Emitting Materials: Products composed wholly of minerals or metals, unless they include organic-based surface coatings, binders, or sealants; and specifically the following:
   1. Concrete.
   2. Clay brick.
   3. Metals that are plated, anodized, or powder-coated.
   4. Glass.
   5. Ceramics.
   6. Solid wood flooring that is unfinished and untreated.

1.04 REFERENCE STANDARDS
D. CARB (SCM) - Suggested Control Measure for Architectural Coatings; California Air Resources Board 2007.
E. CHPS (HPPD) - High Performance Products Database Current Edition at www.chps.net/
I. SCS (CPD) - SCS Certified Products Current Edition.
J. UL (GGG) - GREENGUARD Gold Certified Products Current Edition.

1.05 SUBMITTALS
A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.
B. Product Data: For each VOC-restricted product used in the project, submit evidence of compliance.

1.06 QUALITY ASSURANCE
A. Indoor Emissions Standard and Test Method: CAL (CDPH SM), using Standard Private Office exposure scenario and the allowable concentrations specified in the method, and range of total VOC's after 14 days.
   1. Wet-Applied Products: State amount applied in mass per surface area.
   2. Paints and Coatings: Test tinted products, not just tinting bases.
   3. Evidence of Compliance: Acceptable types of evidence are the following;
      a. Current UL (GGG) certification.
      b. Current SCS (CPD) Floorscore certification.
      c. Current SCS (CPD) Indoor Advantage Gold certification.
      d. Current listing in CHPS (HPPD) as a low-emitting product.
      e. Current CRI (GLP) certification.
      f. Test report showing compliance and stating exposure scenario used.
   4. Product data submittal showing VOC content is NOT acceptable evidence.
   5. Manufacturer's certification without test report by independent agency is NOT acceptable evidence.
B. VOC Content Test Method: 40 CFR 59, Subpart D (EPA Method 24), or ASTM D3960, unless otherwise indicated.
   1. Evidence of Compliance: Acceptable types of evidence are:
      a. Report of laboratory testing performed in accordance with requirements.
C. Testing Agency Qualifications: Independent firm specializing in performing testing and inspections of the type specified in this section.

PART 2 PRODUCTS
2.01 MATERIALS
A. VOC-Content-Restricted Products: VOC content not greater than required by the following:
   3. Paints and Coatings: Each color; most stringent of the following:
      a. 40 CFR 59, Subpart D.
      b. SCAQMD 1113 Rule.
      c. CARB (SCM).

PART 3 EXECUTION
3.01 FIELD QUALITY CONTROL
A. Owner reserves the right to reject non-compliant products, whether installed or not, and require their removal and replacement with compliant products at no extra cost to Owner.
B. Additional costs to restore indoor air quality due to installation of non-compliant products will be borne by Contractor.

END OF SECTION 01 61 16
SECTION 01 70 00
EXECUTION AND CLOSEOUT REQUIREMENTS

PART 1  GENERAL

1.01 SECTION INCLUDES
A. Examination, preparation, and general installation procedures.
B. Pre-installation meetings.
C. Cutting and patching.
D. Surveying for laying out the work.
E. Cleaning and protection.
F. Starting of systems and equipment.
G. Demonstration and instruction of Owner personnel.
H. Closeout procedures, including Contractor's Correction Punch List, except payment procedures.
I. General requirements for maintenance service.

1.02 SUBMITTALS
A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.
B. Survey work: Submit name, address, and telephone number of Surveyor before starting survey work.
   1. On request, submit documentation verifying accuracy of survey work.
   2. Submit a copy of site drawing signed by the Land Surveyor, that the elevations and locations of the work are in compliance with Contract Documents.
   3. Submit surveys and survey logs for the project record.
C. Cutting and Patching: Submit written request in advance of cutting or alteration that affects:
   1. Structural integrity of any element of Project.
   2. Integrity of weather exposed or moisture resistant element.
   3. Efficiency, maintenance, or safety of any operational element.
   5. Work of Owner or separate Contractor.
   6. Include in request:
      a. Identification of Project.
      b. Location and description of affected work.
      c. Necessity for cutting or alteration.
      d. Description of proposed work and products to be used.
      e. Effect on work of Owner or separate Contractor.
      f. Written permission of affected separate Contractor.
      g. Date and time work will be executed.
D. Project Record Documents: Accurately record actual locations of capped and active utilities.

1.03 QUALIFICATIONS
A. For surveying work, employ a land surveyor registered in Florida and acceptable to Architect. Submit evidence of surveyor's Errors and Omissions insurance coverage in the form of an Insurance Certificate. Employ only individual(s) trained and experienced in collecting and recording accurate data relevant to ongoing construction activities,
B. For field engineering, employ a professional engineer of the discipline required for specific service on Project, licensed in Florida. Employ only individual(s) trained and experienced in establishing and maintaining horizontal and vertical control points necessary for laying out construction work on project of similar size, scope and/or complexity.
C. For design of temporary shoring and bracing, employ a Professional Engineer experienced in design of this type of work and licensed in Florida.
1.04 PROJECT CONDITIONS
A. Use of explosives is not permitted.
B. Grade site to drain. Maintain excavations free of water. Provide, operate, and maintain pumping equipment.
C. Protect site from puddling or running water. Provide water barriers as required to protect site from soil erosion.
D. Perform dewatering activities, as required, for the duration of the project.
E. Ventilate enclosed areas to assist cure of materials, to dissipate humidity, and to prevent accumulation of dust, fumes, vapors, or gases.
F. Erosion and Sediment Control: Plan and execute work by methods to control surface drainage from cuts and fills, from borrow and waste disposal areas. Prevent erosion and sedimentation.
   1. Minimize amount of bare soil exposed at one time.
   2. Provide temporary measures such as berms, dikes, and drains, to prevent water flow.
   3. Construct fill and waste areas by selective placement to avoid erosive surface silts or clays.
   4. Periodically inspect earthwork to detect evidence of erosion and sedimentation; promptly apply corrective measures.
G. Noise Control: Provide methods, means, and facilities to minimize noise produced by construction operations.
   1. Outdoors: Limit conduct of especially noisy exterior work to the hours of 6 pm to 7 am.
H. Pest and Rodent Control: Provide methods, means, and facilities to prevent pests and insects from damaging the work.
I. Rodent Control: Provide methods, means, and facilities to prevent rodents from accessing or invading premises.
J. Pollution Control: Provide methods, means, and facilities to prevent contamination of soil, water, and atmosphere from discharge of noxious, toxic substances, and pollutants produced by construction operations. Comply with federal, state, and local regulations.

PART 2 PRODUCTS
2.01 PATCHING MATERIALS
A. New Materials: As specified in product sections; match existing products and work for patching and extending work.
B. Type and Quality of Existing Products: Determine by inspecting and testing products where necessary, referring to existing work as a standard.
C. Product Substitution: For any proposed change in materials, submit request for substitution described in Section 01 60 00 - Product Requirements.

PART 3 EXECUTION
3.01 EXAMINATION
A. Verify that existing site conditions and substrate surfaces are acceptable for subsequent work. Start of work means acceptance of existing conditions.
B. Verify that existing substrate is capable of structural support or attachment of new work being applied or attached.
C. Examine and verify specific conditions described in individual specification sections.
D. Take field measurements before confirming product orders or beginning fabrication, to minimize waste due to over-ordering or misfabrication.
E. Verify that utility services are available, of the correct characteristics, and in the correct locations.
F. Prior to Cutting: Examine existing conditions prior to commencing work, including elements subject to damage or movement during cutting and patching. After uncovering existing work,
assess conditions affecting performance of work. Beginning of cutting or patching means acceptance of existing conditions.

3.02 PREPARATION
A. Clean substrate surfaces prior to applying next material or substance.
B. Seal cracks or openings of substrate prior to applying next material or substance.
C. Apply manufacturer required or recommended substrate primer, sealer, or conditioner prior to applying any new material or substance in contact or bond.

3.03 PREINSTALLATION MEETINGS
A. When required in individual specification sections, convene a preinstallation meeting at the site prior to commencing work of the section.
B. Require attendance of parties directly affecting, or affected by, work of the specific section.
C. Notify Architect four days in advance of meeting date.
D. Prepare agenda and preside at meeting:
   1. Review conditions of examination, preparation and installation procedures.
   2. Review coordination with related work.
E. Record minutes and distribute copies within two days after meeting to participants, with two copies to Architect, Owner, participants, and those affected by decisions made.

3.04 LAYING OUT THE WORK
A. Verify locations of survey control points prior to starting work.
B. Promptly notify Architect of any discrepancies discovered.
C. Contractor shall locate and protect survey control and reference points.
D. Control datum for survey is that established by Owner provided survey.
E. Protect survey control points prior to starting site work; preserve permanent reference points during construction.
F. Promptly report to Architect the loss or destruction of any reference point or relocation required because of changes in grades or other reasons.
G. Replace dislocated survey control points based on original survey control. Make no changes without prior written notice to Architect.
H. Utilize recognized engineering survey practices.
I. Establish a minimum of two permanent bench marks on site, referenced to established control points. Record locations, with horizontal and vertical data, on project record documents.
J. Establish elevations, lines and levels. Locate and lay out by instrumentation and similar appropriate means:
   1. Site improvements including pavements; stakes for grading, fill and topsoil placement; utility locations, slopes, and invert elevations.
   2. Grid or axis for structures.
   3. Building foundation, column locations, ground floor elevations.
   4. Controlling lines and levels required for mechanical and electrical trades.
K. Periodically verify layouts by same means.
L. Maintain a complete and accurate log of control and survey work as it progresses.
M. On completion of foundation walls and major site improvements, prepare a certified survey illustrating dimensions, locations, angles, and elevations of construction and site work.

3.05 GENERAL INSTALLATION REQUIREMENTS
A. Install products as specified in individual sections, in accordance with manufacturer’s instructions and recommendations, and so as to avoid waste due to necessity for replacement.
B. Make vertical elements plumb and horizontal elements level, unless otherwise indicated.
C. Install equipment and fittings plumb and level, neatly aligned with adjacent vertical and horizontal lines, unless otherwise indicated.
D. Make consistent texture on surfaces, with seamless transitions, unless otherwise indicated.
E. Make neat transitions between different surfaces, maintaining texture and appearance.

3.06 CUTTING AND PATCHING
A. Whenever possible, execute the work by methods that avoid cutting or patching.
B. Perform whatever cutting and patching is necessary to:
   1. Complete the work.
   2. Fit products together to integrate with other work.
   3. Provide openings for penetration of mechanical, electrical, and other services.
   4. Match work that has been cut to adjacent work.
   5. Repair areas adjacent to cuts to required condition.
   6. Repair new work damaged by subsequent work.
   7. Remove samples of installed work for testing when requested.
   8. Remove and replace defective and non-complying work.
C. Execute work by methods that avoid damage to other work and that will provide appropriate surfaces to receive patching and finishing. In existing work, minimize damage and restore to original condition.
D. Employ original installer to perform cutting for weather exposed and moisture resistant elements, and sight exposed surfaces.
E. Cut rigid materials using masonry saw or core drill. Pneumatic tools not allowed without prior approval.
F. Restore work with new products in accordance with requirements of Contract Documents.
G. Fit work air tight to pipes, sleeves, ducts, conduit, and other penetrations through surfaces.
H. At penetrations of fire rated walls, partitions, ceiling, or floor construction, completely seal voids with fire rated material in accordance with Section 07 84 00, to full thickness of the penetrated element.
I. Patching:
   1. Finish patched surfaces to match finish that existed prior to patching. On continuous surfaces, refinish to nearest intersection or natural break. For an assembly, refinish entire unit.
   2. Match color, texture, and appearance.
   3. Repair patched surfaces that are damaged, lifted, discolored, or showing other imperfections due to patching work. If defects are due to condition of substrate, repair substrate prior to repairing finish.

3.07 PROGRESS CLEANING
A. Maintain areas free of waste materials, debris, and rubbish. Maintain site in a clean and orderly condition.
B. Remove debris and rubbish from pipe chases, plenums, attics, crawl spaces, and other closed or remote spaces, prior to enclosing the space.
C. Broom and vacuum clean interior areas prior to start of surface finishing, and continue cleaning to eliminate dust.
D. Collect and remove waste materials, debris, and trash/rubbish from site periodically and dispose off-site; do not burn or bury.

3.08 PROTECTION OF INSTALLED WORK
A. Protect installed work from damage by construction operations.
B. Provide special protection where specified in individual specification sections.
C. Provide temporary and removable protection for installed products. Control activity in immediate work area to prevent damage.
D. Provide protective coverings at walls, projections, jambs, sills, and soffits of openings.
E. Protect finished floors, stairs, and other surfaces from traffic, dirt, wear, damage, or movement of heavy objects, by protecting with durable sheet materials.
F. Prohibit traffic or storage upon waterproofed or roofed surfaces. If traffic or activity is necessary, obtain recommendations for protection from waterproofing or roofing material manufacturer.
G. Remove protective coverings when no longer needed; reuse or recycle coverings if possible.

3.09 SYSTEM STARTUP
A. Coordinate schedule for start-up of various equipment and systems.
B. Verify that each piece of equipment or system has been checked for proper lubrication, drive rotation, belt tension, control sequence, and for conditions that may cause damage.
C. Verify tests, meter readings, and specified electrical characteristics agree with those required by the equipment or system manufacturer.
D. Verify that wiring and support components for equipment are complete and tested.
E. Execute start-up under supervision of applicable Contractor personnel and manufacturer's representative in accordance with manufacturers' instructions.
F. Submit a written report that equipment or system has been properly installed and is functioning correctly.

3.10 DEMONSTRATION AND INSTRUCTION
A. Demonstrate operation and maintenance of products to Owner's personnel two weeks prior to date of Substantial Completion.
B. Demonstrate start-up, operation, control, adjustment, trouble-shooting, servicing, maintenance, and shutdown of each item of equipment at scheduled time, at equipment location.
C. For equipment or systems requiring seasonal operation, perform demonstration for other season within six months.
D. Provide a qualified person who is knowledgeable about the Project to perform demonstration and instruction of Owner's personnel.
E. Utilize operation and maintenance manuals as basis for instruction. Review contents of manual with Owner's personnel in detail to explain all aspects of operation and maintenance.
F. Prepare and insert additional data in operations and maintenance manuals when need for additional data becomes apparent during instruction.

3.11 ADJUSTING
A. Adjust operating products and equipment to ensure smooth and unhindered operation.
B. Testing, adjusting, and balancing HVAC systems: See Section 23 05 93 - Testing, Adjusting, and Balancing for HVAC.

3.12 FINAL CLEANING
A. Execute final cleaning after Substantial Completion but before making final application for payment.
B. Use cleaning materials that are nonhazardous.
C. Clean interior and exterior glass, surfaces exposed to view; remove temporary labels, stains and foreign substances, polish transparent and glossy surfaces, vacuum carpeted and soft surfaces.
D. Remove all labels that are not permanent. Do not paint or otherwise cover fire test labels or nameplates on mechanical and electrical equipment.
E. Clean equipment and fixtures to a sanitary condition with cleaning materials appropriate to the surface and material being cleaned.
F. Clean filters of operating equipment.
G. Clean debris from roofs, gutters, downspouts, scuppers, overflow drains, area drains, and drainage systems.
H. Clean site; sweep paved areas, rake clean landscaped surfaces.
I. Remove waste, surplus materials, trash/rubbish, and construction facilities from the site; dispose of in legal manner; do not burn or bury.

3.13 CLOSEOUT PROCEDURES
A. Make submittals that are required by governing or other authorities.
   1. Provide copies to Architect and Owner.
B. Accompany Project Coordinator on preliminary inspection to determine items to be listed for completion or correction in the Contractor's Correction Punch List for Contractor's Notice of Substantial Completion.
C. Notify Architect when work is considered ready for Architect's Substantial Completion inspection.
D. Submit written certification containing Contractor's Correction Punch List, that Contract Documents have been reviewed, work has been inspected, and that work is complete in accordance with Contract Documents and ready for Architect's Substantial Completion inspection.
E. Conduct Substantial Completion inspection and create Final Correction Punch List containing Architect's and Contractor's comprehensive list of items identified to be completed or corrected and submit to Architect.
F. Correct items of work listed in Final Correction Punch List and comply with requirements for access to Owner-occupied areas.
G. Notify Architect when work is considered finally complete and ready for Architect's Substantial Completion final inspection.
H. Complete items of work determined by Architect listed in executed Certificate of Substantial Completion.

3.14 MAINTENANCE
A. Provide service and maintenance of components indicated in specification sections.
B. Maintenance Period: As indicated in specification sections or, if not indicated, not less than one year from the Date of Substantial Completion or the length of the specified warranty, whichever is longer.
C. Examine system components at a frequency consistent with reliable operation. Clean, adjust, and lubricate as required.
D. Include systematic examination, adjustment, and lubrication of components. Repair or replace parts whenever required. Use parts produced by the manufacturer of the original component.
E. Maintenance service shall not be assigned or transferred to any agent or subcontractor without prior written consent of the Owner.

END OF SECTION 01 70 00
SECTION 01 74 19
CONSTRUCTION WASTE MANAGEMENT AND DISPOSAL

PART 1  GENERAL

1.01 WASTE MANAGEMENT REQUIREMENTS

A. Owner requires that this project generate the least amount of trash and waste possible.
B. Employ processes that ensure the generation of as little waste as possible due to error, poor planning, breakage, mishandling, contamination, or other factors.
C. Minimize trash/waste disposal in landfills; reuse, salvage, or recycle as much waste as economically feasible.
D. Required Recycling, Salvage, and Reuse: The following may not be disposed of in landfills or by incineration:
   1. Aluminum and plastic beverage containers.
   2. Corrugated cardboard.
   3. Wood pallets.
   4. Clean dimensional wood.
   5. Land clearing debris, including brush, branches, logs, and stumps; see Section 31 10 00 - Site Clearing for use options.
   6. Metals, including packaging banding, metal studs, sheet metal, structural steel, piping, reinforcing bars, door frames, and other items made of steel, iron, galvanized steel, stainless steel, aluminum, copper, zinc, lead, brass, and bronze.
E. Contractor shall submit periodic Waste Disposal Reports; all landfill disposal, recycling, salvage, and reuse must be reported regardless of to whom the cost or savings accrues; use the same units of measure on all reports.
F. Methods of trash/waste disposal that are not acceptable are:
   1. Burning on the project site.
   2. Burying on the project site.
   3. Dumping or burying on other property, public or private.
   4. Other illegal dumping or burying.
   5. Incineration, either on- or off-site.
G. Regulatory Requirements: Contractor is responsible for knowing and complying with regulatory requirements, including but not limited to Federal, state and local requirements, pertaining to legal disposal of all construction and demolition waste materials.

1.02 RELATED REQUIREMENTS

A. Section 01 30 00 - Administrative Requirements: Additional requirements for project meetings, reports, submittal procedures, and project documentation.
B. Section 01 50 00 - Temporary Facilities and Controls: Additional requirements related to trash/waste collection and removal facilities and services.
C. Section 01 60 00 - Product Requirements: Waste prevention requirements related to delivery, storage, and handling.
D. Section 01 70 00 - Execution and Closeout Requirements: Trash/waste prevention procedures related to demolition, cutting and patching, installation, protection, and cleaning.
E. Section 31 10 00 - Site Clearing: Handling and disposal of land clearing debris.

1.03 DEFINITIONS

A. Clean: Untreated and unpainted; not contaminated with oils, solvents, caulk, or the like.
B. Construction and Demolition Waste: Solid wastes typically including building materials, packaging, trash, debris, and rubble resulting from construction, remodeling, repair and demolition operations.
C. Hazardous: Exhibiting the characteristics of hazardous substances, i.e., ignitibility, corrosivity, toxicity or reactivity.
D. **Nonhazardous:** Exhibiting none of the characteristics of hazardous substances, i.e., ignitibility, corrosivity, toxicity, or reactivity.

E. **Nontoxic:** Neither immediately poisonous to humans nor poisonous after a long period of exposure.

F. **Recyclable:** The ability of a product or material to be recovered at the end of its life cycle and remanufactured into a new product for reuse by others.

G. **Recycle:** To remove a waste material from the project site to another site for remanufacture into a new product for reuse by others.

H. **Recycling:** The process of sorting, cleansing, treating and reconstituting solid waste and other discarded materials for the purpose of using the altered form. Recycling does not include burning, incinerating, or thermally destroying waste.

I. **Return:** To give back reusable items or unused products to vendors for credit.

J. **Reuse:** To reuse a construction waste material in some manner on the project site.

K. **Salvage:** To remove a waste material from the project site to another site for resale or reuse by others.

L. **Sediment:** Soil and other debris that has been eroded and transported by storm or well production run-off water.

M. **Source Separation:** The act of keeping different types of waste materials separate beginning from the first time they become waste.

N. **Toxic:** Poisonous to humans either immediately or after a long period of exposure.

O. **Trash:** Any product or material unable to be reused, returned, recycled, or salvaged.

P. **Waste:** Extra material or material that has reached the end of its useful life in its intended use. Waste includes salvageable, returnable, recyclable, and reusable material.

1.04 **SUBMITTALS**

A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.

B. **Waste Disposal Reports:** Submit at specified intervals, with details of quantities of trash and waste, means of disposal or reuse, and costs; show both totals to date and since last report.
   1. Submit updated Report with each Application for Progress Payment; failure to submit Report will delay payment.
   2. Submit Report on a form acceptable to Owner.
   3. **Landfill Disposal:** Include the following information:
      a. Identification of material.
      b. Amount, in tons or cubic yards, of trash/waste material from the project disposed of in landfills.
      c. State the identity of landfills, total amount of tipping fees paid to landfill, and total disposal cost.
      d. Include manifests, weight tickets, receipts, and invoices as evidence of quantity and cost.

C. **Recycled and Salvaged Materials:** Include the following information for each:
   a. Identification of material, including those retrieved by installer for use on other projects.
   b. Amount, in tons or cubic yards, date removed from the project site, and receiving party.
   c. Transportation cost, amount paid or received for the material, and the net total cost or savings of salvage or recycling each material.
   d. Include manifests, weight tickets, receipts, and invoices as evidence of quantity and cost.
   e. Certification by receiving party that materials will not be disposed of in landfills or by incineration.

D. **Material Reused on Project:** Include the following information for each:
a. Identification of material and how it was used in the project.
b. Amount, in tons or cubic yards.
c. Include weight tickets as evidence of quantity.

6. Other Disposal Methods: Include information similar to that described above, as appropriate to disposal method.

PART 2 PRODUCTS - NOT USED

PART 3 EXECUTION

3.01 WASTE MANAGEMENT PROCEDURES

A. See Section 01 30 00 for additional requirements for project meetings, reports, submittal procedures, and project documentation.
B. See Section 01 50 00 for additional requirements related to trash/waste collection and removal facilities and services.
C. See Section 01 60 00 for waste prevention requirements related to delivery, storage, and handling.
D. See Section 01 70 00 for trash/waste prevention procedures related to cutting and patching, installation, protection, and cleaning.

3.02 WASTE MANAGEMENT PLAN IMPLEMENTATION

A. Manager: Designate an on-site person or persons responsible for instructing workers and overseeing and documenting results of the Waste Management Plan.
B. Communication: Distribute copies of the Waste Management Plan to job site foreman, each subcontractor, Owner, and Architect.
C. Instruction: Provide on-site instruction of appropriate separation, handling, and recycling, salvage, reuse, and return methods to be used by all parties at the appropriate stages of the project.
D. Meetings: Discuss trash/waste management goals and issues at project meetings.
   1. Prebid meeting.
   2. Preconstruction meeting.
   3. Regular job-site meetings.
E. Facilities: Provide specific facilities for separation and storage of materials for recycling, salvage, reuse, return, and trash disposal, for use by all contractors and installers.
   1. Provide containers as required.
   2. Provide adequate space for pick-up and delivery and convenience to subcontractors.
   3. Keep recycling and trash/waste bin areas neat and clean and clearly marked in order to avoid contamination of materials.
F. Hazardous Wastes: Separate, store, and dispose of hazardous wastes according to applicable regulations.
G. Recycling: Separate, store, protect, and handle at the site identified recyclable waste products in order to prevent contamination of materials and to maximize recyclability of identified materials. Arrange for timely pickups from the site or deliveries to recycling facility in order to prevent contamination of recyclable materials.
H. Reuse of Materials On-Site: Set aside, sort, and protect separated products in preparation for reuse.
I. Salvage: Set aside, sort, and protect products to be salvaged for reuse off-site.

END OF SECTION 01 74 19
SECTION 01 78 00  
CLOSEOUT SUBMITTALS  

PART 1 GENERAL  
1.01 SECTION INCLUDES  
   A. Project record documents.  
   B. Operation and maintenance data.  
   C. Warranties and bonds.  

1.02 RELATED REQUIREMENTS  
   A. Section 01 30 00 - Administrative Requirements: Submittals procedures, shop drawings, 
      product data, and samples.  
   B. Section 01 70 00 - Execution and Closeout Requirements: Contract closeout procedures.  
   C. Individual Product Sections: Specific requirements for operation and maintenance data.  
   D. Individual Product Sections: Warranties required for specific products or Work.  

1.03 SUBMITTALS  
   A. Project Record Documents: Submit documents to Architect with claim for final Application for 
      Payment.  
   B. Operation and Maintenance Data:  
      1. Submit two copies of preliminary draft or proposed formats and outlines of contents before 
         start of Work. Architect will review draft and return one copy with comments.  
      2. For equipment, or component parts of equipment put into service during construction and 
         operated by Owner, submit completed documents within ten days after acceptance.  
      3. Submit one copy of completed documents 15 days prior to final inspection. This copy will 
         be reviewed and returned after final inspection, with Architect comments. Revise content 
         of all document sets as required prior to final submission.  
      4. Submit two sets of revised final documents in final form within 10 days after final 
         inspection.  
   C. Warranties and Bonds:  
      1. For equipment or component parts of equipment put into service during construction with 
         Owner's permission, submit documents within 10 days after acceptance.  
      2. Make other submittals within 10 days after Date of Substantial Completion, prior to final 
         Application for Payment.  
      3. For items of Work for which acceptance is delayed beyond Date of Substantial 
         Completion, submit within 10 days after acceptance, listing the date of acceptance as the 
         beginning of the warranty period.  

PART 2 PRODUCTS - NOT USED  
PART 3 EXECUTION  
3.01 PROJECT RECORD DOCUMENTS  
   A. Maintain on site one set of the following record documents; record actual revisions to the Work: 
      1. Drawings.  
      2. Specifications.  
      3. Addenda.  
      4. Change Orders and other modifications to the Contract.  
   B. Ensure entries are complete and accurate, enabling future reference by Owner.  
   C. Store record documents separate from documents used for construction.  
   D. Record information concurrent with construction progress.  
   E. Specifications: Legibly mark and record at each product section description of actual products 
      installed, including the following:  
      1. Manufacturer's name and product model and number.
2. Product substitutions or alternates utilized.
3. Changes made by Addenda and modifications.
F. Record Drawings: Legibly mark each item to record actual construction including:
1. Measured depths of foundations in relation to finish first floor datum.
2. Measured horizontal and vertical locations of underground utilities and appurtenances, referenced to permanent surface improvements.
3. Measured locations of internal utilities and appurtenances concealed in construction, referenced to visible and accessible features of the Work.
4. Field changes of dimension and detail.
5. Details not on original Contract drawings.

3.02 OPERATION AND MAINTENANCE DATA
A. Source Data: For each product or system, list names, addresses and telephone numbers of Subcontractors and suppliers, including local source of supplies and replacement parts.
B. Product Data: Mark each sheet to clearly identify specific products and component parts, and data applicable to installation. Delete inapplicable information.
C. Drawings: Supplement product data to illustrate relations of component parts of equipment and systems, to show control and flow diagrams. Do not use Project Record Documents as maintenance drawings.
D. Typed Text: As required to supplement product data. Provide logical sequence of instructions for each procedure, incorporating manufacturer's instructions.

3.03 OPERATION AND MAINTENANCE DATA FOR MATERIALS AND FINISHES
A. For Each Product, Applied Material, and Finish:
1. Product data, with catalog number, size, composition, and color and texture designations.
B. Instructions for Care and Maintenance: Manufacturer's recommendations for cleaning agents and methods, precautions against detrimental cleaning agents and methods, and recommended schedule for cleaning and maintenance.
C. Additional information as specified in individual product specification sections.
D. Where additional instructions are required, beyond the manufacturer's standard printed instructions, have instructions prepared by personnel experienced in the operation and maintenance of the specific products.

3.04 OPERATION AND MAINTENANCE DATA FOR EQUIPMENT AND SYSTEMS
A. For Each Item of Equipment and Each System:
1. Description of unit or system, and component parts.
2. Identify function, normal operating characteristics, and limiting conditions.
3. Include performance curves, with engineering data and tests.
4. Complete nomenclature and model number of replaceable parts.
B. Where additional instructions are required, beyond the manufacturer's standard printed instructions, have instructions prepared by personnel experienced in the operation and maintenance of the specific products.
C. Panelboard Circuit Directories: Provide electrical service characteristics, controls, and communications; typed.
D. Include color coded wiring diagrams as installed.
E. Operating Procedures: Include start-up, break-in, and routine normal operating instructions and sequences. Include regulation, control, stopping, shut-down, and emergency instructions. Include summer, winter, and any special operating instructions.
F. Maintenance Requirements: Include routine procedures and guide for preventative maintenance and trouble shooting; disassembly, repair, and reassembly instructions; and alignment, adjusting, balancing, and checking instructions.
G. Provide servicing and lubrication schedule, and list of lubricants required.
H. Include manufacturer's printed operation and maintenance instructions.
I. Include sequence of operation by controls manufacturer.
J. Provide original manufacturer's parts list, illustrations, assembly drawings, and diagrams required for maintenance.
K. Provide control diagrams by controls manufacturer as installed.
L. Provide Contractor's coordination drawings, with color coded piping diagrams as installed.
M. Provide charts of valve tag numbers, with location and function of each valve, keyed to flow and control diagrams.
N. Provide list of original manufacturer's spare parts, current prices, and recommended quantities to be maintained in storage.
O. Include test and balancing reports.
P. Additional Requirements: As specified in individual product specification sections.

3.05 ASSEMBLY OF OPERATION AND MAINTENANCE MANUALS
A. Assemble operation and maintenance data into durable manuals for Owner's personnel use, with data arranged in the same sequence as, and identified by, the specification sections.
B. Where systems involve more than one specification section, provide separate tabbed divider for each system.
C. Binders: Commercial quality, 8-1/2 by 11 inch three D side ring binders with durable plastic covers; 2 inch maximum ring size. When multiple binders are used, correlate data into related consistent groupings.
D. Cover: Identify each binder with typed or printed title OPERATION AND MAINTENANCE INSTRUCTIONS; identify title of Project; identify subject matter of contents.
E. Project Directory: Title and address of Project; names, addresses, and telephone numbers of Architect, Consultants, Contractor and subcontractors, with names of responsible parties.
F. Tables of Contents: List every item separated by a divider, using the same identification as on the divider tab; where multiple volumes are required, include all volumes Tables of Contents in each volume, with the current volume clearly identified.
G. Dividers: Provide tabbed dividers for each separate product and system; identify the contents on the divider tab; immediately following the divider tab include a description of product and major component parts of equipment.
H. Text: Manufacturer's printed data, or typewritten data on 20 pound paper.
I. Drawings: Provide with reinforced punched binder tab. Bind in with text; fold larger drawings to size of text pages.
J. Arrangement of Contents: Organize each volume in parts as follows:
   1. Project Directory.
   2. Table of Contents, of all volumes, and of this volume.
   3. Operation and Maintenance Data: Arranged by system, then by product category.
      a. Source data.
      b. Product data, shop drawings, and other submittals.
      c. Operation and maintenance data.
      d. Field quality control data.
      e. Photocopies of warranties and bonds.

3.06 WARRANTIES AND BONDS
A. Obtain warranties and bonds, executed in duplicate by responsible Subcontractors, suppliers, and manufacturers, within 10 days after completion of the applicable item of work. Except for items put into use with Owner's permission, leave date of beginning of time of warranty until Date of Substantial completion is determined.
B. Verify that documents are in proper form, contain full information, and are notarized.
C. Co-execute submittals when required.
D. Retain warranties and bonds until time specified for submittal.
E. Manual: Bind in commercial quality 8-1/2 by 11 inch three D side ring binders with durable plastic covers.
F. Cover: Identify each binder with typed or printed title WARRANTIES AND BONDS, with title of Project; name, address and telephone number of Contractor and equipment supplier; and name of responsible company principal.
G. Table of Contents: Neatly typed, in the sequence of the Table of Contents of the Project Manual, with each item identified with the number and title of the specification section in which specified, and the name of product or work item.
H. Separate each warranty or bond with index tab sheets keyed to the Table of Contents listing. Provide full information, using separate typed sheets as necessary. List Subcontractor, supplier, and manufacturer, with name, address, and telephone number of responsible principal.

END OF SECTION 01 78 00
SECTION 02 41 00
DEMOLITION

PART 1 GENERAL

1.01 SECTION INCLUDES
A. Building demolition excluding removal of hazardous materials and toxic substances.
B. Abandonment and removal of existing utilities and utility structures.

1.02 RELATED REQUIREMENTS
A. Section 01 10 00 - Summary: Limitations on Contractor’s use of site and premises.
B. Section 01 10 00 - Summary: Description of items to be salvaged or removed for re-use by Contractor.
C. Section 01 50 00 - Temporary Facilities and Controls: Site fences, security, protective barriers, and waste removal.
D. Section 01 60 00 - Product Requirements: Handling and storage of items removed for salvage and relocation.
E. Section 01 70 00 - Execution and Closeout Requirements: Project conditions; protection of bench marks, survey control points, and existing construction to remain; reinstallation of removed products; temporary bracing and shoring.
F. Section 02 65 00 - Underground Storage Tank Removal.

1.03 REFERENCE STANDARDS

1.04 SUBMITTALS
A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.
B. Site Plan: Showing:
   1. Vegetation to be protected.
   2. Areas for temporary construction and field offices.
   3. Areas for temporary and permanent placement of removed materials.
C. Project Record Documents: Accurately record actual locations of capped and active utilities and subsurface construction.

1.05 QUALITY ASSURANCE
A. Demolition Firm Qualifications: Company specializing in the type of work required.
   1. Minimum of five years of documented experience.

PART 2 PRODUCTS -- NOT USED

PART 3 EXECUTION

3.01 SCOPE
A. Remove the entire building designated PBSO Marine.
B. Remove paving and curbs as required to accomplish new work.
C. Break up paving within site boundaries to permit natural moisture drainage; leave pieces not larger than 1 square yard.
D. Within area of new construction, remove foundation walls and footings to a minimum of 2 feet below finished grade.
E. Outside area of new construction, remove foundation walls and footings to a minimum of 2 feet below finished grade.
F. Break up concrete slabs on grade within site boundaries to permit natural moisture drainage; leave pieces not larger than 1 square yard.
G. Remove underground tanks.
H. Remove manholes and manhole covers, curb inlets and catch basins.
I. Remove fences and gates.
J. Remove creosote-treated wood utility poles.
K. Remove other items indicated, for salvage, relocation, and recycling.
L. Fill excavations, open pits, and holes in ground areas generated as result of removals, using specified fill; compact fill as required so that required rough grade elevations do not subside within one year after completion.

3.02 GENERAL PROCEDURES AND PROJECT CONDITIONS
A. Comply with applicable codes and regulations for demolition operations and safety of adjacent structures and the public.
   1. Obtain required permits.
   2. Comply with applicable requirements of NFPA 241.
   3. Use of explosives is not permitted.
   4. Take precautions to prevent catastrophic or uncontrolled collapse of structures to be removed; do not allow worker or public access within range of potential collapse of unstable structures.
   5. Provide, erect, and maintain temporary barriers and security devices.
   6. Use physical barriers to prevent access to areas that could be hazardous to workers or the public.
   7. Conduct operations to minimize effects on and interference with adjacent structures and occupants.
   8. Do not close or obstruct roadways or sidewalks without permit.
   9. Conduct operations to minimize obstruction of public and private entrances and exits; do not obstruct required exits at any time; protect persons using entrances and exits from removal operations.
  10. Obtain written permission from owners of adjacent properties when demolition equipment will traverse, infringe upon or limit access to their property.
B. Do not begin removal until receipt of notification to proceed from Owner.
C. Protect existing structures and other elements that are not to be removed.
   1. Provide bracing and shoring.
   2. Prevent movement or settlement of adjacent structures.
   3. Stop work immediately if adjacent structures appear to be in danger.
D. Minimize production of dust due to demolition operations; do not use water if that will result in ice, flooding, sedimentation of public waterways or storm sewers, or other pollution.
E. If hazardous materials are discovered during removal operations, stop work and notify Architect and Owner; hazardous materials include regulated asbestos containing materials, lead, PCB's, and mercury.
F. Partial Removal of Paving and Curbs: Neatly saw cut at right angle to surface.
G. Underground Storage Tanks: Remove and dispose of as specified in Section 02 65 00.

3.03 EXISTING UTILITIES
A. Coordinate work with utility companies; notify before starting work and comply with their requirements; obtain required permits.
B. Protect existing utilities to remain from damage.
C. Do not disrupt public utilities without permit from authority having jurisdiction.
D. Do not close, shut off, or disrupt existing life safety systems that are in use without at least 7 days prior written notification to Owner.
E. Do not close, shut off, or disrupt existing utility branches or take-offs that are in use without at least 3 days prior written notification to Owner.
F. Locate and mark utilities to remain; mark using highly visible tags or flags, with identification of utility type; protect from damage due to subsequent construction, using substantial barricades if necessary.

G. Remove exposed piping, valves, meters, equipment, supports, and foundations of disconnected and abandoned utilities.

3.04 DEBRIS AND WASTE REMOVAL

A. Remove debris, junk, and trash from site.

B. Leave site in clean condition, ready for subsequent work.

C. Clean up spillage and wind-blown debris from public and private lands.

END OF SECTION 02 41 00
SECTION 02 65 00
UNDERGROUND STORAGE TANK REMOVAL

<<<< UPDATE NOTES

PART 1  GENERAL

2.01  SECTION INCLUDES
   A.  Removal and disposal of underground storage tanks and connected piping.
   B.  Cleaning and vapor freeing of tanks.
   C.  Fuel removal.
   D.  Temporary containment of excavated soil.
   E.  Testing soils for contamination.
   F.  Disposal of contaminated soil.
   G.  Water disposal.
   H.  Providing reports required by regulatory agencies.
   I.  Backfilling.

2.02  RELATED REQUIREMENTS
   A.  Section 01 70 00 - Execution and Closeout Requirements:  Dewatering of excavations and water control.
   B.  Section 02 41 00 - Demolition.

2.03  REFERENCE STANDARDS

2.04  SUBMITTALS
   A.  See Section 01 30 00 - Administrative Requirements, for submittal procedures.
   B.  Site Safety and Health Plan:  Describe safety and health plan and procedures as related to underground tank removal and pipe removal, and as related to operations associated with petroleum contaminated soils and water.
   C.  Excavation and Material Handling Plan:  Describe methods, means, equipment, sequence of operations and schedule to be employed in excavation, transport, handling, and stockpiling of soil during underground tank removal.
      1.  Submit to Architect fifteen days before beginning tank removal work.
      2.  Include a material handling plan that describes phases of dealing with the contaminated soil and water as it relates to the proposed tank and piping removal.
      3.  Include methods of excavating, a material handling plan for the contaminated material, soil testing requirements, safety precautions and requirements, and water pumping and collection requirements.
D. Field Sampling and Laboratory Testing Plan: Describe field sampling methods and quality control procedures.
   1. Identify laboratory and laboratory methods to be used for contamination testing.
   2. Sample reports shall show sample identification for location, date, time, sample method, contamination level, name of individual sampler, identification of laboratory, and quality control procedures.

E. Tank and Piping Removal and Disposal Plan: Describe methods, means, sequence of operations, and schedule to be employed in the testing, pumping, cleaning, de-vaporizing, inspecting, removal, and disposal of underground storage tanks and piping.

F. Spill and Discharge Control Plan: Describe procedures and plan related to potential spills and discharge of contaminated soils and water.

G. Reports:
   1. Identification of tanks removed and disposed of, including site map showing location of tank and piping.
   2. Starting and ending dates of reporting period.
   3. Closure report. Incorporate reports, records, and data into a single binder with the title "SITE ASSESSMENT REPORT" on the cover of the binder.
   4. Laboratory testing reports, including location of soil excavated and associated OVA/FID (organic vapor analyzer/flame ionization device) readings, and sampling and test results for:
      a. TPH (total petroleum hydrocarbons).
      b. BTEX (benzene, toluene, ethylbenzene, and xylene).
      c. TCLP (toxicity characteristic leaching procedure); if BTEX indicates gasoline, then provide TCLP.
   5. Cumulative quantities of soil excavated, beginning with start date for each tank and associated piping.

H. Record Documents:
   1. Building permit, inspection permits, and other permits required for underground tank removal.
   2. Results of excavation, including sketch showing location of underground storage tank, sampling locations, and extent of excavation.
   3. Tank disposal paperwork, such as copy of UST Notification Form and method of conditioning tank for disposal.
   4. Contaminated soil disposal paperwork, such as laboratory testing reports.
   5. Contaminated water disposal paperwork, such as laboratory testing results.

2.05 QUALITY ASSURANCE

A. Perform work in accordance with local, state, and federal regulations and 40 CFR 280.

B. Qualifications: Prior to start of work, submit documentation of recent experience and resumes of personnel working on the project.
   1. Data shall indicate that tank removal contractor, subcontractors, and personnel employed on the project have been engaged in removal, transportation, and disposal of underground tanks and associated piping, are familiar with and shall abide with the following:
      a. API RP 1604.
      b. 40 CFR 280 and State and local regulations and procedures.
      c. Applicable safety rules and regulations.
      d. Use of equipment and procedures for testing and vapor-freeing tanks.
      e. Handling and disposal of types of wastes encountered in underground tank and pipe removal including disposal of underground tanks and associated piping.
      f. Excavation, testing, and disposal of petroleum contaminated soils, liquids, and sludge.
      g. Provide documentation that tank removers are certified if locality of project has this requirement.
2. Furnish the name and qualifications of the proposed Site Safety and Health Officer, based on education, training, and work experience.

C. References: Furnish data proving experience on at least three prior projects that included types of activities similar to those in this project. Provide project titles, dates of projects, owners of projects, point of contact for each project, and phone numbers of each point of contact.

PART 2 PRODUCTS

3.01 MATERIALS

A. Plastic Sheeting: ASTM D4397.

PART 3 EXECUTION

4.01 PREPARATION FOR TANK REMOVAL AND DISPOSAL

A. Site Safety And Health Plan (SSHP): Furnish safety, health, and accident prevention provisions and develop a Site Safety and Health Plan (SSHP).
   1. The SSHP shall incorporate the requirements of 29 CFR 1910 and COE EM-385-1-1.
   2. Site work shall not start until the SSHP is approved by the Architect.

B. Site Safety And Health Officer: Identify an individual to serve as the Site Safety and Health Officer (SSHO) who is a Certified Industrial Hygienist (CIH).
   1. The SSHO CIH shall report problems and concerns regarding health and safety to the Architect.
   2. The SSHO CIH shall have a working knowledge of local and Federal occupational safety and health regulations, and shall provide training to Contractor employees in air monitoring practices and techniques.
   3. The SSHO CIH shall also provide day to day industrial hygiene support, including air monitoring, training, and daily site safety inspections.
   4. The SSHO CIH shall be trained in the use of the monitoring and sampling equipment, interpretation of data required to implement the SSHP, and to administer the elements of the SSHP.
   5. The SSHO CIH shall remain on site during project operations and may be assigned other duties, such as project foreman or quality control manager.

C. Spill And Discharge Control Plan: Develop, implement, and maintain a comprehensive spill and discharge control plan.
   1. The plan shall provide contingency measures for potential spills and discharges from handling and transportation of contaminated soils and water.
   2. A possible source of guidance for assessment and remediation is API PUBL 1628.

D. Exclusion Zone (EZ) And Contamination Reduction Zone (CRZ): Do not permit personnel not directly involved with the project to enter work zones, called the EZ and CRZ.
   1. The EZ shall be an area around the tank a minimum of 10 feet from the limits of the tank excavation.
   2. At the perimeter of the EZ, establish a CRZ.
   3. The Contractor’s site office, parking area, and other support facilities shall be located outside the EZ and CRZ.
   4. Clearly mark and post the boundaries of the EZ and CRZ.
   5. Include a site map, outlining the extent of work zones and location of support facilities, in the SSHP.

E. Personnel Protection: Furnish appropriate personal safety equipment and protective clothing to personnel.
   1. Ensure that safety equipment and protective clothing is kept clean and well maintained.

F. Decontamination: Decontaminate or properly dispose of personal protective equipment and clothing worn in contaminated areas at the end of the work day.
   1. The SSHO CIH shall be responsible for ensuring that personal protective clothing and equipment are decontaminated before being reissued.
G. First Aid And Emergency Response Equipment And Procedures: Provide appropriate emergency first aid equipment for treatment of exposure to site physical and chemical hazards.
   1. Provide and post a list of emergency phone numbers and points of contact for fire, hospital, police, ambulance, and other necessary contacts.
   2. Provide and post a route map detailing the directions to the nearest medical facility.

H. Ignition Sources: Do not permit ignition sources in the EZ and CRZ.

I. Waste Disposal: The SSHP shall detail the practices and procedures to be utilized to dispose of wastes. Upon completion of the project, certify that equipment and materials were properly decontaminated prior to being removed from the site.

   1. In an emergency, take action to remove or minimize the cause of the emergency, alert the Architect, and institute necessary measures to prevent repetition of the emergency.
   2. Equip site-support vehicles with route maps providing directions to the medical treatment facility.

K. Unforeseen Hazards: Notify the Architect of any unforeseen hazard or condition that becomes evident during work.

4.02 TANK CLEANING

A. Fuel Removal:
   1. All possible fuel will be pumped or otherwise removed from the tank by Owner.
   2. Consider remaining fuel contaminated or waste fuel; pump into 55 gallon drums or other suitable containers for disposal in accordance with approved procedures meeting local, state, and federal regulations.
      a. Drums or tanks used for containerizing waste fuel shall be furnished by Contractor.
   3. Dispose of remaining fuel emulsions in accordance with applicable local, state, and federal regulations.

4.03 TEMPORARY CONTAINMENT OF EXCAVATED SOIL

A. Provide temporary containment area near the excavated area.

B. Cover containment area with 30 mil polyethylene sheeting.
   1. Place excavated soil on the impervious barrier and cover with 6 mil polyethylene sheeting.
   2. Provide straw bale berm around the outer limits of the containment area and cover with polyethylene sheets.
   3. Secure edges of sheets to keep the polyethylene sheeting in place.

4.04 EXCAVATION

A. Provide Architect with written documentation, no later than 30 days before work begins, that proper state or local authorities have been notified.

B. Notify Architect at least 48 hours prior to start of tank removal work.
   1. Stage operations to minimize the time that tank excavation is open and the time that contaminated soil is exposed to the weather.
   2. Provide protection measures around the excavation area to prevent water runoff and to contain the soil within the excavation area.

C. Excavation: Excavate as required to remove tanks and piping.
   1. Place soil removed from the excavation in a temporary containment area.
   2. Collect and temporarily store water runoff from stockpiled soils.

D. Excavation Methods: Select methods and equipment to remove soil to minimize disturbance to areas beyond the limits of the excavation area.
   1. Material that becomes contaminated as a result of Contractor’s operations shall be removed and disposed of at no additional cost to Owner.
   2. Where excavation extends into groundwater levels, dewatering methods shall be employed on a localized basis to facilitate excavation operations, as specified in Section
3. Water generated by dewatering during excavation required for removal of tanks or piping, surface water collected in open excavation, or water used for washing equipment or existing concrete or bituminous surfaces, shall be collected and tested.
   a. Test in accordance with EPA SW-846 and EPA 600-4-790-20 and state or locally required analyses.
   b. Water that contains contaminants above locally acceptable levels shall be disposed of in accordance with federal, state, and local regulations.
   c. Non-contaminated water may be disposed of on-site.

E. Structures: During excavation activities, if asphalt pavement, concrete slabs, or other structures are encountered, remove and wash with high pressure water cleaning equipment.
   1. Remove and dispose of pavement, concrete, and other structures as specified in Section 02 41 00.

4.05 TESTING

A. Stockpiled Soils: Soils with OVA/FID readings of 10 ppm or greater shall be further sampled and tested.
   1. Test for TPH and for BTEX in accordance with EPA SW-846 and EPA 600-4-790-20.
   2. Test for toxicity characteristic leaching procedure (TCLP) for lead if leaded gasoline was stored in or near the underground tank being removed.
   3. For TPH, provide a minimum of one test for every 100 cubic yards.
   4. For BTEX and TCLP, provide one test for every 100 cubic yards.
   5. Soils that contain 50 ppm or more TPH, 10 ppm or more BTEX or have TCLP reading of 10 ppm lead or virgin petroleum products are considered contaminated materials.
   6. Soils that test at levels less than the above may be used as clean fill.
   7. Furnish results to Architect within 24 hours after the results are obtained.

B. Testing Under Tank After Removal of Tank:
   1. If tank is 20 feet or less in length, take two samples. Each sample shall be 2 feet from each end of the tank and 2 feet below the bottom of the excavation.
   2. If the tank is greater than 20 feet, take three samples. Two samples shall be 2 feet from each end of the tank and 2 feet below the bottom of the excavation. A third sample shall be taken from the middle of the tank area and 2 feet below the bottom of the excavation.
   3. Analyze samples for TPH, BTEX, and TCLP.
   4. Comply with standards for sampling and analysis as specified above for stockpiled soils.
   5. Test for TPH and for BTEX in accordance with EPA SW-846 and EPA 600-4-790-20.
   6. Soils that contain 50 ppm or more TPH, 10 ppm or more BTEX, or have TCLP reading of 10 ppm lead or virgin petroleum products are considered contaminated materials.
   7. Soils that test at levels less than the above may be used as clean fill.
   8. Furnish results to Architect within 24 hours after the results are obtained.
   9. Along with the results furnish a sketch showing underground tank, sampling location, and extent of excavations.

C. Testing Along Piping:
   1. For every 25 linear feet of product delivery piping, for every change in direction, and at every mechanical joint take one soil sample and analyze for TPH, BTEX, and TCLP.
   2. Comply with requirements for sampling and analysis of soil materials as specified above in the paragraph entitled "Testing Under Tank After Removal of Tank."

4.06 WATER DISPOSAL

A. Dewatering will be permitted only with approval of Architect.

B. Store and test water generated during removal of tanks and piping.
   1. If contaminated, transport and dispose of water in an EPA approved disposal site in accordance with federal, state, and local requirements.
   2. Non-contaminated water may be disposed of on-site.

4.07 DISPOSAL OF UNDERGROUND TANKS AND ASSOCIATED PIPING
A. Preparation: API RP 1604. Remove the fill pipe, gauge pipe, vapor recovery truck connection, submersible pumps, and drop tube.
   1. Cap or remove non-product piping, except vent piping.
   2. Plug tank openings so that vapors will exit through vent piping during the vapor-freeing process.

B. Purging: Remove flammable vapors in accordance with API RP 1604. Tanks shall be certified as "vapor free" prior to further work.

C. Cleaning and Testing: Clean tank and perform atmosphere testing in accordance with API RP 1604.
   1. Distribution (product delivery) piping shall be cleaned and removed or the piping shall be cleaned, filled with concrete, and abandoned in place.
   2. Test the tank atmosphere and the excavation area for flammable or combustible vapor concentrations, with a combustible gas indicator until the tank is removed from the excavation and from the site.

D. Tank Removal and Disposal:
   1. Plug or cap accessible holes. One plug shall have a minimum 1/8 inch vent hole.
   2. Remove tank from the excavation, place it on a level surface and render it useless in accordance with API RP 1604.
   3. Provide warning labels on tank if tank contained leaded fuels, as follows:
      a. "TANK HAS CONTAINED LEADED GASOLINE -- NOT VAPOR FREE -- NOT SUITABLE FOR STORAGE OF FOOD OR LIQUIDS INTENDED FOR HUMAN OR ANIMAL CONSUMPTION -- DATE OF REMOVAL: MONTH/DAY/YEAR"
   4. Transport and dispose of tank at an EPA approved disposal site in accordance with federal, state, and local regulations.

4.08 INSPECTIONS
   A. Arrange for and perform required inspections. Provide copies of inspections to the Architect.

4.09 CLOSURE REPORT (SITE ASSESSMENT REPORT)
   A. Provide Architect a Site Assessment Report in a single binder notebook that contains the full collection of reports relating to this work, including but not limited to, records, starting and ending dates of reporting period, inspections, documentation, and data as follows:
      1. Complete UST Notification Form (within 30 days of closure).
      2. Description of work, including removal procedures, number of tanks removed, identification of tanks removed and disposed of, cubic yards of excavated soil, location of disposal sites, and dates of excavation.
      3. Site plan, including location of tanks and piping, limits of excavation, sampling points, results of excavation, and depths.
      4. Laboratory testing reports, copies of data and test results from testing laboratory.
      5. Tank disposal paperwork, contaminated soil disposal paperwork, and contaminated water disposal paperwork.
      6. Certifications required by implementing agency.
      7. Building permit, inspection permits, and other permits required for underground tank removal, notifications, and inspection reports.
      8. Cumulative quantities of soil excavated, beginning with start date for each tank and associated piping.

4.10 SPILLS OF CONTAMINATED SOILS
   A. Use appropriate vehicles and operating practices to prevent spillage or leakage of contaminated materials from occurring during operations. Inspect vehicles leaving the area of contamination to ensure that no contaminated materials adhere to the wheels or undercarriage.

4.11 BACKFILLING
   A. Provide backfill, compaction, grading, and seeding in accordance with 31 23 23.

END OF SECTION 02 65 00
SECTION 03 11 00
CONCRETE FORMWORK

PART 1   GENERAL
1.1 SECTION INCLUDES
1.2 FORMWORK FOR CONCRETE
   A. Related accessories
1.3 REFERENCES
   A. ACI 301 - Specifications for Structural Concrete Buildings
   B. ACI 318 - Building Code Requirements for Structural Concrete
   C. ACI 347 - Guide to Formwork for Concrete
   D. ACI SP-4: Formwork for Concrete
   E. ASME A17.1 - Safety Code for Elevators and Escalators
   F. ASTM E1643 - Standard Practice for Selection, Design, Installation, and Inspection of Water Vapor Retarders Used in Contact with Earth or Granular Fill Under Concrete Slabs
   G. ASTM E1745 - Standard Specification for Plastic Water Vapor Retarders Used in Contact with Soil or Granular Fill under Concrete Slabs
   H. ASTM D1751 - Standard Specification for Preformed Expansion Joint Filler for Concrete Paving and Structural Construction (Non-extruding and Resilient Bituminous Types)
1.4 SYSTEM DESCRIPTION
   A. Concrete Formwork: For surfaces of cast-in-place concrete to be unexposed or to receive rubbed finish.
   B. Form footings and slabs on grade, earth forming are not allowed.
   C. Design/Performance Requirements: Design, engineering and construction of formwork and shoring is the responsibility of the Contractor.
      1. Design formwork with sufficient strength to withstand forces due to placement and vibration and sufficient rigidity to maintain specified tolerances.
      2. Design loads, lateral pressure, and allowable stresses in accordance with ACI 347.
1.5 SUBMITTALS
   A. Product Data: Proprietary materials and items, including forming accessories, water stops, joint systems, and others
   B. Structural Calculations (Threshold Buildings):
      1. Prepare and submit complete design calculations, plans, and details for shoring and re-shoring procedures, indicating conformance to specified performance and design criteria; signed, and sealed by a professional engineer registered in the State of Florida.
      2. Submit calculations for review information only, will not check for accuracy

PART 2   PRODUCTS
2.1 FORM MATERIALS
   A. Concrete Forms for Beams, Columns, and Slabs:
      1. New or properly reconditioned material designed to conform to requirements of ACI SP-4 and to support wet concrete without deflection.
      2. Plywood Panels: PS-1 B-B plywood, Class 1, EXT-APA, sanded, mill oiled, and edge sealed.
   B. Structural Concrete Forms for Joists: New or properly reconditioned removable 18-gauge steel or fiberglass pan forms with tapered end closures.
   C. Cylindrical Column Forms:
1. Metal, fiberglass reinforced plastic, or paper or fiber tubes.
2. Construct paper or fiber tubes of laminated plies using water-resistant adhesive with wax-impregnated exterior for weather and moisture protection.
   a. Provide units with sufficient wall thickness to resist loads imposed by wet concrete without deformation.

2.2 RELATED MATERIALS
A. Vapor Retarder: Related section 07 26 00.
B. Form Coatings: Colorless commercial formulation form release and sealer compounds that will not bond with, stain, nor adversely affect concrete surfaces, and will not impair subsequent treatments of concrete surfaces.
C. Form Ties: Adjustable length, removable or snap off metal form ties, designed to prevent form deflection and to prevent spalling concrete upon removal, 1½" break back, and maximum hole left 1¼" diameter.
D. Bevels and Rustications: Wood strips milled to shapes indicated or formed rigid plastic strips.
E. Dovetail Anchor Slots: 24-ga. galvanized steel with release tape sealed slots and bent tab anchors.
F. Flashing Reglets shall be 16-oz. copper with release tape sealed slots and alignment splines at end joints.
G. Construction Joints shall be 24-ga. galvanized steel keyway form type with knockout holes spaced 6" o. c. to receive doweling.
H. Carton Forms: Fiberboard void boxes capable of supporting min. load of 600 lbs./sq ft
I. Form Joint System for Architectural Concrete Forms:
   1. Gaskets shall be closed cell foam tape - Source Product/Mfg. - No. 4016 by 3M.
   3. Tape: 2-mil Mylar - source Product/Mfg. - No. 371 by 3M.
J. Mastic Water stop: Preformed plastic or butyl resin strips. Source Products/Mfg:
   1. Synko-Flex/Synko-Flex Products Co.
   2. ConSeal CS-102/Concrete Sealants
K. Joint Fillers: Pre-molded mastic strips, asphalt impregnated, ASTM D1751.
L. Fasteners and Anchorages: Nails, spikes, bolts, lag bolts, and other types sized as required to maintain formwork in place.

PART 3 EXECUTION
3.1 EXAMINATION
A. Verify lines, levels, and measurements required before proceeding with formwork.
B. Coordinate the installation of joint materials, reinforcing steel, and vapor retarders with placement of forms.

3.2 INSTALLATION TOLERANCES
A. Allowable tolerances for Structural Concrete Forms shall comply with ACI 301 and 347.
B. Allowable tolerances for camber in slabs and beams shall comply with ACI 301.
C. Allowable tolerances for plumbness in elevator shafts shall comply with requirements of ASME A17.1.

3.3 ERECTION
A. Design, erect, support, brace, and maintain formwork to support vertical and lateral, static, and dynamic loads that may occur before permanent bracing can support such loads.
B. Construction:
1. Construct formwork so finished concrete members and structures are of correct size, shape, alignment, elevation, and position.
2. Build formwork to be readily removable without impact, shock, or damage to cast-in-place concrete surfaces and adjacent materials.
3. Provide openings, offsets, sinkages, keyways, recesses, moldings, rustications, reglets, chamfers, blocking, screeds, bulkheads, anchorages and inserts, and other features required.
4. Solidly butt joints and provide back-up at joints to prevent leakage of cement paste.
5. Kerf wood inserts for forming keyways, reglets, recesses, and the like, to prevent swelling and for easy removal.
6. Provide temporary openings at bottoms of forms to facilitate cleanout and inspection.
   a. Close openings with tight fitting panels and neat joints so that joints will not be apparent in exposed concrete surfaces.
C. Chamfer exposed corners and edges as indicated, or if not indicated, provide \(\frac{3}{4}\)" x \(\frac{3}{4}\)".
D. Provide openings in concrete formwork to accommodate work of other trades.
   1. Determine size and location of openings, recesses, and chases from trades providing such items.
   2. Accurately place and securely support items built into forms.
E. Thoroughly clean forms and adjacent surfaces to receive concrete.
   1. Remove chips, wood, sawdust, dirt, or other debris just before placing concrete.
   2. Retighten forms and bracing after concrete placement to eliminate mortar leaks and maintain proper alignment.
F. Construction Joints:
   1. Locate and install formed construction joints at rustications or, if not indicated, locate so as not to impair strength and appearance of the structure, and as approved by the A/E.
   2. Provide keyways at least 1½" deep in construction joints in walls, slabs, and between walls and footings; accepted bulkheads designed for this purpose may be used for slabs.
   3. Place construction joints perpendicular to main reinforcement.
      a. Continue reinforcement across construction joints, except as otherwise indicated.
G. Isolation Joints in Slabs-on-Ground: Construct continuous joint filler at points of contact between slabs-on-ground and vertical surfaces, such as column pedestals, foundations walls, grade beams, and elsewhere as indicated.
H. Water stops: Provide mastic water stops in construction joints of below grade walls and in joints between below grade slabs and walls.
   1. Install water stops to form continuous diaphragm in each joint.
   2. Fabricate field joints in water stops in accordance with manufacturer's printed instructions.
I. Form Coatings: Apply after erecting forms and sealing the joints but prior to placing reinforcing steel, anchoring devices, and embedded items.
   1. Seal surfaces of wood rustications with two coats of form sealer.
   2. Spray-apply one coat of release agent to formwork faces except concrete surfaces scheduled to receive special finishes or special coatings.
   3. Coat steel forms with a non-staining, rust-preventative form oil to protect against rusting.
      a. Rust-stained steel formwork is not acceptable.
J. Embedded Items: Set and build into work anchorage devices and other embedded items required for other work attached to, or supported by, cast-in-place concrete.
K. Reglets: Install to receive top edge of foundation sheet waterproofing, and to receive thru-wall flashings in outer face of concrete frame at exterior walls, where flashing is shown at lintels, relieving angles, and other conditions.

L. Vapor Retarder: Place, protect, and repair vapor-retarder sheets according to ASTM E1643 and manufacturer's written instructions.

3.4 RE-USE OF FORMS
A. Clean re-used forms of concrete matrix residue, repair, and patch as required returning forms to acceptable surface condition.
B. Recoat contact surfaces of forms with a form-coating compound as specified.

3.5 SHORES AND SUPPORTS
A. Comply with ACI 347 for shoring and re-shoring in multistory construction, for beams, girders, raised slabs, and as herein specified.
B. Space all shoring in such a manner as to prevent any floor or member from excessive loading or inducing stress in any of the concrete members.
   1. Extend shores beyond minimums to ensure proper distribution of loads throughout structure.

3.6 REMOVAL OF FORMS AND SHORING
A. Remove formwork and shoring progressively and in accordance with ACI 301 and ACI 347 to prevent unbalanced loads on the structure.
B. Do not remove shoring and formwork until members have acquired strength as specified by the engineer of record.
   1. Re-shore structural members as original shores are removed as specified by the engineer of record.
C. In the event the Contractor wishes to remove formwork at an earlier time than specified, the Contractor shall pay for and have testing laboratory obtain two additional concrete test cylinders to confirm strength requirement for early form removal.
SECTION 03 20 00
CONCRETE REINFORCEMENT

PART 1   GENERAL
1.1 SECTION INCLUDES
A. Reinforcing steel bars, wire fabric and accessories for cast-in-place concrete

1.2 REFERENCES
A. ACI 301 - Structural Concrete for Buildings
B. ACI 318 - Building Code Requirements For Reinforced Concrete
C. ACI SP-66 - American Concrete Institute - Detailing Manual
D. ASCE 7 - Minimum Design Loads of Buildings and Other Structures
E. ASTM A82/A82M - Standard Specification for Steel Wire, Plain, for Concrete Reinforcement
F. ASTM A184/A184M - Standard Specification for Fabricated Deformed Steel Bar Mats for Concrete Reinforcement
G. ASTM A185/A185M - Standard Specification for Steel Welded Wire Reinforcement, Plain, for Concrete
H. ASTM A496/A496M - Standard Specification for Steel Wire Deformed for Concrete Reinforcement
I. ASTM A497/A497M - Standard Specification for Steel Welded Wire Reinforcement Deformed for Concrete
J. ASTM A615/A615M - Standard Specification for Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement
K. ASTM A706/A706M - Standard Specification for Low Alloy Steel Deformed and Plain Bars for Concrete Reinforcement
L. ASTM A767/A767M- Standard Specification for Zinc Coated (Galvanized) Steel Bars for Concrete Reinforcement
M. ASTM A775/A775M- Standard Specification for Epoxy Coated Reinforcing Steel Bars
N. ASTM D3963/D3963M - Standard Specification for Fabrication and Jobsite Handling of Epoxy Coated Reinforcing Bars
O. AWS D1.4 - Structural Welding Code-Reinforcing Steel
P. CRSI - Concrete Reinforcing Steel Institute - Manual of Standard Practice
Q. CRSI - Placing Reinforcing Bars
R. FBC - Florida Building Code

1.3 SUBMITTALS FOR REVIEW
A. Section  01 33 00 - Submittals Procedures
B. Shop Drawings: Indicate bar sizes, spacing, locations, and quantities of reinforcing steel and wire fabric, bending and cutting schedules, and supporting and spacing devices.

1.4 SUBMITTALS FOR INFORMATION
A. Section  01 33 00 - Submittals Procedures
B. Manufacturer’s Certificate: Certify that products meet or exceed specified requirements.
C. Submit certified copies of mill test report of reinforcement materials analysis.

1.5 DESIGN REQUIREMENTS
A. Design shall comply with the FBC, ASCE 7 – Wind Loads, and ACI 318.
B. Do not weld reinforcing steel.

1.6 QUALITY ASSURANCE
A. Perform work in accordance with ACI 301. Maintain one copy of document on site.
B. Design reinforcement under direct supervision of a Professional Structural Engineer experienced in design of this work and licensed in the State of Florida.
C. Submit under provisions of Section 01 40 00 Manufacturer’s Certificates, certifying welders employed to do the work, verifying AWS qualification within the previous 12 months.

PART 2  PRODUCTS

2.1  REINFORCEMENT
A. Reinforcing Steel:  ASTM A615/A615M, Grade 60; deformed carbon steel bars, unfinished
B. Stirrup and Tie Steel:  ASTM A615/A615M, Grade 40 or 60; deformed carbon steel bars, unfinished
C. Welded Steel Wire Fabric:  ASTM A185/A185M Plain Type; in flat sheets and rolls; unfinished
D. Steel Wire:  ASTM A82/A82M, plain, cold drawn, steel

2.2  ACCESSORIES
A. Tie Wire:  Minimum 16 gage annealed type or patented system.
B. Chairs, Bolsters, Bar Supports, Spacers:  Size and shape for strength and reinforcement support during concrete placement, include load bearing pad on bottom to prevent vapor barrier puncture.
C. Special Chairs, Bolsters, Bar Supports, and Spacers Adjacent to Weather Exposed Concrete Surfaces: Plastic coated steel type; size and shape as required.

2.3  FABRICATION
A. Fabricate concrete reinforcing in accordance with ACI 318.
B. Weld reinforcement in accordance with AWS D1.4.
C. Locate reinforcing splices not shown on plans, at point of minimum stress and review with A/E.

PART 3  EXECUTION

3.1  PLACEMENT
A. Place support and secure reinforcement against displacement, without deviating from the required position.
B. Do not displace or damage vapor barrier.
C. Accommodate placement of formed openings.
D. Conform to applicable code for concrete cover over reinforcement.

3.2  FIELD QUALITY CONTROL
A. Architect, Owner, or Building Department may request field inspections per Section 01 40 00 1.7 Inspection Services.

END OF SECTION
SECTION 03 30 00
CAST-IN-PLACE CONCRETE

PART 1 GENERAL

1.1 SECTION INCLUDES
A. Cast-in-place concrete building frame members, floors, shear walls, elevator shaft walls, foundation walls, footings, and supported slabs.
B. Floors and slabs on grade.
C. Control, expansion, and contraction joint devices associated with concrete work, including joint sealants.
D. Equipment pads, light pole base, flagpole base, thrust blocks, and manholes.

1.2 REFERENCES
A. ACI 211.1 - Standard Practice for Selecting Proportions for Normal, Heavyweight, and Mass Concrete
B. ACI 211.2 - Standard Practice for Selecting Proportions for Structural Lightweight Concrete
C. ACI 301 – Specifications Structural Concrete for Buildings
D. ACI 302.2R - Guide for Concrete Floor and Slab Construction
E. ACI 304R - Guide for Measuring, Mixing, Transporting and Placing Concrete
F. ACI 305R - Hot Weather Concreting.
G. ACI 306R - Cold Weather Concreting.
H. ACI 308.1 - Standard Specification for Curing Concrete
I. ACI 318 - Building Code Requirements for Structural Concrete
J. ACI 347 - Guide to Formwork for Concrete
K. ASTM B221 - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes
L. ASTM C33/C33M - Standard Specification for Concrete Aggregates
M. ASTM C39/C39M - Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens
N. ASTM C94/C94M - Standard Specification for Ready-Mixed Concrete
Q. ASTM C330/C330M - Standard Specification Light Weight Aggregates for Structural Concrete
R. ASTM C494/C494 - Standard Specification for Chemical Admixtures for Concrete
S. ASTM C618 - Standard Specification for Coal Fly Ash and Raw or Calcinated Natural Pozzolan for Use in Concrete
T. ASTM C948 – Standard Test Method for Dry and Wet Bulk Density, Water Absorption and Apparent Porosity of Thin Sections of Glass-Fiber-Reinforced Concrete
U. ASTM C1017/C1017M - Standard Specification for Chemical Admixtures for Use in Producing Flowing Concrete
V. ASTM D994/D994M - Standard Specification for Preformed Expansion Joint Filler for Concrete (Bituminous Type)
W. ASTM D1751 - Standard Specification for Preformed Expansion Joint Fillers for Concrete Paving and Structural Construction (Nonextruding and Resilient Bituminous Types)
Y. ASTM D6690 – Standard Specification for Joint and Crack Sealants, Hot Applied, for Concrete and Asphalt Pavement
Z. FBC - Florida Building Code
AA. Florida Department of Transportation - Standard Specifications for Road and Bridge Construction

1.3 RELATED SECTIONS
A. 31 20 00 Earth Moving
B. 31 31 16 Termite Control
C. 03 11 00 Concrete Formwork
D. 07 26 00 Vapor Retarders

1.4 SUBMITTALS FOR REVIEW and INFORMATION
A. Section 01 33 00 Submittals Procedures
B. Product Data: Provide data on joint devices, attachment accessories, admixtures, curing compound, sealers, and integral coloring.
C. Manufacturer's Installation Instructions: Indicate installation procedures and interface required with adjacent Work.
D. Samples: Submit two 12” long samples of expansion/contraction joint and control joint.
E. Shop Drawings:
   1. Submit drawings indicating the locations of all joints in the concrete, construction joints, expansion joints, and contractions joints.
   2. Include concrete placement schedule, method, sequence, quantities, location, and boundaries.

1.5 SUBMITTALS AT PROJECT CLOSEOUT
A. Section 01 77 00 Contract Closeout: Procedures for submittals
B. Accurately record actual locations of embedded utilities and components concealed from view.

1.6 DESIGN REQUIREMENTS
A. Design in conformance with Florida Building Code, ACI 318, and ACI 301.
B. Provide expansion joints, control joints, construction joints, and isolation joints to prevent uncontrolled stress cracks in the structure and according to the latest engineering standards.

1.7 QUALITY ASSURANCE
A. Perform Work in accordance with ACI 301.
B. Mix and deliver ready mixed concrete in accordance with ASTM C94/C94M.
C. Maintain one copy of each document on site.
D. Acquire cement and aggregate from same source for all work.
E. Conform to ACI 305R when concreting during hot weather.
F. Conform to ACI 306R when concreting during cold weather.

1.8 MOCK-UP
A. Comply with the requirements of section 01 40 00 Quality Control, Requirements for mock-up.
B. Construct and erect a field sample for architectural concrete surfaces receiving special treatment or finish as result of formwork.
C. Sample Panel: Sufficient size to indicate special treatment or finish required.
D. If requested by A/E, cast concrete against sample panel.
   1. Obtain acceptance of resultant surface finish prior to erecting formwork.
E. Use the approved sample panel for basis of quality for the finished work.
   1. Keep sample panel exposed to view for duration of concrete work.
F. Locate where directed.
G. Mock-up may not remain as part of the Work.
PART 2  PRODUCTS

2.1 CONCRETE MATERIALS
   A. Cement:  ASTM C150/C150M, Type I - Normal, Portland type
   B. Fine and Coarse Aggregates:  ASTM C33/C33M
   C. Lightweight Aggregate:  ASTM C330/C330M
   D. Water:  Clean and not detrimental to concrete
   E. Glass Fiber Reinforcement:  ASTM C948

2.2 ADMIXTURES
   A. Air Entrainment:  ASTM C260/C260M
   B. Chemical:  ASTM C494/C494M
      1. Water Reducing - Type A
      2. Retarding - Type B
      3. Accelerating - Type C
      4. Water Reducing and Retarding - Type D
      5. Water Reducing and Accelerating - Type E
      6. Water Reducing, High Range - Type F
      7. Water Reducing, High Range and Retarding - Type G
      8. Flowing Concrete - ASTM C1017/C1017M
   C. Fly Ash:  ASTM C618

2.3 ACCESSORIES
   A. Bonding Agent:  Polymer resin emulsion, Polyvinyl Acetate, Latex emulsion, 2-component-modified epoxy resin, Non-solvent two-component polysulfide epoxy, Mineral filled polysulfide polymer epoxy, Mineral filled polysulfide polymer epoxy-resin, and Versamid cured epoxy.
   B. Vapor Barrier:  Flexible, sandwich of heavy paper, reinforced fibers, and two layers of inert polyethylene, formed into one layer under heat and pressure.  (Perm rating of 0.1)
   C. Non-Shrink Grout:  Premixed compound consisting of non-metallic aggregate, cement, water reducing and plasticizing agents; capable of developing minimum compressive strength of 2,400 psi in 48 hours and 7,000 psi in 28 days.

2.4 JOINT DEVICES AND FILLER MATERIALS
   A. Joint Filler:  ASTM D1751; Asphalt impregnated fiberboard or felt
   B. Joint Filler:  ASTM D1752; Closed cell polyvinyl chloride foam, resiliency recovery of 95% if not compressed more than 50% of original thickness
   C. Construction Joint Devices:  Integral galvanized steel; formed to tongue and groove profile, with removable top strip exposing sealant trough, ribbed steel spikes with tongue to fit top screed edge.
   D. Expansion and Contraction Joint Devices:  ASTM B221 alloy, extruded aluminum; resilient elastomeric filler strip with a Shore A hardness of 35 to permit plus or minus 25% joint movement with full recovery; extruded aluminum cover plate, of longest manufactured length at each location, flush mounted; color as selected.
   E. Sealant and Primer:  Type, as specified in Section 07 92 00
   F. Sealant:  Cold applied

2.5 CONCRETE MIX
   A. Mix concrete in accordance with ACI 304.  Deliver concrete in accordance with ASTM C94/C94M
   B. Select proportions for normal weight concrete in accordance with ACI 301 Method 3
C. Select aggregate proportions for lightweight concrete in accordance with ASTM C330/C330M
D. Use accelerating admixtures in cold weather only when approved by A/E
   1. Use of admixtures will not relax cold weather placement requirements.
E. Use set retarding admixtures during hot weather only when approved by A/E
F. Add air-entraining agent to normal weight concrete mix for work exposed to exterior

PART 3 EXECUTION

3.1 EXAMINATION
A. Verify site conditions under provisions of Section 01 31 00.
B. Verify requirements for concrete cover over reinforcement.
C. Verify that anchors, seats, plates, reinforcement and other items to be cast into concrete are accurately placed, positioned securely, and will not cause hardship in placing concrete.

3.2 PREPARATION
A. Prepare previously placed concrete by cleaning with steel brush and applying bonding agent in accordance with manufacturer's instructions.
B. In locations where doweling new concrete to existing work, drill holes in existing concrete; insert steel dowels and pack solid with non-shrink grout.
C. Coordinate the placement of joint devices with erection of concrete formwork and placement of form accessories.
D. Remove all foreign matter and water from forms or structural excavations.

3.3 FORMWORK
A. Conform to ACI 347
B. Form foundations, earth forms not allowed, unless Engineer of record and the Soil's report can provide information to building official showing the soil conditions are conducive to earth forms.

3.4 PLACING CONCRETE
A. Place concrete in accordance with ACI 301.
B. Notify A/E minimum 24 hours prior to commencement of operations
C. Ensure reinforcement, inserts, embedded parts, formed expansion, and contraction joints are not disturbed during concrete placement.
D. Treat for termites per section 31 31 16.
E. Install vapor retarder under interior slabs on grade, lap joints minimum 6", and seal watertight by taping edges and ends.
F. Repair vapor retarder damaged during placement of concrete reinforcing.
   1. Repair with vapor retarder material; lay over damaged areas minimum 6" and seal watertight.
G. Separate slabs on grade from vertical surfaces with joint filler.
H. Place joint filler in floor slab pattern placement sequence.
   1. Set top to required elevations.
   2. Secure to resist movement by wet concrete.
I. Extend joint filler from bottom of slab to within ¼" of finished slab surface.
   1. Conform to Section 07 92 00 for finish joint sealer requirements.
J. Install joint devices in accordance with manufacturer's instructions.
K. Install construction joint devices in coordination with floor slab pattern placement sequence.
   1. Set top to required elevations.
   2. Secure to resist movement by wet concrete.
L. Install joint device anchors.
1. Maintain correct position to allow joint cover to be flush with floor and wall finish.
M. Install joint covers in one-piece length, when adjacent construction activity is complete.
N. Apply sealants in joint devices in accordance with Section 07 92 00.
O. Maintain records of concrete placement.
   1. Record date, location, quantity, air temperature, and test samples taken.
P. Place concrete continuously between predetermined expansion, control, and construction joints.
Q. Do not interrupt successive placement; do not permit cold joints to occur.
R. Place floor slabs in checkerboard or saw cut pattern indicated.
S. Saw cut joints within 24 hours after placing.
   1. Use $\frac{3}{16}$" thick blade, cut into $\frac{1}{8}$ depth of slab thickness.
T. Screed floors and slabs on grade level, maintaining surface flatness of maximum $\frac{1}{8}$" in 10'.

3.5 SEPARATE FLOOR TOPPINGS
A. Prior to placing floor topping, roughen substrate concrete surface, and remove deleterious material, broom and vacuum clean.
B. Place dividers, edge strips, reinforcing, and other items being cast in the pour as required.
C. Apply bonding agent to substrate in accordance with manufacturer’s instructions.
D. Place concrete floor toppings to required lines and levels.
E. Place topping in checkerboard panels with dimensions not exceeding 20'.
F. Screen toppings level, maintaining surface flatness of maximum 1:1000.

3.6 CONCRETE FINISHING
A. Provide formed concrete surfaces with exposed, concrete walls, columns, beams, joists, with smooth rubbed finish.
B. Finish concrete floor surfaces in accordance with ACI 301.
C. Wood-float the surfaces that receive quarry tile, ceramic tile, and terrazzo with full bed setting system.
D. Steel trowel surfaces that receive carpeting, resilient flooring, seamless flooring, thin-set quarry tile, and thin set ceramic tile.
E. Steel trowel surfaces scheduled to be exposed.
F. In areas with floor drains, maintain floor elevation at walls; pitch surfaces uniformly to drains at 1:50 nominal.

3.7 CURING AND PROTECTION
A. Immediately after placement, protect concrete from premature drying, excessively hot or cold temperatures, and mechanical injury.
B. Maintain concrete with minimal moisture loss at relatively constant temperature for period necessary for hydration of cement and hardening of concrete.
C. Cure floor surfaces in accordance with ACI 308.
D. Ponding: Maintain 100% coverage of water over floor slab areas continuously for 4 days.
E. Spraying: Spray water over floor slab areas and maintain wet for 7 days.

3.8 FIELD QUALITY CONTROL
A. Architect, Owner, or Building Department may request field inspections per Section 01 40 00 1.7 Inspection Services
B. Provide free access to Work and cooperate with appointed firm.
C. Submit proposed mix design of each class of concrete to inspection and testing firm for review prior to commencement of Work.
D. The Owner may perform tests of cement and aggregates to ensure conformance with specified requirements.
E. Take three concrete test cylinders for every 150 cu yards or less of each class of concrete placed.

F. Take one additional test cylinder during cold weather concreting, cured on job site under same conditions as concrete it represents.

G. Take one slump test for each set of test cylinders taken.

3.9 PATCHING

A. Contractor shall allow A/E to inspect concrete surfaces immediately upon removal of forms.

B. Excessive honeycomb or embedded debris in concrete is not acceptable; notify A/E upon discovery.

C. Patch imperfections in accordance with ACI 301.

3.10 DEFECTIVE CONCRETE

A. Defective concrete is concrete not conforming to required lines, details, dimensions, tolerances or specified requirements.

B. A/E shall determine the repair or replacement of defective concrete.

C. Do not patch, fill, touch-up, repair or replace-exposed concrete except upon express direction of A/E for each individual area.

END OF SECTION
SECTION 03 35 00
CONCRETE FLOOR FINISHING

PART 1  GENERAL
1.1 SECTION INCLUDES
   A. Finishing separate floor toppings, slabs-on-grade, and monolithic floor slab.
   B. Surface treatment with concrete hardener, sealer, and slip resistant coatings.

1.2 REFERENCES
   A. ACI 301 - Structural Concrete for Buildings
   B. ACI 302 - Guide for Concrete Floor and Slab Construction
   C. ASTM E1155 - Standard Test Method for Determining F_r Flatness and F_l Floor Levelness Numbers

1.3 SUBMITTALS
   A. Submit under provisions of Section 01 33 00 Submittals Procedures.
   B. Product Data: Provide data on concrete hardener, sealer, and slip resistant treatment, compatibilities, and limitations.

1.4 MAINTENANCE DATA
   A. Submit under provisions of Section 01 77 00 Contract Closeout.
   B. Maintenance Data: Provide data on maintenance renewal of applied coatings.

1.5 QUALITY ASSURANCE
   A. Perform work in accordance with ACI 301 and ACI 302.
   B. Maintain copies of each document on site.

1.6 DELIVERY, STORAGE, AND HANDLING
   A. Deliver, store, protect, and handle products under provisions of Section 01 31 00 Project Management and Coordination.
   B. Deliver materials in manufacturer's packaging including application instructions.

1.7 ENVIRONMENTAL REQUIREMENTS
   A. Temporary Lighting: Provide minimum 200 W light source, 8' above the floor surface, for each 425 sq. ft. of floor being finished.
   B. Temporary Heat: Ambient temperature of 50° F (10° C) minimum
   C. Ventilation: Sufficient to prevent injurious gases from temporary heat or other sources affecting concrete.

1.8 COORDINATION
   A. Coordinate work under provisions of Section 01 31 00 Project Management and Coordination.
   B. Coordinate the work with concrete floor placement and concrete floor curing.

PART 2  PRODUCTS
2.1 COMPOUNDS - HARDENERS AND SEALERS
   A. Non-Metallic Hardener: Premixed, dry powder, colored, emery aggregate and abrasion resistant hardener.

2.2 SLIP RESISTANT TREATMENT
   A. Slip Resistant Finish: Aluminum oxide type, color as selected from manufacturer's standard range

PART 3  EXECUTION
3.1 EXAMINATION
   A. Verify site conditions under provisions of Section 01 31 00 Project Management and Coordination.
   B. Verify that floor surfaces are acceptable to receive the work of this section.
3.2 FLOOR FINISHING
   A. Finish concrete floor surfaces in accordance with ACI 301 and ACI 302.
   B. Wood-float surfaces that will receive quarry tile, ceramic tile, cementitious terrazzo with full bed setting system.
   C. Steel trowel surfaces receiving carpeting, resilient flooring, seamless flooring, thin set terrazzo, thin set quarry tile, and thin set ceramic tile.
   D. Steel trowel surfaces scheduled to be exposed.
   E. In areas with floor drains, maintain design floor elevation at walls; slope surfaces uniformly to drains as indicated on drawings.

3.3 FLOOR SURFACE TREATMENT
   A. Apply dry shake liquid hardener in accordance with manufacturer's instructions as scheduled.
   B. Apply slip resistant finish in accordance with manufacturer's instructions as scheduled.
   C. Apply sealer in accordance with manufacturer's instructions as scheduled.

3.4 TOLERANCES
   A. Measure for \( F_F \) and \( F_L \) tolerances for floors in accordance with ASTM E1155, within 72 hours after slab installation
   B. Finish concrete to achieve the following tolerances:
      1. Under Ceramic or Quarry Tile on Setting Bed: \( F_F \) 25 and \( F_L \) 25
      2. Under Resilient flooring (VCT, sheet vinyl, etc): \( F_F \) 30 and \( F_L \) 25
      3. Exposed to View and Foot Traffic (polished concrete): \( F_F \) 40 and \( F_L \) 35
      4. Exposed stained concrete (mechanical, electrical, custodial): \( F_F \) 20 and \( F_L \) 15
      5. Exception: The \( F_L \) levelness tolerances do not apply to any un-shored elevated construction.
      6. Correct the slab surface if the actual \( F_F \) or \( F_L \) number for the floor installation measures less than required.
   C. Identify areas requiring corrective work.
      1. Correct all defects in the defined traffic floor by grinding or removal and replacement of the defective work.
      2. Re-measure corrected areas by the same process.

END OF SECTION
Section 03 36 00
Polished Concrete Floor

Part 1 General

1.1 Section Includes
A. Finishing separate floor toppings, slabs-on-grade, and monolithic floor slab.
B. Surface treatment with concrete hardener, sealer, and slip resistant coatings.
C. Polished concrete finish for interior flatwork; polish concrete finishes for precast, vertical cast-in-place, and exterior concrete are specified in the sections for those types.
   1. All labor, materials, equipment, and services necessary for the grinding and polishing of concrete floors.
   2. Densifying impregnator/sealer and polishing to specified sheen level and aggregate exposure.
   3. Concrete must be cured a minimum of 28-days prior to polishing.

1.2 References
A. ACI 301 - Structural Concrete for Buildings
B. ACI 302 - Guide for Concrete Floor and Slab Construction
C. ASTM C33/C33M, Standard Specification for Concrete Aggregates
E. ASTM C779/C779M, Standard Test Method for Abrasion of Horizontal Concrete Surfaces
F. ASTM C805/C805M, Standard Test Method for Rebound Number of Hardened Concrete
G. ASTM C1028, Standard Test Method for Determining the Static Coefficient of Friction of Ceramic Tile and Other Like Surfaces by the Horizontal Dynamometer Pull Meter Method
H. ASTM D3960, Standard Practice for Determining Volatile Organic Compound (VOC) Content of Paints and Related Coatings
I. ASTM E1155 - Standard Test Method for Determining F_r Floor Flatness and F_l Floor Levelness Numbers
J. ASTM E2129, Standard Practice for Data Collection for Sustainability Assessment of Building Products

1.3 Submittals
A. Submit under provisions of Section 01 33 00 Submittals Procedures.
   1. Product Data: Provide data on concrete hardener, sealer, and slip resistant treatment, each grinding machine, including all types of grinding heads, dust extraction system, joint filler, concrete densifying impregnator, penetrating sealer, and any other chemicals used in the process, along with compatibilities, and limitations.
   2. VOC Data: Submit Green Seal Certification to GS-11 and description of basis for certification.
   3. Environmental Date: Submit environmental data in accordance with Table 1 of ASTM E2129 for products provided under the work of this section.
   4. Submit Applicators qualifications data.
   5. Submit polished concrete samples: Three samples 12" x 12" for each type of polished concrete finish required.

1.4 Maintenance Data
A. Submit under provisions of Section 01 77 00 Contract Closeout.
B. Maintenance Data: Provide data on maintenance renewal of applied coatings.
C. Provide maintenance procedures using manufacturer’s recommended systems.

1.5 QUALITY ASSURANCE

A. Perform work in accordance with ACI 301 and ACI 302.
B. Maintain copies of each document on site.
C. VOC Content: Determine VOC content of solvent borne, water borne paints and related coatings per EPA method 24 or ASTM D3960.
D. Work inspected by Certified Applicator;
   1. Concrete finish equipment and chemical manufacturer shall certify installer/applicator.
   2. Contractor shall provide adequate number of skilled workers thoroughly trained and experienced in the necessary craft.
E. Pre Installation Conference: Conduct conference at site prior to start of work complying with the requirements of section 01 40 00.
F. Manufacturer’s Certification: Provide certification letter from both the equipment and chemical manufacturer stating the installer is a certified applicator and is familiar with proper procedures and installation requirements required by the manufacturer.
G. Mock-Ups;
   1. General Contractor to notify applicator at least 7-days prior to the pour schedule of mock-up.
   2. Reserve 100 SF for each color and finish at a location adjacent to floor receiving polish at concrete floor area able to be removed, patched, or placed in location where applied any variation in floor substrate will be corrected prior to being, with another flooring material. Place mock-up floor on the same day and same pour as the floors to receive polish.
   3. Install mock-ups to verify selections made under the sample submitted and to demonstrate methods and workmanship proposed for the project.
   4. If stand-alone mock-up is required, form shall be clean and free from extraneous substance and be at least 12" x 12" with a level plywood bottom on level ground with unobstructed access on all four sides.
   5. Test aggregate to ensure it will accept polish.
   6. Include control joints in the mock-up, contractor may saw as soon as the surface is firm enough not to displace any aggregate.
   7. Also, include edge conditions in the mock-up.
   8. Approved mock-ups may become part of the completed work if accepted by the owner.
H. Protection: General Contractor shall protect areas receiving polished concrete finish at all times during construction to prevent oils, dirt, metal, excessive water, and any other potentially damaging materials from affecting the finished concrete surface. Protection measures listed below shall start immediately after the concrete slab is poured:
   1. All hydraulic powered equipment shall be diapered to avoid staining of concrete.
   2. Prohibit all vehicle parking or traffic on finished slab receiving polished finish, if vehicle traffic is necessary; provide drop clothes under the vehicles.
   3. Do not use pipe-cutting machines on the slabs receiving polished finish.
   4. Do not place steel on the slabs receiving polished finish.
   5. Keep all acids and acidic detergents form the slabs receiving polished finish.
   6. Painters shall use drop cloths on the slabs receiving polished finish, and if paint does get on the slab, remove the paint immediately.
   7. Inform all trades and workers of the slabs requiring protection at all times.
I. Environmental Limitations:
   1. Comply with the manufactures written instructions for substrate temperature, moisture...
content, ambient temperature & humidity, ventilation, and other conditions affecting chemical performance.

2. Provide the proper flatness and levelness of the finished concrete slab.
   a. Floor flatness – minimum rating of 40
   b. Floor levelness – minimum rating of 30
   c. Cure time – minimum of 28-days

3. Application of finish system shall take place a minimum of 21-days prior to fixture and trim installation or substantial completion.

4. Close the finish concrete floor area to all traffic during the finish floor application and after application for time as recommended by the manufacturer.

J. Concrete Mix Design:
   1. Concrete mixture shall be at least 3500 PSI, non air-entrained.
      a. Keep any admixtures, plasticizers, slag, fly ash, or anything taking the place of Portland-based cement to a minimum.
      b. Use Portland cement Type I, conforming to ASTM C150/C150M.
      c. Keep concrete as cool and moist as possible, with concrete temperature below 85°F to help control cracking.
      d. Wet cures are most desirable, but if not possible use a penetrating, dissipating, or wax based cure and seal, as recommended by manufacturer.
      e. Do not use a densifier/hardener material due to grinding of the floor after 6 days.
      f. The Architect/Engineer shall determine the saw cut patterns, colors, and layout.
      g. Color loads for integral color shall not be smaller than 3 cubic yards.
      h. Use one source for cement, aggregate, and pozzolan throughout the job.
         i) Monitor and control incoming material consistency.
         ii) Do not use calcium chloride based admixtures.
         iii) May use non-chloride admixture with the Architect’s approval.
      i. Wash out all drums before loading, keep slumps consistent (maximum of 4), and minimize driver added water maintaining a 0.45 water content ratio.
      j. Place concrete to achieve as true and smooth surface as possible.
         i) Mounds or dips are not acceptable.
         ii) Contractor shall control overall flatness and levelness, including on sloping areas within the permitted tolerances allowed by the specification and ASTM E1155.
      k. Protect the slab from indentions and footprints during the pour and the curing.

1.6 DELIVERY, STORAGE, AND HANDLING
   A. Deliver, store, protect, and handle products under provisions of Section 01 31 00 Project Management and Coordination.
   B. Deliver materials in manufacturer’s packaging including application instructions.

1.7 ENVIRONMENTAL REQUIREMENTS
   A. Temporary Lighting: Provide minimum 200 W light source, 8’ above the floor surface, for each 425 sq. ft. of floor being finished.
   B. Temporary Heat: Ambient temperature of 50° F (10° C) minimum
   C. Ventilation: Sufficient to prevent injurious gases from temporary heat or other sources affecting concrete.

1.8 COORDINATION
   A. Coordinate work under provisions of Section 01 31 00 Project Management and Coordination.
   B. Coordinate the work with concrete floor placement and concrete floor curing.
PART 2  PRODUCTS

2.1  COMPOUNDS - HARDENERS AND SEALERS
   A.  Non-Metallic Hardener:  Premixed, dry powder, colored, emery aggregate and abrasion resistant hardener.

2.2  SLIP RESISTANT TREATMENT
   A.  Slip Resistant Finish:  Aluminum oxide type, color as selected from manufacturer's standard range

2.3  POLISHING MATERIALS
   A.  Three-phase 480 Volt generator and step down transformer.
   B.  3-head or 4-head counter rotating variable grinder equal to HTC Superfloor™ approved floor grinder with at least 600 pounds down pressure (Example: HTC 950RX, HTC 800HDX, HTC 800HD, HTC 650HDX, or etc.)
   C.  Use a dust extraction system, pre-separator, and squeegee attachments in compliance with project IAQ Management Plan.
      1.  HTC Superfloor™ Dust extraction system, pre-separator, and squeegee attachments with minimum flow rate of 322 cubic feet per minute such as a HTC 75D.
   D.  Grinding Head:
      1.  Metal bonded 16, 25, 40, 80, 150, and/or 300 grits.
      2.  Bonded phenolic diamonds 100, 200, 400, 800, 1500, and 3000 grits
   E.  Grinding Pads for Edges
      1.  40, 60, and 120 grits
      2.  100, 200, 400, 800, 1500, and 3000 grits
   F.  Hand grinder with dust extraction attachment and pads.
   G.  Penetrating liquid sealer hardener densifying impregnator or as specified by construction manager with the following performance criteria:
      1.  Chemical reactive, waterborne solution of inorganic silicate or siliconate materials and propriety components, odorless and colorless, which hardens and densifies concrete surfaces to protect against abrasion, dusting, and absorption of liquids.
   H.  Control joint and saw cut filler, two part filler or polyurea as specified by construction manager and approved by architect.
   I.  A ready to use penetrating dye or reactive stain that chemically combines with cured concrete to produce permanent variegated or translucent color effects or a hydrolyzed, or a lithium quartz or siliceous materials to create a translucent or marbled color effect.
   J.  Graphic design with water based color dye used based on final design and color selection by the Architect.

PART 3  EXECUTION

3.1  EXAMINATION
   A.  Verify site conditions under provisions of Section 01 31 00 Project Management and Coordination.
   B.  Verify that floor surfaces are acceptable to receive the work of this section.
      1.  Installer shall examine and approve concrete substrate for conditions affecting performance of the finished polished concrete slab.
      2.  General Contractor shall correct any conditions found not in compliance with this section.
      3.  Architect shall approve the repairs based on the requirements of this section.
      4.  Provide floor clean of materials and debris.
      5.  Protect adjacent surfaces as necessary to prevent damage by concrete polishing procedure.
3.2 CONCRETE FLOOR POLISHING

A. Basis of Design is the HTC Superfloor™ system, any other system used shall be pre-approved by the architect.
B. Finish concrete floor surfaces in accordance with ACI 301 and ACI 302.
C. In areas with floor drains, maintain design floor elevation at walls, slope surfaces uniformly to drains as indicated on plans.
D. See plans for locations and type of specialized floor finish, color, and treatment in accordance with the design intent; contractor shall coordinate with architect all field samples and installations.
E. Grind the concrete floor within 2-3 inches of wall with 16, 25, 40, and 80 grit removing construction debris, floor slab imperfections until there is a uniform scratch pattern, and achievement of the desired concrete aggregate exposure.
   1. Vacuum the floor thoroughly using a squeegee vacuum attachment.
F. Apply material approved by the architect for color effects in accordance with the architect’s plans, accepted mock-up, and the manufacturers recommended guidelines.
G. Fill construction joints and cracks with filler products as specified in the manufacturer’s instructions colored to match (or contrast) with the concrete color specified by the architect.
H. Apply densifying impregnator per the manufacturer’s recommendations.
   1. Cover the entire work area liberally and allow setting as required by manufacturer.
   2. Apply again to areas where the densifying impregnator has soaked in and allow setting.
   3. Squeegee excess material off the floor.
   4. Allow 12 to 24 hours for curing, as required by the manufacturer.
I. Grind the floor to within 2-3 inches of walls with metal bonded diamond grits of 150 and 300, grinding 90° from each previous grind and removing all the scratches from the previous grit.
   1. Vacuum the floor thoroughly after each grind, using a squeegee vacuum attachment.
J. Grind the edges with 40, 60, and 120 grit grinding pads, removing all scratches from the previous grit.
   1. Vacuum the floor thoroughly after each grind, using a squeegee vacuum attachment.
K. Polish the floor to the desired sheen level with phenolic resin bonded diamond grits of 100, 200, 400, 800, 1500, and 3000, first polishing the edges (if specified) with pads of the same grit, then the field of the floor, removing all scratches from the previous grit.
   1. After each polish, clean the floor thoroughly using clean water and an auto scrubber or a mop and wet vacuum.
L. Apply HTC Superfloor™ Stainguard, buff with Green 300 grit twister pad as necessary.
M. Upon completion, the work shall be ready for final inspection and acceptance by the architect and owner.

3.3 SHEEN

A. Polished Concrete Level 1:
   1. At a distance of 100’, the floor will reflect images from side lighting.
B. Polished Concrete Level 2:
   1. At a distance of 30’ to 50’, the floor will clearly reflect from side and overhead lighting.

3.4 EXPOSED AGGREGATE

A. Exposure rate per architect and owner selection based on approved mock-up.

3.5 EDGES

A. Polish all edges to match the field finish area.

3.6 PROTECTION
A. Protect the floors from damage as required.

3.7 TOLERANCES
A. Measure for $F_r$ and $F_l$ tolerances for floors in accordance with ASTM E1155, within 72 hours after slab installation
B. Finish concrete to achieve the following tolerances:
   1. Exposed to View and Foot Traffic (polished concrete): $F_r 40$ and $F_l 35$
   2. Exposed stained concrete (mechanical, electrical, custodial): $F_r 20$ and $F_l 15$
   3. Exception: The $F_l$ levelness tolerances do not apply to any un-shored elevated construction.
   4. Correct the slab surface if the actual $F_r$ or $F_l$ number for the floor installation measures less than required.
C. Identify areas requiring corrective work.
   1. Correct all defects in the defined traffic floor by grinding or removal and replacement of the defective work.
   2. Re-measure corrected areas by the same process.

3.8 SITE ENVIRONMENTAL PROCEDURES
A. Indoor Air Quality: Provide temporary ventilation as necessary and recommended by the manufacturer to meet the project IAQ requirements.
B. Waste Management:
   1. Coordinate with manufacturer for take-back program.
   2. Set aside scrap to be returned to manufacturer for recycling into new product.
   3. Close and seal all partially used containers of paint maintaining quality necessary for reuse.

END OF SECTION
SECTION 03 41 00
STRUCTURAL PRECAST CONCRETE

PART 1 GENERAL

1.1 SECTION INCLUDES
A. Columns and bearing saddles
B. Beams, spandrels, girders, purlins
C. Floor of single, double, quad tees; channel slabs or inverted tee beam
D. Grout packing.
E. Connection and supporting devices
F. Lintels and bond beams.
G. Piles

1.2 REFERENCES
A. ACI 301 - Structural Concrete for Buildings
B. ACI 318 - Building Code Requirements for Structural Concrete
C. ASCE-7 – Minimum Design Loads for Building & Other Structures
D. ASTM A36/A36M - Standard Specification for Carbon Structural Steel
E. ASTM A153/A153M - Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware
F. ASTM A185/A185M - Standard Specification for Steel Welded Wire Reinforcement, Plain, for Concrete
G. ASTM A416/A416M – Standard Specification for Steel Strand, Uncoated Seven-Wire (Stress-Relieved) for Pre-stressed Concrete
I. ASTM A615/A615M - Standard Specification for Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement
J. ASTM A666 - Standard Specification for Annealed or Cold-Worked Austenitic Stainless Steel, Sheet, Strip, Plate and Flat Bar
L. AWS D1.1/D1.1M - Structural Welding Code Bundled Set B
M. AWS D1.4/D1.4M - Structural Welding Code - Reinforcing Steel
N. PCI MNL-116 - Manual for Quality Control for Plants and Production of Pre-cast Concrete Products
O. PCI MNL-120 – PCI Design Handbook – Precast and Prestressed Concrete
P. PCI MNL-123 - Design & Typical Details of Connections for Precast & Prestressed Concrete
Q. PCI MNL-124 - Design for Fire Resistance of Precast Concrete
R. FBC - Florida Building Code
S. UL - Underwriter’s Laboratories

1.3 DESIGN REQUIREMENTS
A. Size the components to withstand design loads.
B. Maximum Allowable Deflection: In accordance with FBC and ACI 318
C. Design members exposed to the weather to provide for movement of components without damage, failure of joint seals, undue stress on fasteners or other detrimental effects, when subject to seasonal or cyclic day/night temperature ranges.
D. Design system to accommodate construction tolerances, deflection of other building structural elements.
members and clearances of intended openings.
E. Calculate structural properties of framing members in accordance with FBC, and ACI 318.
F. Design and construction shall comply with FBC, ASCE 7-Wind Loads.
G. Superimposed design dead loads on roofs shall be the actual dead loads of the system, roofing, MEP allowance, plus 5-psf for re-roofing.

1.4 SUBMITTALS FOR REVIEW
A. Section 01 33 00 - Submittals Procedures
B. Shop Drawings: Indicate layout, unit locations, fabrication details, unit identification marks, reinforcement, connection details, support items, dimensions, openings and relationship to adjacent materials, and sealed by a Professional Structural Engineer licensed in the State of Florida. Indicate design loads, deflections, cambers, bearing requirements and special conditions.
C. Product Data: Indicate standard component configurations, design loads, deflections, cambers and bearing requirements.

1.5 SUBMITTALS FOR INFORMATION
A. Section 01 33 00 - Submittals Procedures
B. Design Data: Submit design data reports indicating calculations for loadings and stresses of fabricated, designed framing.
C. Provide a visual record of surrounding structures outside of school property at construction projects requiring driven piles.

1.6 QUALITY ASSURANCE
A. Perform work in accordance with the requirements of PCI MNL-116, PCI MNL-123, and PCI MNL-120.
B. Fabricator: Company specializing in manufacturing the work of this section with minimum five years documented experience.
C. Erector: Company specializing in erecting the work of this section with three years documented experience and approved by manufacturer.
D. Design pre-cast concrete members under direct supervision of a Professional Structural Engineer experienced in design of this work and licensed in the State of Florida.
E. Welder: Person qualified within previous 12 months in accordance with AWS D1.1 and AWS D1.4.

1.7 REGULATORY REQUIREMENTS
A. Conform to ACI 318 and applicable code for design load and construction requirements applicable to work of this section.
B. Conform to UL Assembly to achieve hour fire rating for floor or roof assembly.

1.8 PRE-INSTALLATION MEETING
A. Convene a pre-installation conference two weeks prior to commencing work of this section, under provisions of Section 01 31 00.
B. Instruct others when field cutting of required openings are 10: and smaller.

1.9 DELIVERY, STORAGE AND PROTECTION
A. Section 01 60 00 - Material Equipment and approved equals
B. Handle pre-cast members in position consistent with their shape, design, and Engineer's requirements.
   1. Lift and support only from support points.
C. Lifting or Handling Devices: Capable of supporting member in positions anticipated during manufacture, storage, transportation, and erection.
D. Protect members to prevent staining, chipping or spalling of concrete.
E. Mark each member with date of production and final position in structure.

1.10 PROJECT CONDITIONS
A. Section 01 31 00 - Coordination and Meetings
B. Coordinate the work of framing components not pre-tensioned but associated with the work of this section.

PART 2 PRODUCTS

2.1 MATERIALS
A. Cement: White or Gray Portland, conforming to ASTM C150/C150M Type I or III.
B. Aggregate, Sand, Water, and Admixtures, Pre-cast Fabricator determined as appropriate to design requirements and PCI MNL-116.

2.2 REINFORCEMENT
A. Tensioning Steel Tendons: ASTM A416/A416M Grade 250K or 270K, of sufficient strength commensurate with member design
B. Reinforcing Steel: ASTM A615/A615M Grade 60 deformed steel bars.
C. Welded Steel Wire Fabric: ASTM A185/A185M Plain Type, ASTM A497/A497M Welded Deformed Type, and ASTM A497/A497 Deformed Type in flat sheets galvanized.
D. Coating: Galvanize reinforcement to resist corrosion.

2.3 ACCESSORIES
A. Connecting and Supporting Devices:
   1. ASTM A36/A36M carbon steel plates, angles, items cast into concrete inserts, hot-dip galvanized in accordance with ASTM A153/A153M.
   2. Do not paint surfaces in contact with concrete or surfaces requiring field welding.
B. Grout: Non-shrink, non-metallic, non-ferrous minimum yield strength of 10,000 psi at 28 days.
C. Bearing Pads: High-density plastic, smooth both sides, Vulcanized elastomeric compound molded to size, Neoprene.
D. Bolts, Nuts and Washers: High strength steel type recommended for structural steel joints.
E. Prime Paint: Zinc rich alkyd type.

2.4 FABRICATION
A. Fabrication procedure to conform to PCI MNL-116
B. Maintain plant records and quality control program during production of pre-cast members and make records available upon request.
C. Ensure reinforcing steel, anchors, inserts, plates, angles and other cast-in items are embedded in the locations as shown on shop drawings.
D. Tension reinforcement tendons as required to achieve design load criteria.
E. Provide required openings with a dimension larger than 10-inches and embed accessories provided by other sections, at indicated locations.
F. Exposed Ends at Stressing Tendons: Fill recess with [non-shrink] [epoxy] grout, trowel flush.

2.5 FINISHES
A. Ensure exposed-to-view finish surfaces of pre-cast concrete members are uniform in color and appearance.
B. Cure members under identical conditions to develop required concrete quality, and minimize appearance blemishes such as non-uniformity, staining, or surface cracking.
C. Rubbed Finish: Surface holes or bubbles over 1/4 inch filled with matching cementitious paste, fins or protrusions removed and surface ground smooth, surface then rubbed with neat
cementitious paste to smooth and even color and texture.

2.6 FABRICATION TOLERANCES
   A. Conform to PCI MNL-116.

2.7 SOURCE QUALITY CONTROL AND TESTS
   A. Section 01 40 00 - Quality Control: Provide mix design for concrete.
   B. Test samples in accordance with applicable ASTM standard.

PART 3 EXECUTION

3.1 APPLICATION
   A. Verify that site conditions are ready to receive work and field measurements are as shown on shop drawings.

3.2 PREPARATION
   A. Prepare support equipment for the erection procedure, temporary bracing, and induced loads during erection.

3.3 ERECTION
   A. Erect members without damage to structural capacity, shape, or finish.
      1. Replace or repair damaged members.
   B. Align and maintain uniform horizontal and vertical joints, as erection progresses.
   C. Protect members from staining by maintaining temporary bracing until final placement of all supports.
   D. Provide temporary lateral support to prevent bowing, twisting, or warping of members.
   E. Adjust differential camber between precast members to tolerance before final attachment.
   F. Install bearing pads.
   G. Level differential elevation of adjoining horizontal members with grout to maximum slope of 1:12
   H. Set vertical units dry, without grout, attaining joint dimension with lead or plastic spacers.
   I. Grout underside of column and beam bearing plates and joints between members at roof and floor locations.
   J. Secure units in place and perform welding in accordance with AWS D1.1.

3.4 ERECTION TOLERANCES
   A. Section 01 40 00 - Quality Control: Tolerances
   B. Erect all members’ level and plumb within allowable tolerances.
   C. Conform to PCI MNL-116.
   D. When members cannot be adjusted to conform to design or tolerance criteria, cease work and advise Architect/Engineer.
      1. Execute modifications as directed.

3.5 PROTECTION
   A. Protect members from damage caused by field welding or erection operations.
   B. Provide non-combustible shields during welding operations.

3.6 CLEANING
   A. Clean weld marks, dirt or blemishes from surface of exposed members.

END OF SECTION
SECTION 03 52 16
LIGHTWEIGHT INSULATING CONCRETE

PART 1  GENERAL
1.1  SECTION INCLUDES
A. Insulating concrete fill over structural roof decking
B. Perimeter joint filler

1.2  REFERENCES
A. ASTM A185/A185M - Standard Specification for Steel Welded Wire, Reinforcement, Plain for Concrete
B. ASTM C138/C138M – Standard Test Method for Density (Unit Weight), Yield, and Air Content (Gravimetric) of Concrete
F. ASTM C495/C495M – Standard Test Method for Compressive Strength of Lightweight Insulating Concrete
G. FBC - Florida Building Code

1.3  PERFORMANCE REQUIREMENTS
A. Minimum Thermal Resistance of Installed Fill: Refer to plans and energy form for required R-value.

1.4  SUBMITTALS FOR REVIEW
A. Section 01 33 00 - Submittals Procedures
B. Shop Drawings: Indicate layout of slopes, drain locations, and interruptions.
C. Product Data: Provide physical characteristics, thermal values, and product limitations.
D. Certificates: Certify that products meet or exceed specified requirements and achieves the required density, thermal value and performance.
E. Manufacturer's Installation Instructions: Indicate mix instructions.

1.5  QUALITY ASSURANCE
A. Installer: Company specializing in placing lightweight concrete fill-material specified in this section with minimum three years documented experience and licensed by manufacturer.
B. Thermal Resistance Values: Use values base the thermal conductivity of insulating concrete in accordance with ASTM specifications at 40°F mean temperature.
C. Wind Uplift Resistance: Use a deck system tested approved and listed in Factory Mutual System Approval Guide for FM Class rating matching the required uplift loads of the structural plans.
D. Certification: Upon completion of roof deck, supply the Owner through the Architect the Manufacturer’s certificate certifying the concrete is per manufacturer's requirements by certified installer.

1.6  REGULATORY REQUIREMENTS
A. Conform to applicable code for combustibility requirements.

1.7  WARRANTY
A. Provide Owner with a no-dollar limit insulating concrete warranty for a minimum of 10-years, signed by the manufacturer stating:
   1. Insulating concrete system shall retain a minimum of 80% of designed thermal resistance for the warranty period.
2. Warranty shall include the composite roof deck system - both the concrete and insulation board.
3. Insulating concrete system shall remain re-roofable for the warranty period.
4. Warranty shall not limit by geographic location the Owner’s right for claims, actions, or proceedings.
5. Insulating concrete shall remain in place when the roof membrane sustains wind damage.

1.8 PRE-INSTALLATION MEETING
A. Section 01 31 00 – Project Management and Coordination: Pre-installation meeting.
B. Convene two weeks prior to commencing work of this section.

1.9 ENVIRONMENTAL REQUIREMENTS
A. Section 01 60 00 - Material Equipment and approved equals: Environmental conditions affecting products on site
B. Do not place fill at ambient temperatures below 40°F without heating mix water to 90-110°F.

PART 2 PRODUCTS

2.1 MATERIALS
A. Cement: ASTM C150/C150M, Portland Type I Normal, gray color
B. Lightweight Aggregate: ASTM C332; Group I, perlite or vermiculite
C. Concrete Materials: Aggregate required by manufacturer and water
D. Air-Entrainment Agent: ASTM C260/C260M, type recommended by lightweight aggregate manufacturer

2.2 ACCESSORIES
A. Reinforcement: Hexagonal woven wire mesh, galvanized.
B. Perimeter Joint Filler: Glass fiber strips, compressible to 50% original thickness under load of 25 psi with full recovery
C. Vents: Type recommended by lightweight aggregate manufacturer
D. Insulation: Molded polystyrene with venting holes to 3% of board area

2.3 CONCRETE MIX
A. Provide cellular concrete mix to:

<table>
<thead>
<tr>
<th>Compressive Strength</th>
<th>Wet Density</th>
<th>Oven Dry Density</th>
</tr>
</thead>
<tbody>
<tr>
<td>350 psi Minimum</td>
<td>50 lb/cu ft Maximum</td>
<td>36 lb/cu ft Maximum</td>
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</table>

PART 3 EXECUTION

3.1 EXAMINATION
A. Section 01 31 00 Project Management and Coordination: Verify existing conditions prior to beginning work.
B. Verify the grouting/taping of joints in roof members to prevent seepage of wet insulating concrete.

3.2 PREPARATION
A. Install one-inch thick expansion joint filler at:
   1. Perimeter of roof decking
   2. Around penetrations through deck
   3. Every 100' of deck surface dimension
   4. Each change of deck direction on metal roof deck surfaces

3.3 INSTALLATION
A. Slurry deck surface; place insulation; use mix to fill holes and breaks.
B. Place insulating concrete and screed surface to achieve minimum thickness.
C. Slope surface ¼”/foot minimum for roof surface drainage
D. Provide ½”/foot sloped crickets on the high side of roof equipment curb.

3.4 CURING
A. Cure in accordance with lightweight aggregate manufacturer's instructions.
B. Protect insulating concrete from excess evaporation of surface moisture.
C. During low humidity conditions, sprinkle water over concrete surface to aid hydration and curing.

3.5 FIELD QUALITY CONTROL
A. Section 01 40 00 - Quality Control Field inspection and testing for dry density.
B. Testing Laboratory: Take three test samples from each 75 or less cu yds of insulating concrete placed.
C. Testing Laboratory: Take one additional test sample during cold weather concreting.

END OF SECTION
SECTION 04 05 13  
MASONRY MORTAR AND GROUT

PART 1  GENERAL
1.1 SECTION INCLUDES
A. Mortar for Masonry
B. Grout for Unit Masonry
1.2 REFERENCES
A. ACI 530/ASCE 5/TMS 402 - Building Code Requirements for Masonry Structures
B. ACI 530.1/ASCE 6/TMS 602 - Specifications for Masonry Structures
C. ASTM C91/C91M - Standard Specification for Masonry Cement
D. ASTM C94/C94M - Standard Specification for Ready-Mixed Concrete
E. ASTM C144 - Standard Specification for Aggregate for Masonry Mortar
F. ASTM C150/C150M - Standard Specification for Portland Cement
G. ASTM C207 - Standard Specification for Hydrated Lime for Masonry Purposes
H. ASTM C270 - Standard Specification for Mortar for Unit Masonry
I. ASTM C404 - Standard Specification for Aggregates for Masonry Grout
J. ASTM C476 - Standard Specification for Grout for Masonry
L. ASTM C780 – Standard Test Method for Preconstruction and Construction Evaluation of Mortars for Plain and Reinforced Unit Masonry
N. FBC - Florida Building Code
1.3 SUBMITTALS
A. Submit mix design for mortar indicating whether to use the proportion or the property specification of ASTM C270.
B. Submit mix design for grout indicating conformance of grout to requirements of ASTM C476.
C. Submit test reports indicating conformance of mortar materials to property specifications of ASTM C270.
D. Submit test reports of pre-construction tests of mortar for consistency, mortar aggregate ratio, water content, air content, compressive strength, and splitting tensile strength in conformance with ASTM C780.
E. Submit test reports of grout tests in conformance to ASTM C1019.
F. Submit manufacturer’s certificate for products indicating conformance with specified requirements.
G. Submit two samples representative of mortar color.
1.4 DELIVERY, STORAGE, AND HANDLING
A. Deliver and store packaged materials in original unopened containers and store in dry weather-tight enclosures.
B. Stockpile and handle aggregates to prevent segregation and contamination.
C. Maintain sand for volume proportioning of mortar and grout in a damp loose condition.
1.5 ENVIRONMENTAL REQUIREMENTS
A. Follow requirements of ACI530.1/ASCE6/TMS 602 for cold and hot weather construction.

PART 2  PRODUCTS
2.1 MORTAR MATERIALS
A. Cementitious Materials:
   1. Masonry Cement: ASTM C91/C91M, Type M or S, gray color
   2. Portland Cement: ASTM C150/C150M, Type I, gray color
3. Hydrated Lime: ASTM C207, Type S
   B. Sand: ASTM C144
   C. Water: Provide water suitable for drinking, clean, and free of harmful amounts of acid, alkalis, salts, or organic materials.
   D. Admixtures:
      1. When required use only non-chloride based accelerators as approved by specifier.
      2. Do not add antifreeze substances to the mortar.
   E. Pigments: When required used mineral oxide pigments not to exceed 5% of the weight of masonry cement or 10% of the weight of Portland Cement in the mortar.

2.2 GROUT MATERIALS
   A. Portland Cement: ASTM C150/C150M, Type I
   B. Hydrated Lime: ASTM C207, Type S
   C. Aggregates: ASTM C404
   D. Water: Provide water suitable for drinking, clean, and free of harmful amounts of acid, alkalis, salts, or organic materials.

2.3 MORTAR MIXES
   A. Mortar: Provide ASTM C270, type ‘M’ or type ‘S’ in conformance with proportion specifications.

2.4 GROUT MIXES
   A. Grout: ASTM C476, coarse grout meeting proportion requirements

2.5 MORTAR MIXING
   A. Measure sand by volume or equivalent weight; do not measure by shovel.
   B. In clean mortar mixer, mix ingredients for 3 to 5 minutes with maximum amount of water to produce proper workability.
   C. Re-temper mortar as needed within 2½-hours after initial mixing.
   D. Discard unused mortar 2½-hours after initial mixing.

2.6 GROUT MIXING
   A. Control batching procedure to ensure proper volume proportions of grout materials and achieve grout slump between 8” and 11”.
   B. Mix grout in accordance with ASTM C94.
   C. Measure grout materials mixed at job site by volume and mix all ingredients in mechanical mixer for minimum of five minutes.

2.7 MIX TESTS
   A. Testing of Mortar: In accordance with ASTM C270
   B. Testing of Grout: In accordance with ASTM C1019

PART 3 EXECUTION

3.1 INSTALLATION
   A. Install mortar and grout in accordance with ACI 530.1/ASCE 6/TMS 602.

3.2 FIELD QUALITY CONTROL
   A. Architect, Owner, or Building Department may request field inspections per Section 01 40 00 1.7 Quality Control.
   B. Test Mortar in accordance with ASTM C780 for consistency, mortar aggregate ratio, water content, air content, compressive strength, and splitting tensile strength.
   C. Test Grout in accordance with ASTM C1019

END OF SECTION
SECTION 04 20 00
MASONRY UNITS

PART I GENERAL

1.1 SECTION INCLUDES

A. Concrete masonry and brick
B. Reinforcement, anchorage, and accessories

1.2 REFERENCES

A. ASCE 7 – American Society of Civil Engineers – Minimum Design Loads of Buildings and Other Structures
B. ACI 530/ASCE 5/TMS 402 – Building Code Requirements for Masonry Structures
C. ACI 530.1 /ASCE 6/TMS 602 – Specifications for Masonry Structures
D. ASTM A82/A82M – Standard Specification for Steel Wire, Plain, for Concrete Reinforcement
H. ASTM A615/A615M – Standard Specification for Deformed and Plain Carbon Steel Bars for Concrete Reinforcement
J. ASTM A653/A653M – Standard Specifications for Steel Sheet, Zinc-Coated (Galvanized) or Zinc Iron Alloy Coated (Galvanized) by the Hot-Dip Process
K. ASTM B370 - Standard Specification for Cooper Sheet and Strip for Building Construction
M. ASTM C55 – Standard Specification for Concrete Building Brick
O. ASTM C62 – Standard Specification for Building Brick (Solid Masonry Units Made from Clay or Shale)
P. ASTM C73 – Standard Specification for Calcium Silicate Face Brick (Sand-Line Brick)
Q. ASTM C90 - Standard Specification for Load-Bearing Concrete Masonry Units
S. ASTM C129 – Standard Specification for Non-Load Bearing Concrete Masonry Units
U. ASTM C216 – Standard Specification for Facing Brick (Solid Masonry Units Made from Clay or Shale)
X. ASTM C652 – Standard Specification for Hollow Brick (Hollow Masonry Units Made from Clay or Shale)
Y. ASTM C744 – Standard Specification for Prefaced Concrete and Calcium Silicate Masonry Units
1.3 SUBMITTALS
   A. Submit under provisions of Section 01 33 00.
   B. Product Data: Provide data for masonry units and fabricated wire reinforcement.
   C. Samples: Submit four samples of decorative block, face brick, pre-faced, units to illustrate color, texture and extremes of color range.
   D. Manufacturer’s Certificate: Certify that products meet or exceed specified requirements.

1.4 QUALIFICATIONS
   A. Manufacturer: Company specializing in manufacturing the Products specified in this section with minimum three years documented experience.

1.5 REGULATORY REQUIREMENTS
   A. Design and construction shall comply with ASEC 7 Wind Loads, FBC, ACI 530/ASCE 5/TMS 402, and ACI 530.1/ASCE 6/TMS 602
   B. Conform to applicable code for UL Assembly requirements for fire-rated masonry construction.
   C. Provide lateral support for block walls, both vertical and horizontal.
      1. The vertical heights of masonry between horizontal supports shall be in accordance with the wall lateral support requirements, FBC table 2107.1.

1.6 MOCK-UP
   A. Provide mock-up of composite masonry under provisions of Section 01 40 00.
   B. Construct a masonry wall into a panel sized 5' long by 4' high, which includes a corner, mortar, and accessories, structural backup, wall openings, flashings, wall insulation, air barrier, vapor barrier and parging.
   C. Locate where directed.
   D. Mock-up to remain intact and protected until the Punch List is completed or until Owner agrees in writing to removal.
   E. Mock-up may remain as part of the work with the Owner's approval.

1.7 PRE-INSTALLATION CONFERENCE
   A. Meet one week prior to commencing work of this section, under provisions of Section 01 31 00.

1.8 DELIVERY, STORAGE AND HANDLING
   A. Deliver, store, protect, and handle products to site under provisions of Section 01 60 00.

1.9 ENVIRONMENTAL REQUIREMENTS

1.10 COORDINATION
   A. Coordinate work under provisions of Section 01 31 00.
   B. Coordinate the masonry work with installation of window anchors.

PART 2 PRODUCTS
2.1 CONCRETE MASONRY UNITS
   A. Load-Bearing Concrete Masonry Units (CMU): ASTM C90, Type II – Non-Moisture Controlled
   B. Hollow Non-Load Bearing Block Units (CMU): ASTM C129, Type II – Non-Moisture Controlled
C. Concrete Brick Units: ASTM C55, Grade N, Type II – Non-Moisture Controlled of same Type and Weight as block units
D. Provide special units for 90° corners, bond beams, lintels, coved bases, bull nosed corners and angle corners.
E. All block installed if fire-rated walls and partitions shall be classified units or certified for the intended use in accordance with FBC.

2.2 BRICK UNITS
A. Face Brick: ASTM C216, Type FBS, Grade MW; color as selected
B. Building Brick: ASTM C62, Grade NW; solid units
C. Hollow Facing and Building Brick: ASTM C652, Grade SW, Type HBS; color as selected
D. Sand-Lime Face Brick: ASTM C73, Grade SW
E. Size and Shape: Provide special units for 90° corners, lintels, bull nosed corners and angle corners.
F. Special Brick Shape: Shaped to profile indicated; surface texture on exposed sides and ends.
G. Giant Face Brick: ASTM C216, Type FBS, Grade MW; color as selected
H. Giant Hollow Facing and Building Brick: ASTM C652, Grade SW, Type HBS; color as selected
I. Provide special units for 90° corners, lintels, bull nosed corners and angle corners.
J. Special Giant Brick Shape: Shaped to profile indicated; surface texture on sides and ends.

2.3 REINFORCEMENT AND ANCHORAGE
A. Single Wythe Joint Reinforcement: Truss type; steel wire, hot dip galvanized to ASTM A641/A641M Class 3 after fabrication, 3/16” side rods with 9-gauge crossties
B. Multiple Wythe Joint Reinforcement: Ladder type; with moisture drip; adjustable type, steel wire, hot dip galvanized ASTM A641/A641M Class 3 fabrication, 3/16” side rods with 9-gauge crossties.
C. Reinforcing Steel: ASTM A615/A615M Grade 40 and 60, deformed carbon bars, unfinished
D. Wall Ties: Corrugated formed sheet metal, gauge thick, adjustable, hot dip galvanized to ASTM A123/A123M B2 steel finish.
E. Wall Ties: Formed steel wire, gage thick, adjustable, eye and pintle type, hot dip galvanized to ASTM A123/A123M B2 steel finish.

2.4 MORTAR AND GROUT
A. Mortar and Grout: As specified in Section 01 05 13.

2.5 FLASHINGS
A. Copper: ASTM B370/B370M, cold-rolled; 20 oz/sq ft, 0.027” thick; natural finish
B. Galvanized Steel: ASTM A653/A653M, G90 finish, 24-gauge core steel
C. Stainless Steel: ASTM A167, Type 304, soft temper; 24-gauge thick; smooth finish
D. Provide dovetail, saw tooth, or other design to develop all direction bonding
E. Lap Sealant: Butyl type as specified in Section 07 92 00

2.6 ACCESSORIES
A. Performed Control Joints: Neoprene material with corner and tee accessories, cement fused joints
B. Joint Filler: Closed cell polyvinyl chloride; oversize 50% to joint width; self-expanding.
C. Cavity Wall Drainage System: High-density polyethylene to support mortar droppings and debris within the cavity.
D. Building Paper: No. 30 asphalt saturated felt.
E. Nailing Strips: Softwood, preservative treated for moisture resistance, dovetail shape, sized to masonry joints.
F. Weep: Preformed plastic tubes, hollow
G. Cavity Vents: Molded polyvinyl chloride grilles, insect resistant.
H. Cleaning Solutions: Non-acidic, not harmful to masonry work or adjacent materials

PART 3 EXECUTION

3.1 EXAMINATION
A. Verify that field conditions are acceptable and are ready to receive work.
B. Verify items provided by other sections of work are properly sized and located.
C. Verify that built-in items are in proper location, and ready for roughing into masonry work.

3.2 PREPARATION
A. Direct and coordinate placement of metal anchors supplied to other sections.
B. Provide temporary bracing during installation of masonry work. Maintain in place until building structure provides permanent bracing.

3.3 COURSING
A. Establish lines, levels, and coursing indicated.
   1. Protect from displacement.
B. Maintain masonry courses to uniform dimension.
   1. Provide vertical and horizontal joints of uniform thickness.
C. Concrete Masonry Units:
   1. Coursing: One unit and one mortar joint to equal 8"
   2. Mortar Joints: Concave
D. Brick Units:
   1. Coursing: Three units and three mortar joints to equal 8"
   2. Mortar Joints: Concave

3.4 PLACING AND BONDING
A. Lay solid masonry units in full bed of mortar, with full head joints, uniformly jointed with other work.
B. Lay hollow masonry units with face shell bedding on head and bed joints.
C. Do not butter corners of joints or excessively furrow mortar joints.
D. Remove excess mortar as work progresses.
E. Interlock intersections and external corners.
F. Do not shift or tap masonry units after mortar has achieved initial set.
   1. To make an adjustment, remove mortar and replace.
G. To prevent broken masonry unit corners or edges perform jobsite cutting of masonry units with proper tools to provide straight, clean, un-chipped edges.
H. Cut mortar joints flush where wall tile is scheduled, cement parging is required, resilient base is scheduled, cavity insulation vapor barrier adhesive or bitumen damp proofing is applied.
I. Isolate masonry partitions from vertical structural framing members with a control joint.
J. Isolate top joint of masonry partitions from horizontal structural framing members and slabs or decks with compressible joint filler.

3.5 WEEPS
A. Install weeps in veneer at intervals recommended by the Brick Institute of America.

3.6 CAVITY WALL
A. Do not permit mortar to drop or accumulate into cavity air space or to plug weeps. Provide a system of high-density polyethylene strands woven to a mesh to collect mortar dropping and permanently suspend them above the weeps.
B. Build inner wythe ahead of outer wythe to receive cavity insulation air/vapor barrier adhesive.

3.7 REINFORCEMENT AND ANCHORAGES – SINGLE WYTHE MASONRY
A. Install horizontal joint reinforcement 16" o.c.
B. Place masonry joint reinforcement in 1st and 2nd joints above and below openings. Extend minimum 16" each side of opening.
C. Place joint reinforcement continuous in first and second joint below top of walls.
D. Lap joint reinforcement ends minimum 6".
E. Reinforce stack-bonded unit, joint corners, and intersections with strap anchors 16" o.c.
F. All masonry below grade is to be grouted solid.
   1. Provide footing/wall dowels.
   2. Measure the splice length from the finish floor.

3.8 REINFORCEMENT AND ANCHORAGES – VENEER MASONRY
A. Install horizontal joint reinforcement 16" o.c.
B. Place masonry joint reinforcement in 1st and 2nd horizontal joints above and below openings. Extend minimum 16" each side of opening.
C. Place joint reinforcement ends minimum 6".
D. Lap joint reinforcement ends minimum 6".
E. Embed wall ties in masonry back up for bonding veneer at maximum 16" o.c. vertically and 36" o.c. horizontally.
   1. Place maximum 3" o.c. each way around perimeter of openings, within 12" of openings.
F. Secure wall ties, rods, strap, anchors to back-up and embed into masonry veneer at maximum 16" o.c. vertically, and 36" o.c. horizontally.
G. Place at maximum 3" o.c. each way around perimeter of openings, within 12" of openings.
H. Provide length to extend a minimum of 1½" into the exterior wythe.

3.9 REINFORCEMENT AND ANCHORAGES – CAVITY WALL MASONRY
A. Install horizontal joint reinforcement 16" o.c.
B. Place masonry joint reinforcement in 1st and 2nd horizontal joints above and below openings.
   1. Extend minimum 16" each side of opening.
C. Place joint reinforcement continuous in first and second joint below top of walls.
D. Lap joint reinforcement ends minimum 6".
E. Embed anchors in concrete or attached to structural steel members.
   1. Embed anchorages in every second block or sixth brick joint.
   2. Provide length to extend a minimum 1½" into the exterior wythe.
F. Reinforce stack bonded unit joint corners and intersection with strap anchors 16" o.c.

3.10 REINFORCEMENT AND ANCHORAGES – MULTIPLE WYTHE UNIT MASONRY
A. Install horizontal joint reinforcement 16" o.c.
B. Place masonry joint reinforcement in 1st and 2nd horizontal joints above and below openings.
   1. Extend minimum 16" each side of opening.
C. Place joint reinforcement continuous in first and second joint below top of walls.
D. Lap joint reinforcement ends minimum 6".
E. Support and secure reinforcing bars from displacement.
   1. Maintain position within ½" of dimensioned position.
F. Embed anchors embedded in concrete or attach to structural steel members.
1. Embed anchorages in every second block or sixth brick joint.
G. Provide length to extend a minimum 1½" into the exterior wythe.
H. Reinforce stack bonded unit joint corners and intersection with strap anchors 16" o.c.

3.11 MASONRY FLASHINGS
A. Provide through wall flashing under parapet copings, for counter-flashing in masonry walls, where roofs abut, at lintels of exterior wall openings, ledge or shelf angles, under windowsills and band courses, at spandrel beams, foundation walls and where shown on drawings.
B. Turn flashing up minimum 8" and bed into mortar joint of masonry, seal to concrete, and seal to sheathing over framed back up.
C. Lap end joints minimum 6" and seal watertight.
D. Turn flashing, fold and seal at corners, bends and interruptions to form dams.

3.12 SILLS
A. See specification section 08 51 13 – 3.1 B Sill & Buck for windowsill requirements.

3.13 LINTELS
A. Install lintels over openings.
B. Install reinforced unit masonry lintels over openings where steel or pre-cast concrete lintels area not scheduled.
C. Openings up to 42" Wide: Place two, No. 4 reinforcing bars 1" from bottom web
D. Openings from 42": Up to 78" wide:
   1. Place two, No. 5 reinforcing bars 1" from bottom web.
E. Opening over 78": Reinforce openings as detailed.
F. Do not splice reinforcing bars.
G. Support and secure reinforcing bars from displacement.
   2. Maintain position within ½" of dimensioned position.
H. Place and consolidate grout fill without displacing reinforcing.
I. Allow masonry lintels to attain specified strength before removing temporary supports.
J. Maintain bearing on each side of opening. Minimum bearing of 4" on concrete, 3" on steel and 8" on masonry

3.14 ENGINEERED MASONRY
A. Lay masonry units with core cells vertically aligned and cavities between wythes clear of mortar and unobstructed.
B. Place mortar in masonry unit bed-joints back ¼" from edge of unit grout spaces, bevel back and upward.
   1. Permit mortar to cure seven days before placing grout.
C. Reinforce masonry unit cores and cavities with reinforcement bars and grout as indicated.
D. Retain vertical reinforcement in position at top and bottom of cells and at intervals not exceeding 192 bar diameters.
E. Grout space dimension is the clear dimension between any masonry protrusions and increases by diameters of the horizontal bars within the cross-section of the grout space.
F. Wet masonry unit surfaces in contact with grout just prior to grout placement.
G. The minimum grouted spaces in both horizontal dimensions shall be as follows:
   1. Low-Lift Grouted Construction
      a. Fine aggregate: Grout spaces may be less than 2".
      b. Fine or coarse aggregate: Grout spaces shall be 2" or more.
   2. High-Lift Grouted Construction:
      a. Fine or coarse aggregate: Grout space shall not be less than 2" wide.
H. The area of vertical reinforcement shall not exceed 6% of the area of the grout space.
I. When grouting is stopped for more than one hour, terminate grout 1½" below top of upper masonry unit to form a positive key for subsequent grout placement.
J. Low Lift Grouting – Place first lift of grout to a height of 16" and rod for grout consolidation.
   1. Place subsequent lifts in 8" increments and rod for grout consolidation.
K. High Lift Grouting:
   1. Provide cleanout opening no less than 4" high at the bottom of each cell to be grouted by cutting one face shell of masonry unit,
   2. In double wythe walls, omit every second masonry unit in one of the wythes for clean out and cell inspection purposes.
   3. In double wythe walls, construct vertical grout barriers or dams between the masonry wythes, with masonry units every 25' maximum.
   4. Clean out masonry cells and cavities with high-pressure water spray before pouring or pumping grout.
      a. Allow the complete water drainage and use compressed air to remove debris.
   5. Contractor shall request inspection of the cells and cavities before concealing them.
      a. Allow three days advance notice of inspection.
   6. After cleaning and cell inspections, seal openings with masonry units.
   7. Pump grout into spaces. Maintain water content in grout to intended slump without aggregate segregation.
   8. Limit grout lift to 48" and rod for grout consolidation. Wait 30 to 60 minutes before placing next lift.

3.15 CONTROL AND EXPANSION JOINTS
A. Provide expansion joints and control joints to prevent uncontrolled stress cracks in the structure and according to the engineering’s plans and standards.
B. Do not continue horizontal joint reinforcement through control and expansion joints.
C. Install preformed control joint device in continuous lengths. Seal butt and corner joints in accordance with manufacturer’s instructions.
D. Size control joint in accordance with Section 07 92 00 for sealant performance.

3.16 BUILT-IN WORK
A. As work progresses, install built-in metal door and glazed frames, fabricated metal frames, window frames, wood nailing strips, anchor bolts, plates, and other items to be built-in the work and furnished by other sections.
B. Install built-in items plumb and level.
C. Bed anchors of metal door and glazed frames in adjacent mortar joints.
   1. Fill frame voids solid with grout. Fill adjacent masonry cores with grout minimum 12" from framed openings.
D. Do not build in organic materials subject to deterioration.

3.17 TOLERANCES
A. Maximum Variation from Alignment of Columns: Pilasters: ¼"
B. Maximum Variation from Unit to Adjacent Unit: 1/32"
C. Maximum Variation from Plane of Wall: ¼" in 10' and ½" in 20' or more
D. Maximum Variation from Plumb: ¼" per story non-cumulative and ½" in two stories or more
E. Maximum Variation from Level Coursing: ¼" in 3', ⅛" in 10' and ½" in 30'
F. Maximum Variation of Joint Thickness: ¼" in 3'
G. Maximum Variation from Cross-Section Thickness of Walls: ¼"
3.18 CUTTING AND FITTING
   A. Cut and fit for chases, pipes, conduit, sleeves, and grounds.
      1. Coordinate with other sections of work to provide correct size, shape, and location.
   B. Obtain approval prior to cutting or fitting masonry work not indicated or where appearance or strength of masonry work may be impaired.

3.19 PARGING
   A. Dampen masonry walls prior to parging.
   B. Scarify each parging coat to ensure full bond to subsequent coat.
   C. Parge masonry walls in two uniform coats of mortar to a total thickness of ¾" minimum.
   D. Steel trowel surface smooth and flat with a maximum surface variation of ⅛" per foot.
   E. Strike top edge of parging at 45°

3.20 FIELD QUALITY CONTROL
   A. Architect, Owner, or Building Department may request field inspections per Section 01 40 00 1.7 Quality Control.

3.21 CLEANING
   A. Clean work under provisions of 01 77 00, and comply with ASTM, BIA, and ACI 530.
   B. Remove excess mortar and mortar smears as work progresses.
      1. Mortar streaks and/or stains that cannot be removed by light cleaning shall be replaced.
      2. Do not use abrasives for rubbing or scraping off mortar stains.
   C. Replace defective mortar and match adjacent work.
   D. Clean soiled surfaces with cleaning solution.
      1. Use only cleaning products approved by the Architect and applied in direct conformance with the manufacturer’s instructions.
      2. DO NOT USE Muratic acid to clean masonry.
   E. Use non-metallic tools in cleaning operations.

3.22 PROTECTION OF FINISHED WORK
   A. Protect finished work under provisions of Section 01 50 00.
   B. Without damaging completed work, provide protective boards at exposed external corners, only at those corners subject to damage due to construction activities.

END OF SECTION
SECTION 04 20 10
REINFORCED MASONRY UNITS

PART 1 GENERAL

1.1 SECTION INCLUDES
A. Concrete masonry or brick units
B. Reinforcement, anchorage, and accessories
C. Parged masonry surfaces

1.2 REFERENCES
A. ACI 530/ASCE 5/TMS 402– Building Code Requirements for Masonry Structures
B. ACI 530.1/ASCE 6/TMS 602- Specifications For Masonry Structures
C. ASCE 7 - American Society of Civil Engineers – Minimum Design Loads of Buildings and Other Structures
D. ASTM A82/A82M - Standard Specification for Steel Wire for Concrete Reinforcement
E. ASTM A123/A123M - Standard Specification for Zinc (Hot Dipped Galvanized) Coatings on Iron and Steel Products
G. ASTM A653/A653M - Standard Specifications for Steel Sheet, Zinc Coated, (Galvanized) or Zinc Iron Alloy (Galvannealed) by the Hot-Dip Process.
I. ASTM A615/A615M - Standard Specification for Deformed and Plain Carbon Steel Bars For Concrete Reinforcement
J. ASTM A641/A641M – Standard Specification for Zinc-Coated (Galvanized) Carbon Steel Wire
K. ASTM B370 - Standard Specification for Cooper Sheet and Strip For Building Construction
M. ASTM C55 - Standard Specification for Concrete Building Brick
O. ASTM C62 – Standard Specification for Building Brick (Solid Masonry Units Made from Clay or Shale)
P. ASTM C73 – Standard Specification for Calcium Silicate Face Brick (Sand-Line Brick)
Q. ASTM C90- Standard Specification for Load-Bearing Concrete Masonry Units
S. ASTM C652 - Standard Specification for Hollow Brick (Hollow Masonry Units Made From Clay or Shale).
T. FBC - Florida Building Code
W. UL - Fire Resistance Directory

1.3 SUBMITTALS
A. Submit under provisions of Section 01 33 00.
B. Shop Drawings: Indicate bars sizes, spacing, locations, reinforcement quantities, bending and cutting schedules, supporting and spacing devices for reinforcement and accessories.
C. Product Data: Provide data for brick and masonry units and fabricated wire reinforcement.
D. Samples: Submit samples of decorative block, brick units to illustrate color, texture, and extremes of color range.
E. Design Data: Indicate required mortar strength, masonry unit assembly strength in all planes with supportive test data.
F. Manufacturer's Certificate: Certify that products meet or exceed specified requirements.

1.4 QUALITY ASSURANCE
A. Perform work in accordance with ACI 530 and ACI 530.1.
B. Maintain one copy of each document on site.

1.5 QUALIFICATIONS
A. Manufacturer: Company specializing in manufacturing the products specified in this section with minimum five years documented experience.

1.6 REGULATORY REQUIREMENTS
B. Conform to applicable code for UL Assembly requirements for fire rated masonry construction.
C. Provide lateral support for block walls, both vertical and horizontal.
   1. The vertical heights of masonry between horizontal supports shall be in accordance with the wall lateral support requirements, FBC table 2107.1

1.7 MOCK-UP
A. Provide mock-up of composite masonry under provisions of Section 01 40 00.
B. Construct a masonry wall panel sized 8' long by 6' high, which includes mortar and accessories, backup, wall openings, flashings, wall insulation, air barrier, vapor barrier, and parging.
C. Locate where directed.
D. Mock-up to remain intact and protected until the Punch List is completed or until Owner agrees in writing to removal.
E. Mockup may not remain as part of the work.

1.8 PRE-INSTALLATION CONFERENCE
A. Meet two weeks prior to commencing work of this section, under provisions of Section 01 31 00.

1.9 DELIVERY, STORAGE, AND HANDLING
A. Store, protect, and deliver products to site under provisions of Section 01 60 00.

1.10 ENVIRONMENTAL REQUIREMENTS

1.11 COORDINATION
A. Coordinate work under provisions of Section 01 31 00.
B. Coordinate the masonry work with installation of window anchors.

PART 2 PRODUCTS
2.1 CONCRETE MASONRY UNITS
A. Hollow Load Bearing Block Units (CMU): ASTM C90, Type II – Non-Moisture Controlled
B. Load Bearing Concrete Masonry Units (CMU): ASTM C90, Type II – Non-Moisture Controlled
C. Decorative Block Units (CMU): ASTM C90, Type II – Non-Moisture Controlled

Reinforced Masonry Units 04 20 10
D. Concrete Brick Units: ASTM C55, Grade N, Type II – Non-Moisture Controlled of same type and weight as block units
E. All block installed in fire rated walls and partitions shall be classified units or certified for the intended use in accordance with FBC.

2.2 BRICK UNITS
A. Face Brick: ASTM C216, Type FBS, Grade MW; color as selected.
B. Building Brick: ASTM C62, Grade NW; solid units
C. Hollow Facing and Building Brick: ASTM C652, Grade SW, Type HBS; color as selected
D. Sand-Lime Face Brick: ASTM C73, Grade SW

E. Size and Shape: Provide special units for 90° corners, lintels, bull nosed corners and angle corners
F. Special Brick Shape: Shaped to profile indicated; surface texture on sides and ends
G. Giant Face Brick: ASTM C216, Type FBS, Grade MW; color as selected
H. Giant Hollow Facing and Building Brick: ASTM C652, Grade SW, Type HBS; color as selected
I. Provide special units for 90° corners, lintels, bull nosed corners and angle corners
J. Special Giant Brick Shape: Shaped to profile indicated; surface texture on sides and ends

2.3 REINFORCEMENT AND ANCHORAGE
A. Single Wythe Joint Reinforcement: Truss type; steel wire, hot dip galvanized to ASTM A641/A641M Class 3 after fabrication, 3/16" side rods with 9-ga cross ties.
B. Multiple Wythe Joint Reinforcement: Ladder type; with moisture drip; adjustable type, steel wire, hot dip galvanized ASTM A641/A641M Class 3 fabrication, 3/16" side rods with 9-gauge cross ties.
C. Reinforcing Steel: A615/A615M, Grade 40 or Grade 60; deformed carbon bars as specified in Section 03 20 00, unfinished
D. Wall Ties: Corrugated formed sheet metal, gauge thick, adjustable, hot dip galvanized to ASTM A123/A123M B2 steel finish.
E. Wall Ties: Formed steel wire, gage thick, adjustable, eye and pintle type, hot dip galvanized to ASTM A123/A123M B2 steel finish.
F. Dovetail Anchors: Bent steel strap, galvanized to ASTM A123/A123M B2 finish.

2.4 MORTAR AND GROUT
A. Mortar and Grout: As specified in Section 04 05 13.

2.5 FLASHINGS
A. Copper: ASTM B370, cold rolled; 20 oz/sq ft, 0.027 inch thick; natural finish.
B. Galvanized Steel: ASTM A653/A653M, G90 finish, 24-ga core steel
C. Stainless Steel: ASTM A167, Type 304, soft temper; 24-ga thick; smooth finish.
D. Provide dovetail; saw tooth, or other design to develop all direction bonding.
E. Lap Sealant: Butyl type as specified in Section 07 92 00

2.6 ACCESSORIES
A. Preformed Control Joints: Neoprene material, provide with corner and tee accessories, cement fused joints.
B. Joint Filler: Closed cell polyvinyl chloride; oversizes 50% to joint width and self-expanding.
C. Cavity Wall Drainage System: High-density polyethylene to support mortar droppings and debris within the cavity.
D. Building Paper: No. 30 asphalt saturated felt.
F. Weep: Preformed plastic tubes, hollow
G. Cavity Vents: Molded polyvinyl chloride grilles insect resistant.
H. Cleaning Solutions: Non-acidic, not harmful to masonry work or adjacent materials

PART 3 EXECUTION
3.1 EXAMINATION
A. Verify that field conditions are acceptable and are ready to receive work.
B. Verify items provided by other sections of work are properly sized and located.
C. Verify that built-in items are in proper location, and ready for roughing into masonry work.

3.2 PREPARATION
A. Direct and coordinate placement of metal anchors supplied to other sections.
B. Provide temporary bracing during installation of masonry work.
   1. Maintain in place until building structure provides permanent bracing.

3.3 COURSING
A. Establish lines, levels, and coursing indicated. Protect from displacement.
B. Maintain masonry courses to uniform dimension, with vertical and horizontal joints of uniform thickness.
C. Concrete Masonry Units:
   1. Coursing: One unit and one mortar joint to equal 8"
   2. Mortar Joints: Concave
D. Brick Units:
   1. Coursing: Three units and three mortar joints to equal 8"
   2. Mortar Joints: Concave

3.4 PLACING AND BONDING
A. Lay solid masonry units in full bed of mortar, with full head joints, uniformly jointed with other work.
B. Lay hollow masonry units with face shell bedding on head and bed joints.
C. Buttering corners of joints or excessive furrowing of mortar joints is not permitted.
D. Remove excess mortar as work progresses.
E. Interlock intersections and external corners.
F. Do not shift or tap masonry units after mortar has achieved initial set.
   1. Where adjustments are made, remove mortar, and replace.
G. Perform job site cutting of masonry units with proper tools to provide straight, clean, un-chipped edges.
   1. Prevent broken masonry unit corners or edges.
H. Cut mortar joints flush where wall tile is scheduled, cement parging is required, resilient base is scheduled, cavity insulation vapor barrier adhesive is applied, or bitumen damp proofing is applied.
I. Isolate masonry partitions from vertical structural framing members with a control joint.
J. Isolate top joint of masonry partitions from horizontal structural framing members and slabs or decks with compressible joint filler.

3.5 WEEPS
A. Install weeps in veneer at intervals recommended by the Brick Institute of America.

3.6 REINFORCEMENT AND ANCHORAGES
A. Install horizontal joint reinforcement 16" o.c.
B. Place masonry joint reinforcement in first and second horizontal joints above and below openings, and extend minimum 16" each side of opening.
C. Place joint reinforcement continuous in first and second joint below top of walls.
D. Lap joint reinforcement ends minimum 6".
E. Reinforce stack-bonded unit, joint corners, and intersections with strap anchors 16" o.c.
F. All masonry below grade is to be grouted solid.
   1. Provide footing/wall dowels.
G. Measure the splice length from the finish floor

3.7 REINFORCEMENT AND ANCHORAGES - VENEER MASONRY
A. Install horizontal joint reinforcement 16" o.c.
B. Place masonry joint reinforcement in first and second horizontal joints above and below openings, and extend minimum 16" each side of opening.
C. Place joint reinforcement continuous in first and second joint below top of walls.
D. Lap joint reinforcement ends minimum 6".
E. Embed wall ties in masonry back-up for bonding veneer at maximum 16" o.c. vertically and 36" o.c. horizontally.
   1. Place at maximum 3" o.c. each way around perimeter of openings, within 12" of openings.
F. Secure wall ties, rods, strap, anchors to back-up and embed into masonry veneer at maximum 16" o.c. vertically and 36" o.c. horizontally.
   1. Place at maximum 3" o.c. each way around perimeter of openings, within 12" of openings.
   2. Provide length to extend a minimum of 1½" into the exterior wythe.
G. Reinforce stack-bonded unit joint corners and intersections with strap anchors 16" o.c.

3.8 REINFORCEMENT AND ANCHORAGES - CAVITY WALL MASONRY
A. Install horizontal joint reinforcement 16" o.c.
B. Place masonry joint reinforcement in first and second horizontal joints above and below openings, and extend minimum 16" each side of opening.
C. Place joint reinforcement continuous in first and second joint below top of walls.
D. Lap joint reinforcement ends minimum 6".
E. Embed anchors in concrete or attached to structural steel members in every second block or sixth brick joint.
   1. Provide length to extend a minimum 1½" into the exterior wythe.
F. Reinforce stack-bonded unit joint corners and intersections with strap anchors 16" o.c.

3.9 REINFORCEMENT AND ANCHORAGES - MULTIPLE WYTHE UNIT MASONRY
A. Install horizontal joint reinforcement 16" o.c.
B. Place masonry joint reinforcement in first and second horizontal joints above and below openings, and extend minimum 16" each side of opening.
C. Place joint reinforcement continuous in first and second joint below top of walls.
D. Lap joint reinforcement ends minimum 6".
E. Support and secure reinforcing bars from displacement.
   1. Maintain position within ½" of dimensioned position.
F. Embed anchors embedded in concrete or attached to structural steel members.
   1. Embed anchorages in every second block or sixth brick joint.
   2. Provide length to extend a minimum 1½" into the exterior wythe.
G. Reinforce stack bonded unit joint corners and intersections with strap anchors 16" o.c.

3.10 MASONRY FLASHINGS
A. Provide thru-wall flashing under parapet copings, for counter-flashing in masonry walls, where roofs abut, at lintels of exterior wall openings, ledge or shelf angles, under windowsills and band courses, at spandrel beams, foundation walls and where shown on drawings.
B. Turn flashing up minimum 8" and bed into mortar joint of masonry, seal to concrete, and seal to sheathing over framed back up.
C. Lap end joints minimum 6" and seal watertight.
D. Turn flashing, fold, and seal at corners, bends, and interruptions to form dams.

3.11 SILLS
A. See specification section 08 51 13 – 3.1 B Sill & Buck for windowsill requirements

3.12 LINTELS
A. Install pre-cast concrete lintels over openings.
B. Install reinforced unit masonry lintels over openings where steel or precast concrete lintels are not scheduled.
C. Openings Up to 42" wide: Place two, No. 4 reinforcing bars 1" from bottom
D. Openings From 42" Up to 78" wide: Place two, No. 5 reinforcing bars 1" from bottom.
E. Opening Over 78": Reinforce openings as detailed.
F. Do not splice reinforcing bars.
G. Support and secure reinforcing bars from displacement.
   1. Maintain position within ½" of dimensioned position.
H. Place and consolidate grout fill without displacing reinforcing.
I. Allow masonry lintels to attain specified strength before removing temporary supports.
J. Maintain bearing on each side of opening.
   1. Minimum bearing of 4" on concrete, 3" on steel and 8" on masonry

3.13 ENGINEERED MASONRY
A. Lay masonry units with core cells vertically aligned and cavities between wythes clear of mortar and unobstructed.
B. Place mortar in masonry unit bed joints back ¼" from edge of unit grout spaces, bevel back and upward.
   1. Permit mortar to cure seven days before placing grout.
C. Reinforce masonry unit cores and cavities with reinforcement bars and grout.
D. Retain vertical reinforcement in position at top and bottom of cells and at intervals not exceeding 192 bar diameters.
   1. Splice reinforcement in accordance with Section 03 20 00.
E. Wet masonry unit surfaces in contact with grout just prior to grout placement.
F. Grout spaces less than 2" in width with fine grout using low lift grouting techniques.
G. Grout spaces 2" or greater in width, use a course grout.
H. When grouting is suspended for more than one hour, terminate grout 1½" below top of upper masonry unit to form a positive key for subsequent grout placement.
I. Low Lift Grouting:
   1. Place first lift of grout to a height of 16" and rod for grout consolidation.
   2. Place subsequent lifts in 8" increments and rod for grout consolidation.
J. High Lift Grouting:
   1. Provide cleanout opening no less than 4" high at the bottom of each grouted cell by cutting one face shell of masonry unit.
2. In double wythe walls, omit every second masonry unit in one of the wythes for clean out and cell inspection purposes.

3. In double wythe walls, construct vertical grout barriers or dams between the masonry wythes, with masonry units every 30' maximum.

4. Clean out masonry cells and cavities with high-pressure water spray. Permit complete water drainage.

5. Contractor shall request inspection of the cells and cavities.
   a. Allow three days advance notice of inspection.

6. After cleaning and cell inspection, seal openings with masonry units.

7. Pump grout into spaces. Maintain water content in grout to intended slump without aggregate segregation.

8. Limit grout lift to 60" and rod for grout consolidation.
   a. Wait 30 to 60 minutes before placing next lift.

3.14 CONTROL AND EXPANSION JOINTS

A. Provide expansion joints and control joints to prevent uncontrolled stress cracks in the structure and according to the engineering’s plans and standards.

B. Do not continue horizontal joint reinforcement through control and expansion joints.

C. Install preformed control joint device in continuous lengths.
   1. Seal butt and corner joints in accordance with manufacturer’s instructions.

D. Size control joint in accordance with Section 07 92 00 for sealant performance.

3.15 BUILT-IN WORK

A. As work progresses, install built-in metal door and glazed frames, fabricated metal frames, window frames, wood nailing strips, anchor bolts, plates, and other items to be built-in the work and furnished by other sections.

B. Install built-in items plumb and level.

C. Bed anchors of metal door and glazed frames in adjacent mortar joints.
   1. Fill frame voids solid with grout.
   2. Fill adjacent masonry cores with grout minimum 12" from framed openings.

D. Do not build in organic materials subject to deterioration.

3.16 TOLERANCES

A. Maximum Variation From Alignment of Columns and Pilasters: ¼"

B. Maximum Variation From Unit to Adjacent Unit: 1/32"

C. Maximum Variation From Plane of Wall: ¼" in 10' and ⅛" in 20' or more

D. Maximum Variation From Plumb: ¼" per story non-cumulative, ½" in two stories or more

E. Maximum Variation From Level Coursing: ½" in 3' and ¼" in 10', ½" in 30'

F. Maximum Variation of Joint Thickness: ¼" in 3'

G. Maximum Variation from Cross-Section Thickness of Walls: ¼"

3.17 CUTTING AND FITTING

A. Cut and fit for chases, pipes, conduit, sleeves, and grounds.
   1. Coordinate with other sections of work to provide correct size, shape, and location.

B. Obtain approval prior to cutting or fitting masonry work not indicated or where appearance or strength of masonry work may be impaired.

3.18 PARGING

A. Dampen masonry walls prior to parging.

B. Scarify each parging coat to ensure full bond to subsequent coat.

C. Parge masonry walls in two uniform coats of mortar to a total thickness of ¾" minimum.
D. Steel trowel surface smooth and flat with a maximum surface variation of ⅛" per foot.
E. Strike top edge of parging at 45°

3.19 FIELD QUALITY CONTROL
A. Architect, Owner, or Building Department may request field inspections per Section 01 40 00 1.7 Inspection Services.

3.20 CLEANING
A. Clean work under provisions of 01 77 00 and conform to ASTM, BIA, and ACI 530.
B. Remove excess mortar and mortar smears as work progresses.
   1. Replace material when mortar streaks and/or stains are not removable by light cleaning.
   2. Do not use Abrasives for rubbing or scraping off mortar stains
C. Replace defective mortar and match adjacent work.
D. Clean soiled surfaces with cleaning solution.
   1. Use only cleaning products approved by the Architect and applied in direct conformance with the manufacturer’s instructions.
   2. DO NOT USE Muratic acid to clean masonry.
E. Use non-metallic tools in cleaning operations.

3.21 PROTECTION OF FINISHED WORK
A. Protect finished work under provisions of Section 01 50 00.
B. Without damaging completed work, provide protective boards at exposed external corners that may be damaged by construction activities.

END OF SECTION
SECTION 05 50 00
METAL FABRICATIONS

PART 1 GENERAL

1.1 SECTION INCLUDES
   A. Shop fabricated ferrous metal items.
   B. Shop fabricated aluminum items.

1.2 REFERENCES
   A. AAMA 204 - Voluntary Specification, Performance Requirements and Test Procedures for High
      Performance Organic Coatings on Aluminum Extrusions and Panels
   B. AAMA 606.1 - Voluntary Guide Specifications and Inspection Methods for Integral Color Anodic
      Finishes for Architectural Aluminum
      Architectural Aluminum
   D. AAMA 608.1 - Voluntary Guide Specifications and Inspection Methods for Electrolytically
      Deposited Color Anodic Finishes for Architectural Aluminum
   E. AAMA 2603 - Voluntary Specification, Performance Requirements and Test Procedures for
      Pigmented Organic Coatings on Aluminum Extrusions and Panels
   F. ANSI ASC A14.3 - American National Standard for Ladders - Fixed - Safety Requirements
   G. ASTM A36/A36M - Standard Specification for Carbon Structural Steel
   H. ASTM A53/A53M - Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-coated
      Welded and Seamless
   I. ASTM A123/A123M - Standard Specification for Zinc (Hot-Galvanized) Coatings on Iron and Steel
      Products
   J. ASTM A153/A153M - Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware
   L. ASTM A307 - Standard Specification for Carbon Steel Bolts and Studs, 60,000 psi Tensile Strength
   M. ASTM A500/A500M - Standard Specification for Cold-Formed Welded and Seamless Carbon Steel
      Structural Tubing in Round and Shapes.
   N. ASTM A501 - Standard Specification for Hot-Formed Welded and Seamless Carbon Steel
      Structural Tubing.
   Q. ASTM B177/B177M - Standard Guide for Engineering Chromium Electroplating
   R. ASTM B209 - Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate
   S. ASTM B210 - Standard Specification for Aluminum and Aluminum-Alloy Drawn Seamless Tubes
   T. ASTM B211 - Standard Specification for Aluminum and Aluminum-Alloy Rolled or Cold Finished
      Bar, Rod and Wire
   U. ASTM B221 - Standard Specification for Aluminum-and Aluminum-Alloy Extruded Bars, Rods,
      Wire, Profiles and Tubes
   V. AWS A2.4 - Standard Symbols for Welding, Brazing, Nondestructive Examination
   W. AWS D1.1/D1.1M - Structural Welding Code Bundled Set B
   X. FBC - Florida Building Code
   Y. SSPC - Steel Structure Painting Council - Steel Structures Painting Council

1.3 SUBMITTALS FOR REVIEW
   A. Section 01 33 00 - Submittals Procedures
   B. Shop Drawings: Indicate profiles, sizes, connection attachments, reinforcing, anchorage, size, and
      type of fasteners, and accessories.
1. Include erection drawings, elevations, and details.
C. Indicate welded connections using standard AWS A2.0 welding symbols.
1. Indicate net weld lengths.

1.4 QUALIFICATIONS
A. Prepare Shop Drawings under direct supervision of a Professional Structural Engineer experienced in design of this work and licensed in the State of Florida.
B. Welders' Certificates: Submit under provisions of Section 01 33 00, certifying welders employed on the Work, verifying AWS qualification within the previous 12-months.

PART 2 PRODUCTS
2.1 MATERIALS - STEEL
A. Steel Sections: ASTM A36/A36M
B. Steel Tubing: ASTM A500/A500M, Grade B
C. Plates: ASTM A283/A283M
D. Pipe: ASTM A53/A53M, Type E or S, Grade B, Schedule 40 minimum
E. Bolts, Nuts, and Washers: ASTM A325 or A307 galvanized to ASTM A153/A153M for galvanized components
F. Welding Materials: AWS D1.1; type required for welded materials
G. Ladders: ANSI A14.3
H. Shop and Touch-Up Primer: SSPC 15, Type I, red oxide
I. Touch-Up Primer for Galvanized Surfaces: SSPC 20, Type I Inorganic zinc rich

2.2 MATERIALS - ALUMINUM
A. Extruded Aluminum: ASTM B221, Alloy 6063, Temper T5
B. Sheet Aluminum: ASTM B209, Alloy, Temper
C. Aluminum-Alloy Drawn Seamless Tubes: ASTM B210, Alloy 6063, Temper T6
D. Aluminum-Alloy Bars: ASTM B211, Alloy 6063, Temper T6
E. Aluminum-Alloy Sand Castings: ASTM B26/B26M, Alloy
F. Aluminum-Alloy Die Castings: ASTM B85/B85M, Alloy
G. Bolts, Nuts and Washers: Stainless steel
H. Welding Materials: AWS D1.1/D1.1M; type required for welded materials

2.3 FABRICATION
A. Fit and shop assemble in largest practical sections for delivery to site.
B. Fabricate items with joints tightly fitted and secured.
C. Continuously seal joined members by continuous welds.
D. Grind exposed joints flush and smooth with adjacent finish surface.
   1. Make exposed joints butt tight, flush, and hairline.
   2. Ease exposed edges to small uniform radius.
E. Exposed Mechanical Fastenings: Provide flush countersunk screws or bolts unobtrusively located consistent with design of component except as noted otherwise
F. Supply components required for anchorage of fabrications.
   1. Fabricate anchors and related components of same material and finish as fabrication, except as noted otherwise.

2.4 FABRICATION TOLERANCES
A. Square: 1/8" maximum difference in diagonal measurements.
B. Maximum Offset between Faces: 1/16"
C. Maximum Misalignment of Adjacent Members: 1/16"
D. Maximum Bow: 1/8" in 48"
E. Maximum Deviation from Plane: 1/16" in 48"
2.5 FINISHES - STEEL
   A. Prepare surfaces to be primed in accordance with SSPC SP 2.
   B. Clean surfaces of rust, scale, grease, and foreign matter prior to finishing.
   C. Do not prime surfaces in where field welding is required.
   D. Prime paint items with one coat.
   E. Structural Steel Members:
      1. Galvanize after fabrication to ASTM A123/A123M.
      2. Provide minimum 1.25 oz/sq ft galvanized coating.
   F. Non-structural Items:
      1. Galvanize after fabrication to ASTM A123/A123M.
      2. Provide minimum 1.25 oz/sq ft galvanized coating.

2.6 FINISHES - ALUMINUM
   A. Exterior Aluminum Surfaces: Exterior, hard coat, two step anodized to clear color to 0.0007" thickness organic coating to color selected.
   B. Interior Aluminum Surfaces: Interior, hard coat, two-step anodized to clear color to 0.0007" thickness organic coating to color selected.
   C. Apply one coat of bituminous paint to concealed aluminum surfaces in contact with cementitious or dissimilar materials.

PART 3 EXECUTION
3.1 EXAMINATION
   A. Verify that field conditions are acceptable and are ready to receive work.

3.2 PREPARATION
   A. Clean and strip primed steel items to bare metal and aluminum where site welding is required.
   B. Supply required items for casting into concrete or embedded in masonry with setting templates to appropriate sections.

3.3 INSTALLATION
   A. Install items plumb and level, accurately fitted, free from distortion or defects.
   B. Provide for erection loads and for sufficient temporary bracing to maintain true alignment until completion of erection and installation of permanent attachments.
   C. Field weld components indicated on shop drawings.
   D. Perform field welding in accordance with AWS D1.1.
   E. Obtain approval prior to site cutting or making adjustments not scheduled.
   F. After erection, prime welds, abrasions and surfaces not shop primed or galvanized, except surfaces to be in contact with concrete.
   G. Provide isolation coatings where dissimilar metals are in contact or where aluminum is in contact with concrete.

3.4 ERECTION TOLERANCES
   A. Maximum Variation from Plumb: ¼" per story, non-cumulative
   B. Maximum Offset from True Alignment: ¼"
   C. Maximum Out-of-Position: ¼"

END OF SECTION
PART 1 GENERAL

1.1 SECTION INCLUDES
A. Steel stair frame of structural sections with closed risers.
B. Steel pan to receive concrete-fill stair treads and landings.
C. Integral balusters and aluminum hand railing.
D. Aluminum hand railing on walls.

1.2 REFERENCES
B. ASCE 7 - American Society of Civil Engineers, Minimum Design Loads of Buildings and Other Structures
C. ASTM A36/A36M - Standard Specification for Carbon Structural Steel
D. ASTM A53/A53M - Standard Specification for Pipe, Black, and Hot-Dipped, Zinc-coated Welded and Seamless
F. ASTM A153/A153M - Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware
G. ASTM A283/A283M - Standard Specification for Low and Intermediate Tensile Strength Carbon Steel Plates
H. ASTM A307 - Standard Specification for Carbon Steel Bolts and Studs, 60 000 PSI Tensile Strength
I. ASTM A325 - Standard Specification for Structural Bolts, Steel, Heat Treated, 120/105 ksi Minimum Tensile Strength
J. ASTM A500/A500M - Standard Specification for Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes
K. ASTM A501 - Standard Specification for Hot-Formed Welded and Seamless Carbon Steel Structural Tubing
L. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process
M. ASTM A1011/A1011M - Standard Specification for Steel, Sheet and Strip, Hot-Rolled, Carbon, Structural, High-Strength Low-Alloy and High-Strength Low-Alloy with Improved Formability, and Ultra High Strength
O. ASTM E985 - Standard Specification for Permanent Metal Railing Systems and Rails for Buildings
P. AWS A2.4 - Standard Symbols Welding, Brazing, Nondestructive Examination
Q. AWS D1.1/D1.1M - Structural Welding Code Steel Bundled Set B
R. NAAMM AMP 510 - Metal Stairs Manual
S. NAAMM MBG 531 - Metal Bar Grating Manual
T. SSPC (Steel Structures Painting Council) - Steel Structures Painting Manual

1.3 DESIGN REQUIREMENTS
A. Florida Building Code (FBC)
B. Design stair assembly in accordance with ASCE 7

1.4 SUBMITTALS FOR REVIEW
A. Section 01 33 00 - Submittals Procedures
B. Shop Drawings: Indicate profiles, sizes, connection attachments, reinforcing, anchorage, size, and type of fasteners, and accessories.
C. Indicate welded connections using standard AWS A2.4 welding symbols show net weld lengths.

1.5 QUALITY ASSURANCE
A. Prepare work in accordance with ASTM E985.
B. Prepare and submit signed & sealed Shop Drawings under direct supervision of a Professional Structural Engineer experienced in design of this work and licensed in the State of Florida.
C. Welders' Certificates: Submit under provisions of Section 01 33 00, certifying welders employed on the Work, verifying AWS qualification within the previous 12-months.

PART 2 PRODUCTS

2.1 MATERIALS
A. Steel Sections: ASTM A36/A36M
B. Steel Tubing: ASTM A500/A500M, Grade B
C. Plates: ASTM A283/A283M
D. Pipe: ASTM A53/A53M, Grade B Schedule 40
E. Sheet Steel: ASTM A653/A653M, Grade B Structural Quality with G90, 0.90 oz/sq ft galvanized coating
F. Bolts, Nuts, and Washers: ASTM A325 or A307 galvanized to ASTM A153/A153M for galvanized components
G. Exposed Mechanical Fastenings: Flush countersunk screws or bolts; consistent with design of stair structure
H. Welding Materials: AWS D1.1/D1.1M; type required for welded materials
I. Shop and Touch-Up Primer: SSPC 15, Type 1, red oxide
J. Touch-Up Primer for Galvanized Surfaces: SSPC 20 Type-I Inorganic zinc rich

2.2 COMPONENTS
A. Gratings: ANSI A202.1
B. Concrete for Treads and Landings: Portland Cement Type I, 3000 psi 28 day strength, with a 2" to 3" slump

2.3 FABRICATION - GENERAL
A. Fit and shop assemble components in largest practical sections for delivery to site.
B. Fabricate components with joints tightly fitted and secured.
C. Continuously seal jointed pieces by continuous welds.
D. Grind exposed joints flush and smooth with adjacent finish surface.
   1. Make exposed joints butt tight, flush, and hairline.
   2. Ease exposed edges to small uniform radius.
E. Exposed Mechanical Fastenings shall be flush countersunk screws or bolts unobtrusively located consistent with design of component except as noted otherwise.
F. Supply components required for anchorage of fabrications of same material and finish as fabrication, except as noted otherwise.
G. Accurately form components required for anchorage of stairs, landings, and railings to each other and to building structure.
2.4 **FABRICATION - PAN STAIRS AND LANDINGS**
   A. Fabricate stairs and landings with closed risers and treads of metal pan construction, ready to receive concrete.
   B. Prime paint components.

2.5 **FABRICATION - UNIT STAIR TOWERS**
   A. Fabricate self-supporting steel stair towers with formed treads and risers; steel channel stringers; landing platforms; sectioned for transport; corner structural support members designed to support full weight of complete stair tower plus design live load; with aluminum railings, newel posts, and balusters.
   B. Fabricate stair towers to height not exceeding 40' for transportation purposes; designed for stacking to height of building as a self-supporting structure.

2.6 **FINISHES**
   A. Prepare surfaces to be primed in accordance with SSPC SP 2.
   B. Clean surfaces of rust, scale, grease, and foreign matter prior to finishing.
   C. Do not prime surfaces where field welding is required.
   D. Prime paint items with one coat.
   E. Galvanized items to minimum 1.25-oz/sq ft zinc coating in accordance with ASTM A123/A123M.

**PART 3 EXECUTION**

3.1 **EXAMINATION**
   A. Verify that field conditions are acceptable and are ready to receive work.

3.2 **PREPARATION**
   A. Clean and strip primed steel items to bare metal where site welding is required.
   B. Supply items required to be casted into concrete and embedded in masonry with setting templates.

3.3 **INSTALLATION**
   A. Install items plumb and level, accurately fitted, free from distortion or defects.
   B. Provide anchors, plates, angles, hangers, and struts required for connecting stairs to structure.
   C. Allow for erection loads and for sufficient temporary bracing to maintain true alignment until completion of erection and installation of permanent attachments.
   D. Field weld components as indicated on shop drawings in accordance with AWS D1.1/D1.1M.
      1. Grind welds smooth and flush.
   E. Field bolt and weld to match shop bolting and welding.
      1. Conceal bolts and screws whenever possible.
      2. Where not concealed, use flush countersunk fastenings.
   F. Mechanically fasten joints butted tight, flush, and hairline.
   G. Obtain approval prior to site cutting or making adjustments not scheduled.
   H. After erection, clean and remove any rust before priming any field welds, abrasions, and surfaces not shop primed or galvanized.

3.4 **ERECTION TOLERANCES**
   A. Maximum Variation From Plumb: ¼" per story, non-cumulative
   B. Maximum Offset From True Alignment: ¼"
   C. Completed installations shall meet FBC tolerance requirements for rise and run.

END OF SECTION
SECTION 05 52 00
METAL RAILINGS

PART 1  GENERAL
1.1 SECTION INCLUDES
A. Aluminum pipe handrails, balusters, and fittings

1.2 REFERENCES
A. ACSE 7 – Minimum Design Loads of Buildings and Other Structures
B. ASTM B210 - Standard Specification for Aluminum and Aluminum-Alloy Drawn Seamless Tubes
C. ASTM B211 - Standard Specification for Aluminum and Aluminum and Aluminum Alloy Rolled or Cold Finished Bars, Rods, and Wire
D. ASTM B221 - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes
E. ASTM B241/A241M - Standard Specification for Aluminum and Aluminum Alloy Seamless Pipe and Seamless Extruded Tube
F. ASTM B483 - Standard Specification for Aluminum and Aluminum and Aluminum Alloy Drawn Tubes for General Purpose Applications
I. FBC - Florida Building Code

1.3 DESIGN REQUIREMENTS
A. Railing assembly, wall rails, and attachments shall conform to the FBC.
B. Design stairs and handrails to conform to ASCE 7.

1.4 SUBMITTALS FOR REVIEW
A. Section 01 33 00 - Submittals Procedures
B. Shop Drawings: Indicate profiles, sizes, connection attachments, anchorage, size, and type of fasteners, and accessories.
C. Samples: Submit 1’ long samples of handrail. Submit samples of elbow, tee, wall bracket, escutcheon and end stop.
D. Certification: Submit written certification prepared, signed, and sealed by a Professional Engineer, registered to practice in the State of Florida verifying that the metal handrail system design meets indicated loading requirements and codes of authorities having jurisdiction.

PART 2   PRODUCTS
2.1 ALUMINUM RAILING SYSTEM
A. Rails and Posts: 1½" outside diameter, excluding tubing conforming to ASTM B211
B. Fittings: Elbows, T-shapes, wall brackets, escutcheons; cast aluminum
C. Mounting:
   1. Provide adjustable brackets and flanges, with aluminum inserts for casting in concrete with aluminum brackets for embedding in masonry.
   2. Prepare backing plate for mounting in wall.
D. Exposed Fasteners: Flush countersunk screws or bolts consistent with design of railing.
E. Splice Connectors: Concealed spigots; cast aluminum.
F. Exterior Aluminum Surfaces: Exterior anodized to clear color.
   1. May use an electrostatic painting system with prior approval by the District and the Architect, must provide minimum 3-year warranty.
G. Interior Aluminum Surfaces: Interior anodized to clear color.
   1. May use an electrostatic painting system with prior approval by the District and the Architect, must provide minimum 3-year warranty.

H. Apply one coat of bituminous paint to concealed aluminum surfaces in contact with cementitious or dissimilar materials.

2.2 FABRICATION
A. Fit and shop assemble components as large as practical for delivery to site.
B. Fabricate components with joints tightly fitted and secured.
   1. Provide spigots and sleeves to accommodate site assembly and installation.
C. Provide anchors, plates, and angles required for connecting railings to structure.
D. Exposed Mechanical Fastenings, install flush-countersunk screws or bolts that are unobtrusively located and are consistent with the design of component.
E. Supply components required for anchorage of fabrications.
   1. Fabricate anchors and related components of same material and finish as fabrication, except as noted otherwise.
F. Exterior Components:
   1. Continuously seal joined pieces by continuous welds.
   2. Drill condensate drainage holes at bottom of members at locations that will not encourage water intrusion.

G. Interior Components: Continuously seal joined pieces by continuous welds.
H. Grind exposed joints flush and smooth with adjacent finish surface.
   1. Make exposed joints butt tight, flush, and hairline.
   2. Ease exposed edges to small uniform radius.
I. Accurately form components to suit stairs and landings to each other and to building structure.
J. Accommodate for expansion and contraction of members and building movement without damage to connections or members.

2.3 FINISHES
A. Exterior Aluminum Surfaces: Exterior anodized to clear color.
B. Interior Aluminum Surfaces: Interior anodized to clear color.
C. Apply one coat of bituminous paint to concealed aluminum surfaces in contact with cementitious or dissimilar materials.

PART 3 EXECUTION
3.1 EXAMINATION
A. Verify that field conditions are acceptable and ready to receive work.

3.2 PREPARATION
A. Clean and strip aluminum where site welding is required.
B. Supply items being casted into concrete, embedded in masonry, or placed in partitions with setting templates to appropriate sections.

3.3 INSTALLATION
A. Install in accordance with manufacturer’s instructions.
B. Install components plumb and level, accurately fitted, free from distortion or defects.
C. Anchor railings to structure with anchor plates and angles.
D. Field weld anchors as indicated on shop drawings grind welds smooth and touch-up with primer.
E. Conceal bolts and screws whenever possible, if cannot, use flush countersunk fastenings.
F. Assemble with spigots and sleeves to accommodate tight joints and secure installation.
G. Install floor mounted support posts plumb and secure in the concrete within a core-drilled hole.
filled with epoxy grout.

H. All fasteners into concrete shall be stainless steel.

3.4 ERECTION TOLERANCES

A. Maximum Variation From Plumb: ¼" per story, non-cumulative
B. Maximum Offset From True Alignment: ¼"
C. Maximum Out-of-Position: ¼"

END OF SECTION
SECTION 06 10 00
ROUGH CARPENTRY

PART 1  GENERAL

1.01  SECTION INCLUDES

A. Nonstructural dimension lumber framing.
B. Rough opening framing for doors, windows, and roof openings.
C. Sheathing.
D. Roof-mounted curbs.
E. Fire retardant treated wood materials.
F. Miscellaneous framing and sheathing.
G. Communications and electrical room mounting boards.
H. Concealed wood blocking, nailers, and supports.
I. Miscellaneous wood nailers, furring, and grounds.

1.02  RELATED REQUIREMENTS

A. Section 07 62 00 - Sheet Metal Flashing and Trim: Sill flashings.

1.03  REFERENCE STANDARDS

G. ASTM D3498 - Standard Specification for Adhesives for Field-Gluing Wood Structural Panels (Plywood or Oriented Strand Board) to Wood Based Floor System Framing 2019a.
L. PS 1 - Structural Plywood 2009 (Revised 2019).
N. SPIB (GR) - Grading Rules 2014.

1.04  DELIVERY, STORAGE, AND HANDLING

A. General: Cover wood products to protect against moisture. Support stacked products to prevent deformation and to allow environmental circulation.
B. Fire Retardant Treated Wood: Prevent exposure to precipitation during shipping, storage, and installation.

1.05  WARRANTY
A. See Section 01 78 00 - Closeout Submittals for additional warranty requirements.
B. Correct defective work within a two-year period commencing on Date of Substantial Completion.

PART 2 PRODUCTS

2.01 GENERAL REQUIREMENTS
A. Dimension Lumber: Comply with PS 20 and requirements of specified grading agencies.
   1. If no species is specified, provide species graded by the agency specified; if no grading agency is specified, provide lumber graded by grading agency meeting the specified requirements.
   2. Grading Agency: Grading agency whose rules are approved by the Board of Review, American Lumber Standard Committee at www.alsc.org; grade lumber stamped with grade mark unless otherwise indicated.
   3. Lumber of other species or grades is acceptable provided structural and appearance characteristics are equivalent to or better than products specified.

2.02 DIMENSION LUMBER FOR CONCEALED APPLICATIONS
A. Grading Agency: Southern Pine Inspection Bureau, Inc; SPIB (GR).
B. Sizes: Nominal sizes as indicated on drawings, S4S.
C. Moisture Content: S-dry or MC19.
D. Miscellaneous Framing, Blocking, Nailers, Grounds, and Furring:
   1. Lumber: S4S, No. 2 or Standard Grade.
   2. Boards: Standard or No. 3.

2.03 CONSTRUCTION PANELS
   1. Mold Resistance: Score of 10, when tested in accordance with ASTM D3273.
   2. Edges: Square.
B. Communications and Electrical Room Mounting Boards: PS 1 A-D plywood, or medium density fiberboard; 3/4 inch thick; flame spread index of 25 or less, smoke developed index of 450 or less, when tested in accordance with ASTM E84.
C. Other Applications:
   1. Plywood Concealed From View But Located Within Exterior Enclosure: PS 1, C-C Plugged or better, Exterior grade.
   2. Plywood Exposed to View But Not Exposed to Weather: PS 1, A-D, or better.
   3. Other Locations: PS 1, C-D Plugged or better.

2.04 ACCESSORIES
A. Fasteners and Anchors:
   2. Drywall Screws: Bugle head, hardened steel, power driven type, length three times thickness of sheathing.
B. Die-Stamped Connectors: Hot dipped galvanized steel, sized to suit framing conditions.
   1. For contact with preservative treated wood in exposed locations, provide minimum G185 galvanizing complying with ASTM A653/A653M.
C. Sill Gasket on Top of Foundation Wall: 1/4 inch thick, plate width, closed cell plastic foam from continuous rolls.
D. Sill Flashing: As specified in Section 07 62 00.
E. Construction Adhesives: Adhesives complying with ASTM C557 or ASTM D3498.
2.05 FACTORY WOOD TREATMENT

A. Treated Lumber and Plywood: Comply with requirements of AWPA U1 - Use Category System for wood treatments determined by use categories, expected service conditions, and specific applications.
   1. Fire-Retardant Treated Wood: Mark each piece of wood with producer's stamp indicating compliance with specified requirements.
   2. Preservative-Treated Wood: Provide lumber and plywood marked or stamped by an ALSC-accredited testing agency, certifying level and type of treatment in accordance with AWPA standards.

B. Fire Retardant Treatment:
   1. Exterior Type: AWPA U1, Category UCFB, Commodity Specification H, chemically treated and pressure impregnated; capable of providing a maximum flame spread index of 25 when tested in accordance with ASTM E84, with no evidence of significant combustion when test is extended for an additional 20 minutes both before and after accelerated weathering test performed in accordance with ASTM D2898.
      a. Kiln dry wood after treatment to a maximum moisture content of 19 percent for lumber and 15 percent for plywood.
      b. Treat exterior rough carpentry items.
      c. Do not use treated wood in direct contact with the ground.
   2. Interior Type A: AWPA U1, Use Category UCFA, Commodity Specification H, low temperature (low hygroscopic) type, chemically treated and pressure impregnated; capable of providing a maximum flame spread index of 25 when tested in accordance with ASTM E84, with no evidence of significant combustion when test is extended for an additional 20 minutes.
      a. Kiln dry wood after treatment to a maximum moisture content of 19 percent for lumber and 15 percent for plywood.
      b. Interior rough carpentry items are to be fire retardent treated.
      c. Treat rough carpentry items as indicated.
      d. Do not use treated wood in applications exposed to weather or where the wood may become wet.

PART 3 EXECUTION

3.01 PREPARATION

A. Where wood framing bears on cementitious foundations, install full width sill flashing continuous over top of foundation, lap ends of flashing minimum of 4 inches and seal.
B. Install sill gasket under sill plate of framed walls bearing on foundations; puncture gasket cleanly to fit tightly around protruding anchor bolts.
C. Coordinate installation of rough carpentry members specified in other sections.

3.02 INSTALLATION - GENERAL

A. Select material sizes to minimize waste.
B. Reuse scrap to the greatest extent possible; clearly separate scrap for use on site as accessory components, including: shims, bracing, and blocking.
C. Where treated wood is used on interior, provide temporary ventilation during and immediately after installation sufficient to remove indoor air contaminants.

3.03 FRAMING INSTALLATION

A. Set structural members level, plumb, and true to line. Discard pieces with defects that would lower required strength or result in unacceptable appearance of exposed members.
B. Make provisions for temporary construction loads, and provide temporary bracing sufficient to maintain structure in true alignment and safe condition until completion of erection and installation of permanent bracing.
C. Install structural members full length without splices unless otherwise specifically detailed.
D. Comply with member sizes, spacing, and configurations indicated, and fastener size and spacing indicated, but not less than required by applicable codes and AWC (WFCM) Wood Frame Construction Manual.

E. Frame wall openings with two or more studs at each jamb; support headers on cripple studs.

### 3.04 BLOCKING, NAILERS, AND SUPPORTS

A. Provide framing and blocking members as indicated or as required to support finishes, fixtures, specialty items, and trim.

B. In framed assemblies that have concealed spaces, provide solid wood fireblocking as required by applicable local code, to close concealed draft openings between floors and between top story and roof/attic space; other material acceptable to code authorities may be used in lieu of solid wood blocking.

C. In metal stud walls, provide continuous blocking around door and window openings for anchorage of frames, securely attached to stud framing.

D. In walls, provide blocking attached to studs as backing and support for wall-mounted items, unless item can be securely fastened to two or more studs or other method of support is explicitly indicated.

E. Where ceiling-mounting is indicated, provide blocking and supplementary supports above ceiling, unless other method of support is explicitly indicated.

F. Provide the following specific nonstructural framing and blocking:
   1. Cabinets and shelf supports.
   2. Wall brackets.
   3. Handrails.
   4. Grab bars.
   5. Towel and bath accessories.
   6. Wall-mounted door stops.
   7. Chalkboards and marker boards.
   8. Wall paneling and trim.
   9. Joints of rigid wall coverings that occur between studs.

### 3.05 ROOF-RELATED CARPENTRY

A. Coordinate installation of roofing carpentry with deck construction, framing of roof openings, and roofing assembly installation.

B. Provide wood curb at all roof openings except where prefabricated curbs are specified and where specifically indicated otherwise. Form corners by alternating lapping side members.

### 3.06 INSTALLATION OF CONSTRUCTION PANELS

A. Wall Sheathing: Secure with long dimension perpendicular to wall studs, with ends over firm bearing and staggered, using nails, screws, or staples.
   1. Use plywood or other acceptable structural panels at building corners, for not less than 96 inches, measured horizontally.
   2. Provide inlet diagonal bracing at corners.
   3. Place water-resistive barrier horizontally over wall sheathing, weather lapping edges and ends.

B. Communications and Electrical Room Mounting Boards: Secure with screws to studs with edges over firm bearing; space fasteners at maximum 24 inches on center on all edges and into studs in field of board.
   1. At fire-rated walls, install board over wall board indicated as part of the fire-rated assembly.
   2. Where boards are indicated as full floor-to-ceiling height, install with long edge of board parallel to studs.
   3. Install adjacent boards without gaps.
   4. Size: 48 by 96 inches, installed horizontally at ceiling height.
3.07 TOLERANCES
A. Framing Members: 1/4 inch from true position, maximum.
B. Variation from Plane, Other than Floors: 1/4 inch in 10 feet maximum, and 1/4 inch in 30 feet maximum.

3.08 CLEANING
   1. Comply with applicable regulations.
   2. Do not burn scrap on project site.
   3. Do not burn scraps that have been pressure treated.
   4. Do not send materials treated with pentachlorophenol, CCA, or ACA to co-generation facilities or “waste-to-energy” facilities.
B. Do not leave wood, shavings, sawdust, etc. on the ground or buried in fill.
C. Prevent sawdust and wood shavings from entering the storm drainage system.

END OF SECTION 06 10 00
SECTION 07 05 53
FIRE AND SMOKE ASSEMBLY IDENTIFICATION

PART 1  GENERAL

1.01 RELATED REQUIREMENTS
   A. Section 09 91 23 - Interior Painting: Paint finish.

1.02 PRICE AND PAYMENT PROCEDURES
   A. See Section 01 21 00 - Allowances, for cash allowances affecting this section.
   B. Allowance amount covers purchase, delivery, and installation.

1.03 REFERENCE STANDARDS
   A. ICC (IBC) - International Building Code Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

1.04 SUBMITTALS
   A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.
   B. Product Data: Manufacturer's printed product literature for each type of marking, indicating font, foreground and background colors, wording, and overall dimensions.
   C. Schedule: Completely define scope of proposed marking, and indicate location of affected walls and partitions, and number of markings.
   D. Samples: Submit two samples of each type of marking proposed for use, of size similar to that required for project, illustrating font, wording, and method of application.

1.05 QUALITY ASSURANCE
   A. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum three years of documented experience.

1.06 FIELD CONDITIONS
   A. Do not install adhered markings when ambient temperature is lower than recommended by label or sign manufacturer.
   B. Do not install painted markings when ambient temperature is lower than recommended by coating manufacturer.

PART 2  PRODUCTS

2.01 FIRE AND SMOKE ASSEMBLY IDENTIFICATION

PART 3  EXECUTION

3.01 INSTALLATION
   A. Locate markings as required by ICC (IBC).
   B. Install neatly, with horizontal edges level.
   C. Protect from damage until Date of Substantial Completion; repair or replace damaged markings.

END OF SECTION 07 05 53
SECTION 07 13 26
UNDER-SLAB VAPOR BARRIER

PART 1 – GENERAL
1.01 SUMMARY
   A. Products supplied under this section:
      1. Vapor barrier and installation accessories for installation under concrete slabs.
   B. Related sections:
      1. Section 03 30 00 Cast-in-Place Concrete
      2. Section 07 26 00 Vapor Retarders

1.02 REFERENCES
   A. ASTM International:
      1. ASTM E1745-17 Standard Specification for Plastic Water Vapor Retarders Used in Contact with Soil or Granular Fill Under Concrete Slabs.
      2. ASTM E1643-18a Selection, Design, Installation, and Inspection of Water Vapor Retarders Used in Contact with Earth or Granular Fill Under Concrete Slabs.
   B. Technical Reference - American Concrete Institute (ACI):
      1. ACI 302.2R-06 Guide for Concrete Slabs that Receive Moisture-Sensitive Flooring Materials.
      2. ACI 302.1R-15 Guide to Concrete Floor and Slab Construction.

1.03 SUBMITTALS
   A. Quality control/assurance:
      1. Summary of test results per paragraph 9.3 of ASTM E1745.
      2. Manufacturer’s samples and literature.
      3. Manufacturer’s installation instructions for placement, seaming, penetration prevention and repair, and perimeter seal per ASTM E1643.
      4. All mandatory ASTM E1745 testing must be performed on a single production roll per ASTM E1745 Section 8.1.

PART 2 – PRODUCTS
2.01 MATERIALS
   A. Vapor barrier shall have all of the following qualities:
      1. Maintain permeance of less than 0.01 Perms as tested in accordance with mandatory conditioning tests per ASTM E1745 Section 7.1 (7.1.1-7.1.5).
      2. Other performance criteria:
         a. Strength: ASTM E1745 Class A.
         b. Thickness: 15 mils minimum
         c. Provide third party documentation that all testing was performed on a single production roll per ASTM E1745 Section 8.1
   3. Vapor barrier products:
      a. Poly-America: Husky Yellowguard (15 mil)
      b. Stego Industries LLC.: Stego Wrap Vapor Barrier (15-mil)
      c. Tex-Trude LP: Xtreme Vapor Barrier (15-mil)
      d. W.R. Meadows, Inc.: Perminator (15-mil)

2.02 ACCESSORIES
   A. Seams:
      1. Seam tape as recommended by membrane manufacturer.
   B. Sealing Penetrations of Vapor barrier:
      1. Mastic as recommended by membrane manufacturer.
      2. Tape as recommended by membrane manufacturer.

PART 3 – EXECUTION
3.01 PREPARATION
   A. Ensure that subsoil is approved by Geotechnical Engineer.
      1. Level and compact base material.

3.02 INSTALLATION
   A. Install vapor barrier in accordance ASTM E1643.
      1. Unroll vapor barrier with the longest dimension parallel with the direction of the concrete
         placement and face laps away from the expected direction of the placement whenever
         possible.
      2. Extend vapor barrier to the perimeter of the slab. If practicable, terminate it at the top of
         the slab, otherwise (a) at a point acceptable to the structural engineer or (b) where
         obstructed by impediments, such as dowels, waterstops, or any other site condition
         requiring early termination of the vapor barrier. At the point of termination, seal vapor
         barrier to the foundation wall, grade beam or slab itself.
            a. Seal vapor barrier to the entire slab perimeter per manufacturer's instructions.
      3. Overlap joints 6 inches and seal with manufacturer's seam tape.
      4. Apply seam tape/Crete Claw to a clean and dry vapor barrier.
      5. Seal all penetrations (including pipes) per manufacturer's instructions.
      6. For interior forming applications, avoid the use of non-permanent stakes driven through
         vapor barrier.
      7. If non-permanent stakes must be driven through vapor retarder, repair as recommended
         by vapor retarder manufacturer.
      8. Use reinforcing bar supports with base sections that eliminate or minimize the potential for
         puncture of the vapor barrier.
      9. Repair damaged areas with vapor barrier material of similar (or better) permeance,
         puncture and tensile.
     10. For vapor barrier-safe concrete screeding applications, install vapor barrier-safe screed
         system per manufacturer's instructions prior to placing concrete.

END OF SECTION  07 13 26
SECTION 07 21 00
THERMAL INSULATION

PART 1 GENERAL

1.01 SECTION INCLUDES
A. Board insulation and integral vapor retarder at perimeter foundation wall, underside of floor slabs, over roof deck, and exterior wall behind furring and gyp. board wall finish.
B. Batt insulation and vapor retarder in exterior wall, ceiling, and roof construction.
C. Batt insulation for filling perimeter window and door shim spaces and crevices in exterior wall and roof.

1.02 REFERENCE STANDARDS

1.03 SUBMITTALS
A. See Section 01 30 00 - Administrative Requirements for submittal procedures.
B. Product Data: Provide data on product characteristics, performance criteria, and product limitations.
C. ABAA Field Quality Control Submittals: Submit third-party reports of testing and inspection required by ABAA QAP.
D. Manufacturer's Installation Instructions: Include information on special environmental conditions required for installation and installation techniques.
E. ABAA Manufacturer Qualification: Submit documentation of current evaluation of proposed manufacturer and materials.
F. ABAA Installer Qualification: Submit documentation of current contractor accreditation and current installer certification. Keep copies of contractor accreditation and installer certification on project site during and after installation. Present on-site documentation upon request.

1.04 QUALITY ASSURANCE
A. Air Barrier Association of America (ABAA) Quality Assurance Program (QAP); www.airbarrier.org/#sle:
   1. Installer Qualification: Use accredited contractors, certified installers, evaluated materials, and third-party field quality control audit.
   2. Manufacturer Qualification: Use evaluated materials from a single manufacturer regularly engaged in air barrier material manufacture. Use secondary materials approved in writing by primary material manufacturer.

1.05 FIELD CONDITIONS
A. Do not install insulation adhesives when temperature or weather conditions are detrimental to successful installation.

PART 2 PRODUCTS
2.01 APPLICATIONS
A. Insulation Under Concrete Slabs: Extruded polystyrene (XPS) board.
B. Insulation at Perimeter of Foundation: Extruded polystyrene (XPS) board.
C. Insulation on Inside of Concrete and Masonry Exterior Walls: Polyisocyanurate board.
D. Insulation in Metal Framed Walls: Batt insulation with integral vapor retarder.
E. Insulation at Structural Connections: Rigid, high-strength polyurethane.

2.02 FOAM BOARD INSULATION MATERIALS
A. Expanded Polystyrene (EPS) Board Insulation: Complies with ASTM C578.
   1. Flame Spread Index (FSI): Class A - 0 to 25, when tested in accordance with ASTM E84.
   2. Smoke Developed Index (SDI): 450 or less, when tested in accordance with ASTM E84.
   3. Complies with fire resistance requirements indicated on drawings as part of an exterior non-load-bearing exterior wall assembly when tested in accordance with NFPA 285.
   6. Type and Compressive Resistance: Type I, 5 psi (35 kPa), minimum.
   7. Type and Water Absorption: Type I, 4.0 percent by volume, maximum, by total immersion.
   8. Type and Thermal Resistance, R-value: Type I, 3.1 (0.55), minimum, per 1 inch thickness at 75 degrees F mean temperature.
B. Extruded Polystyrene (XPS) Board Insulation: Complies with ASTM C578 with either natural skin or cut cell surfaces.
   1. Type and Compressive Resistance: Type IV, 25 psi (173 kPa), minimum.
   2. Flame Spread Index (FSI): Class A - 0 to 25, when tested in accordance with ASTM E84.
   3. Smoke Developed Index (SDI): 450 or less, when tested in accordance with ASTM E84.
   4. Type and Thermal Resistance, R-value: Type IV, 5.0 (0.88), minimum, per 1 inch thickness at 75 degrees F mean temperature.
   5. Complies with fire resistance requirements indicated on drawings as part of an exterior non-load-bearing exterior wall assembly when tested in accordance with NFPA 285.
   7. Type and Water Absorption: Type IV, 0.3 percent by volume, maximum, by total immersion.
C. Polyisocyanurate (ISO) Board Insulation: Rigid cellular foam, complying with ASTM C1289.
   1. Classifications:
      a. Type I: Faced with aluminum foil on both major surfaces of the core foam.
         1) Class 1 - Non-reinforced core foam.
         2) Compressive Strength: 16 psi, minimum.
         3) Thermal Resistance, R-value: At 1-1/2 inch thick; 9.0, minimum, at 75 degrees F.
   2. Flame Spread Index (FSI): Class A - 0 to 25, when tested in accordance with ASTM E84.
   3. Smoke Developed Index (SDI): 450 or less, when tested in accordance with ASTM E84.
   4. Water Vapor Permeance: 1.2 perm, maximum, at 1 inch thickness, and when tested in accordance with ASTM E96/E96M, desiccant method.
   5. Complies with fire resistance requirements indicated on drawings as part of an exterior non-load-bearing exterior wall assembly when tested in accordance with NFPA 285.
   7. Board Thickness: 1.5 inch.

2.03 BATT INSULATION MATERIALS
A. Glass Fiber Batt Insulation: Flexible preformed batt or blanket, complying with ASTM C665; friction fit.
1. Combustibility: Non-combustible, when tested in accordance with ASTM E136, except for facing, if any.
2. Formaldehyde Content: Zero.

B. Mineral Fiber Batt Insulation: Flexible or semi-rigid preformed batt or blanket, complying with ASTM C665; friction fit, unfaced flame spread index of 0 (zero) when tested in accordance with ASTM E84.
   1. Flame Spread Index: 25 or less, when tested in accordance with ASTM E84.
   2. Smoke Developed Index: 0 (zero), when tested in accordance with ASTM E84.

2.04 ACCESSORIES
A. Sheet Vapor Retarder: Black polyethylene film for above grade application, 10 mil, 0.010 inch thick.
B. Tape: Reinforced polyethylene film with acrylic pressure sensitive adhesive.
   1. Application: Sealing of interior circular penetrations, such as pipes or cables.
   2. Width: As required for application.
C. Flashing Tape: Special reinforced film with high performance adhesive.
   2. Width: As required for application.
D. Tape: Bright aluminum self-adhering type, mesh reinforced, 2 inch wide.
E. Tape joints of rigid insulation in accordance with roofing and insulation manufacturers’ instructions.
F. Insulation Fasteners: Lengths of unfinished, 13 gauge, 0.072 inch high carbon spring steel with chisel or mitered tips, held in place by tension, length to suit insulation thickness and substrate, capable of securely supporting insulation in place.
G. Adhesive: Type recommended by insulation manufacturer for application.

PART 3 EXECUTION
3.01 EXAMINATION
A. Verify that substrate, adjacent materials, and insulation materials are dry and that substrates are ready to receive insulation.
B. Verify substrate surfaces are flat, free of honeycomb, fins, irregularities, or materials or substances that may impede adhesive bond.

3.02 BOARD INSTALLATION AT FOUNDATION PERIMETER
A. Adhere a 6 inches wide strip of polyethylene sheet over construction, control, and expansion joints with double beads of adhesive each side of joint.
   1. Tape seal joints.
   2. Extend sheet full height of joint.
B. Apply adhesive to back of boards:
   1. Three continuous beads per board length.
   2. Full bed 1/8 inch thick.
C. Install boards horizontally on foundation perimeter.
   1. Place boards to maximize adhesive contact.
   2. Install in running bond pattern.
   3. Butt edges and ends tightly to adjacent boards and to protrusions.
D. Extend boards over expansion joints, unbonded to foundation on one side of joint.
E. Cut and fit insulation tightly to protrusions or interruptions to the insulation plane.
F. Immediately following application of board insulation, place protective boards over exposed insulation surfaces.
   1. Apply adhesive in five continuous beads per board length.
   2. Install boards horizontally from base of foundation to top of insulation.
   3. Butt boards tightly, with joints staggered from insulation joints.
3.03 BOARD INSTALLATION AT EXTERIOR WALLS
A. Adhere 6 inches wide strip of polyethylene sheet over expansion joints with double beads of adhesive each side of joint.
   1. Tape seal joints between sheets.
   2. Extend sheet full height of joint.
B. Apply adhesive to back of boards:
   1. Three continuous beads per board length.
   2. Full bed 1/8 inch thick.
C. Install boards horizontally on walls.
   1. Place boards to maximize adhesive contact.
   2. Install in running bond pattern.
   3. Butt edges and ends tightly to adjacent boards and protrusions.
D. Extend boards over expansion joints, unbonded to wall on one side of joint.
E. Cut and fit insulation tightly to protrusions or interruptions to the insulation plane.
F. Place 6 inches wide polyethylene sheet at perimeter of wall openings, from adhesive vapor retarder bed to window and door frames, and tape seal in place to ensure continuity of vapor retarder and air seal.
G. Tape insulation board joints.

3.04 BOARD INSTALLATION UNDER CONCRETE SLABS
A. Place insulation under slabs on grade after base for slab has been compacted.
B. Cut and fit insulation tightly to protrusions or interruptions to the insulation plane.
C. Prevent insulation from being displaced or damaged while placing vapor retarder and placing slab.

3.05 BOARD INSTALLATION OVER LOW SLOPE ROOF DECK
A. Installation of board insulation over low slope roof deck, see Section [______].
B. Board Installation Over Roof Deck, General:
   1. See applicable roofing specification section for specific board installation requirements.
   2. Ensure vapor retarder is clean and dry, continuous, and ready for application of roofing system.
   3. Fasten insulation to deck in accordance with roofing manufacturer's written instructions and applicable Factory Mutual requirements.
   4. Do not apply more insulation than can be covered with roofing on the same day.

3.06 BATT INSTALLATION
A. Install insulation in accordance with manufacturer's instructions.
B. Install in exterior wall and roof spaces without gaps or voids. Do not compress insulation.
C. Trim insulation neatly to fit spaces. Insulate miscellaneous gaps and voids.
D. Fit insulation tightly in cavities and tightly to exterior side of mechanical and electrical services within the plane of the insulation.

3.07 FIELD QUALITY CONTROL
A. See Section 01 40 00 - Quality Requirements for additional requirements.
B. Coordination of Air Barrier Association of America (ABAA) Tests and Inspections:
   1. Provide testing and inspection required by ABAA Quality Assurance Program (QAP).
   2. Notify ABAA in writing of schedule for air barrier work, and allow adequate time for testing and inspection.
   3. Cooperate with ABAA testing agency.
   4. Allow access to air barrier work areas and staging.
   5. Do not cover air barrier work until tested, inspected, and accepted.
3.08 PROTECTION
   A. Do not permit installed insulation to be damaged prior to its concealment.

END OF SECTION  07 21 00
PART 1 GENERAL

1.1 SECTION INCLUDES

A. Hot Applied 2-Ply Asphalt Roofing (StressPly). (2.9) (3.5)
B. Accessories. (2.19)
C. Edge Treatment and Roof Penetration Flashings. (2.20)(3.9)

1.2 RELATED SECTIONS

A. Section 06100 - Rough Carpentry.
B. Section 06114 - Wood Blocking and Curbing: Wood nailers and cant strips.
C. Section 07620 - Sheet Metal Flashing and Trim: Weather protection for base flashings.
D. Section 07710 - Manufactured Roof Specialties: Counter flashing gravel stops, and fascia.
E. Section 07724 - Roof Hatches: Frame and integral curb; Counter flashing.
F. Section 08950 - Translucent Wall and Roof Assemblies: Counter flashing
G. Section 08960 - Sloped Glazing Assemblies: Counter flashing.
H. Section 15120 - Piping Specialties: Roof Drains, Sumps.

1.3 REFERENCES

A. ASTM D 41 - Standard Specification for Asphalt Primer Used in Roofing, Dampproofing, and Waterproofing.
B. ASTM D 312 - Standard Specification for Asphalt used in Roofing.


N. ASTM E 108 - Standard Test Methods for Fire Test of Roof Coverings

O. Factory Mutual Research (FM): Roof Assembly Classifications.


U. ASCE 7, Minimum Design Loads for Buildings and Other Structures

V. UL - Fire Resistance Directory.

W. FM Approvals - Roof Coverings and/or RoofNav assembly database.

X. FBC - Florida Building Code.


1.4 DESIGN / PERFORMANCE REQUIREMENTS

A. Perform work in accordance with all federal, state and local codes.

B. Exterior Fire Test Exposure: Roof system shall achieve a UL, FM or WH Class rating for roof slopes indicated on the Drawings as follows:
   1. Factory Mutual Class A Rating.
   2. Underwriters Laboratory Class A Rating.
   3. Warnock Hersey Class A Rating.

C. Design Requirements:
   1. Uniform Wind Uplift Load Capacity
      a. Installed roof system shall withstand negative (uplift) design wind loading pressures complying with the following criteria.
         2) Importance Category:
            a) II.
         3) Wind Speed: 170mph
         4) Exposure Category:
a) C.

5) Roof Pitch: 0.25:12.

6) Roof Area Design Uplift Pressure:
   a) Zone 1 – 66 psf
   b) Zone 2 – 86 psf
   c) Zone 3 - 118

2. Live Load: 20 psf, or not to exceed original building design.

3. Dead Load:
   a. Installation of new roofing materials shall not exceed the dead load capacity of
      the existing roof structure.

D. Energy Star: Roof System shall comply with the initial and aged reflectivity required by the

E. Roof System membranes containing recycled or bio-based materials shall be third party
   certified through UL Environment.

F. Roof system shall have been tested in compliance with the following codes and test
   requirements:
   1. Miami-Dade County:
      a. Torch and Mop Membrane Systems Over
         1) Lightweight Concrete Decks N.O.A.
            a) 21-1004.05
            1) PG#47-48
            a) System #2
      b. Roofing Underlayments
         1) Garland Underlayments N.O.A.
      c. Roofing Cements and Coatings
         1) Garland Coatings and Mastics N.O.A.
   2. Underwriters Laboratories:
      a. Certification TGFU.R________
   3. Warnock Hersey
      a. ITS Directory of Listed Products
   4. FM Approvals:
      a. RoofNav Website

1.5 SUBMITTALS

A. Provide the following to the Owner at the time of bid submittal:
   1. Written certification from the roofing system manufacturer corporate officer
      certifying that the applicator is currently approved for installation of the specified
      roofing system.
   2. Descriptive product data including MSD sheets.
   3. Certification of Class A roof system.
   4. Sample copy of contractor’s workmanship warranty.
   5. Sample copy of specified Manufacturer’s warranty.
   6. Sample copy of Manufacturer’s Architectural indemnification Agreement.

B. Product Data: Submit brochures containing material samples, SDS, schedules, charts,
   literature, and illustrations to indicate the performance, fabrication procedures, product
   variations, and accessories.
   1. Within four (4) weeks of award of contract, submit:
      a. Minimum of two (2) samples of each sheet material and descriptive literature.
      b. Manufacturer’s specifications and other independent test data according to
         ASTM designation D-5147-91 "Standard Test Methods for Sampling and
         Testing Modified Bituminous Sheet Material" needed to prove compliance with
         specified requirements.
c. All other data and information to satisfy requirements of manufacturer on warranty needs.
d. A written statement from the roofing materials manufacturers corporate officer approving the installer and stating the intent to guarantee the completed project as specified.
e. Samples of proposed warranty complete with any addenda necessary to meet the warranty requirements as specified.
f. Certified copy of ISO 9001 compliance.

C. Shop Drawings: Submit shop drawings including installation details of roofing, flashing, fastening, including notation of roof slopes and fastening patterns of base modified bitumen membrane. Indicate size and materials. Show locations and installation procedures. Submit one electronic original prior to the job start and retain approved copies at the site.

D. Materials: Modified Bitumen Manufacturer must also manufacturer all edge metal and standing seam radius panels. Private labeling of material will not be permitted.

E. Design Pressure Calculations: Submit design pressure calculations for the roof area in accordance with ASCE 7-98 and local Building Code requirements. Include a roof system attachment analysis report, certifying the system's compliance with applicable wind load requirements before Work begins. Report shall be signed and sealed by a Professional Engineer registered in the State of Florida who has provided roof system attachment analysis for not less than 5 consecutive years.

F. Maintenance Procedures: Upon substantial completion of the project, deliver to Owner three (3) copies of manufacturers printed instructions regarding care and maintenance of the roof.

G. LEED Submittals: Provide documentation of how the requirements of Credit will be met:
1. List of proposed materials with recycled content. Indicate post-consumer recycled content and pre-consumer recycled content for each product having recycled content.
2. Product data and certification letter indicating percentages by weight of post-consumer and pre-consumer recycled content for products having recycled content.
3. Product reflectivity and emissivity criteria to qualify for one point under the LEED credit category, Credit 7.2, Landscape & Exterior Design to Reduce Heat Island - Roof.

H. Recycled or Bio-Based Materials: Provide third party certification through UL Environment of roof System membranes containing recycled or bio based materials

I. Verification Samples: For each modified bituminous membrane ply product specified, two samples, minimum size 6 inches (150 mm) square, representing actual product, color, and patterns.

J. Manufacturer's Certificates: Provide to certify products meet or exceed specified requirements.

K. Test Reports: Submit test reports, prepared by an independent testing agency, for all modified bituminous sheet roofing, indicating compliance with ASTM D5147. Testing must be performed at 77 deg. F. Tests at 0 deg. F will not be considered.

L. Manufacturer's Fire Compliance Certificate: Certify that the roof system furnished is approved by Factory Mutual (FM), Underwriters Laboratories (UL), Warnock Hersey (WH) or approved third party testing facility in accordance with ASTM E108, Class A for external fire and meets local or nationally recognized building codes.

M. Closeout Submittals: Provide manufacturer's maintenance instructions that include
recommendations for periodic inspection and maintenance of all completed roofing work. Provide product warranty executed by the manufacturer. Assist Owner in preparation and submittal of roof installation acceptance certification as may be necessary in connection with fire and extended coverage insurance on roofing and associated work.

1.6 QUALITY ASSURANCE

A. Perform Work in accordance with NRCA Roofing and Waterproofing Manual.

B. Manufacturer Qualifications: Company specializing in manufacturing products specified with documented ISO 9001 certification and minimum of twelve years of documented experience and must not have been in Chapter 11 bankruptcy during the last five years.

C. Installer Qualifications: Company specializing in performing Work of this section with minimum five years documented experience and a certified Pre-Approved Garland Contractor.

D. Installer's Field Supervision: Maintain a full-time Supervisor/Foreman on job site during all phases of roofing work while roofing work is in progress.

E. Product Certification: Provide manufacturer's certification that materials are manufactured in the United States and conform to requirements specified herein, are chemically and physically compatible with each other, and are suitable for inclusion within the total roof system specified herein.

F. Source Limitations: Obtain all components of roof system from a single manufacturer. Secondary products that are required shall be recommended and approved in writing by the roofing system Manufacturer. Upon request of the Architect or Owner, submit Manufacturer's written approval of secondary components in list form, signed by an authorized agent of the Manufacturer.

1.7 PRE-INSTALLATION MEETINGS

A. Convene minimum two weeks prior to commencing Work of this section.

B. Review installation procedures and coordination required with related Work.

C. Inspect and make notes of job conditions prior to installation:
   1. Record minutes of the conference and provide copies to all parties present.
   2. Identify all outstanding issues in writing designating the responsible party for follow-up action and the timetable for completion.
   3. Installation of roofing system shall not begin until all outstanding issues are resolved to the satisfaction of the Architect.

1.8 DELIVERY, STORAGE, AND HANDLING

A. Deliver and store products in manufacturer’s unopened packaging with labels intact until ready for installation.

B. Store all roofing materials in a dry place, on pallets or raised platforms, out of direct exposure to the elements until time of application. Store materials at least 4 inches above ground level and covered with “breathable” tarpaulins.

C. Store in accordance with the instructions of the manufacturer prior to their application or installation. Store roll goods on end on a clean flat surface. No wet or damaged materials will be used in the application.

D. Store at room temperature wherever possible, until immediately prior to installing the roll.
During winter, store materials in a heated location with a 50 degree F (10 degree C) minimum temperature, removed only as needed for immediate use. Keep materials away from open flame or welding sparks.

E. Avoid stockpiling of materials on roofs without first obtaining acceptance from the Architect/Engineer.

F. Adhesive storage shall be between the range of above 50 degree F (10 degree C) and below 80 degree F (27 degree C). Area of storage shall be constructed for flammable storage.

1.9 COORDINATION

A. Coordinate Work with installing associated metal flashings as work of this section proceeds.

1.10 PROJECT CONDITIONS

A. Maintain environmental conditions (temperature, humidity, and ventilation) within limits recommended by manufacturer for optimum results. Do not install products under environmental conditions outside manufacturer's absolute limits.

1.11 WARRANTY

A. Upon completion of the work, provide the Manufacturer's written and signed Edge-To-Edge NDL System Warranty, warranting that, if a leak develops in the roof during the term of this warranty, due either to defective material or defective workmanship by the installer, the manufacturer shall provide the Owner, at the Manufacturer's expense, with the labor and material necessary to return the defective area to a watertight condition including Garland Metal Components.
   1. Warranty Period:
      a. 30 years from date of acceptance.

B. Installer is to guarantee all work against defects in materials and workmanship for a period indicated following final acceptance of the Work.
   1. Warranty Period:
      a. 5 years from date of acceptance.

PART 2 PRODUCTS

2.1 MANUFACTURERS


B. Requests for substitutions will be considered in accordance with provisions of Section 01600.

C. Any alternate or substitution submittal must meet or exceed all aspects of the performance criteria of the basis of design.

D. Manufacturer of the modified bitumen must also manufacturer the edge metal for sole source warranty purposes and compatibility.

E. The Products specified are intended and the Standard of Quality for the products required for this project. If other products are proposed the bidder must disclose in the bid the manufacturer and the products that they intend to use on the Project. If no manufacturer and products are listed, the bid may be accepted only with the use of products specified.
1. Bidder will not be allowed to change materials after the bid opening date.
2. If alternate products are included in the bid, the products must be equal to or exceed the products specified. Supporting technical data shall be submitted to the Architect/Owner for approval prior to acceptance.
3. In making a request for substitution, the Bidder/Roofing Contractor represents that it has:
   a. Personally investigated the proposed product or method, and determined that it is equal or superior in all respects to that specified.
   b. Will provide the same guarantee for substitution as for the product and method specified.
   c. Will coordinate installation of accepted substitution in work, making such changes as may be required for work to be completed in all respects.
   d. Will waive all claims for additional cost related to substitution, which consequently become apparent.
   e. Cost data is complete and includes all related cost under his/her contract or other contracts, which may be affected by the substitution.
   f. Will reimburse the Owner for all redesign cost by the Architect for accommodation of the substitution.
4. Architect/Owner reserves the right to be the final authority on the acceptance or rejection of any or all bids, proposed alternate roofing systems or materials that has met ALL specified requirement criteria.
5. Failure to submit substitution package, or any portion thereof requested, will result in immediate disqualification and consideration for that particular contractors request for manufacturer substitution.
6. Material substitution request must be submitted no later than 10 days prior to the bid submittal date for review.

2.2 HOT APPLIED 2-PLY ASPHALT ROOFING - STRESSPLY, OPTIMAX, OR VERSIPLY

A. Nailable Base Sheet: One ply fastened to the deck per wind uplift calculations.
   1. HPR Tri-Base Premium

B. Base (Ply) Sheet: One ply bonded to the prepared substrate with Interply Adhesive:
   1. StressBase 80:

C. Modified Cap (Ply) Sheet: One ply bonded to the prepared substrate with Interply Adhesive.
   1. StressPly E FR Mineral (Environmental):

D. Interply Adhesive: (1 and 2)
   1. HPR All-Temp Asphalt:

E. Flashing Base Ply: One ply bonded to the prepared substrate with Interply Adhesive: except torch sheet.
   1. StressBase 80:

F. Flashing Cap (Ply) Sheet: One ply bonded to the prepared substrate with Interply Adhesive: except torch sheet.
   1. StressPly E FR Mineral (Environmental):

G. Flashing Ply Adhesive:
   1. HPR All-Temp Asphalt:

2.3 ACCESSORIES:

A. Nails and Fasteners: Non-ferrous metal or galvanized steel, except that hard copper nails shall be used with copper; aluminum or stainless steel nails shall be used with aluminum;
and stainless steel nails shall be used with stainless steel, Fasteners shall be self-clinching type of penetrating type as recommended by the deck manufacturer. Fasten nails and fasteners flush-driven through flat metal discs not less than 1 inch (25 mm) diameter. Omit metal discs when one-piece composite nails or fasteners with heads not less than 1 inch (25 mm) diameter are used.

B. Walkway Pads - Commercial Innovations Walkway Pads: As recommended and furnished by the membrane manufacturer set in approved adhesive to control foot traffic on roof top surface and provide a durable system compliant non-slip walkway.

C. Sealant - Green-Lock Structural Adhesive: Single component, 100% solids structural adhesive as furnished and recommended by the membrane manufacturer.
1. Elongation, ASTM D 412: 300%
2. Hardness, Shore A, ASTM C 920: 50
3. Shear Strength, ASTM D 1002: 300 psi

D. Non-Shrink Grout GarRock: All weather fast setting chemical action concrete material to fill pitch pans.
1. Flexural Strength, ASTM C 78: (modified) 7 days 1100psi
2. High Strength, ASTM C 109: (modified) 24 days 8400lbs (3810kg)

E. Pitch Pocket Sealer - Seal-Tite: Two part, 100% solids, self-leveling, polyurethane sealant for filling pitch pans as recommended and furnished by the membrane manufacturer.
1. Durometer, ASTM D 2240: 40-50 Shore
2. Elongation, ASTM D 412: 250%
3. Tensile Strength, ASTM D 412: 200 @ 100 mil

F. Glass Fiber Cant - Glass Cant: Continuous triangular cross Section made of inorganic fibrous glass used as a cant strip as recommended and furnished by the membrane manufacturer.

2.4 EDGE TREATMENT AND ROOF PENETRATION FLASHINGS

A. Pre-Manufactured Coping Cap: R-Mer Edge Coping Cap Cover and Splice Plate.
1. Aluminum, ASTM B209, alloy 3105-H14, in thickness of .050" nom. or .063" nom

B. Pre-Manufactured Coping Cap: R-Mer Edge Coping Chairs
1. Zinc-coated steel, ASTM A653, coating designation G-90, in thickness of 0.0635 nom./ 16 gauge, 36" to 48" by coil length, chemically treated, commercial or lock-forming quality.

C. Pre-Manufactured Edge Metal Finishes:
1. Exposed and unexposed surfaces for mill finish flashing, fascia, and coping cap, as shipped from the mill
2. Exposed surfaces for coated panels:
   a. Steel Finishes: fluorocarbon finish. Epoxy primer baked both sides, .2-.25 mils thickness as approved by finish coat manufacturer. Weathering finish as referred by National Coil Coaters Association (NCCA). Provided with the following properties.
      2) Bend: ASTM D-4145, O-T / NCCA II-19
      3) Cross-Hatch Adhesion: ASTM D3359, no loss of adhesion
      4) Gloss (60 deg. angle): ASTM D523, 25+/-5%
      5) Reverse Bend: ASTM D2794, no cracking or loss of adhesion
      6) Nominal Thickness: ASTM D1005
         a) Primer: 0.2 mils
         b) Topcoat, 0.7 mils min
MODIFIED BITUMINOUS MEMBRANE ROOFING
07 52 00

c) Clear Coat (optional, only used with 22 ga. steel) 0.3 mils
7) Color: Provide as specified. (Subject to minimum quantities)

D. Vents and Breathers: Heavy gauge aluminum and fully insulated vent that allows moisture and air to escape but not enter the roof system as recommended and furnished by the membrane manufacturer.

E. Pitch pans, Rain Collar 24 gauge stainless or 20oz (567gram) copper. All joints should be welded/soldered watertight. See details for design.

F. Drain Flashings should be 4lb (1.8kg) sheet lead formed and rolled.

G. Plumbing stacks should be 4lb (1.8kg) sheet lead formed and rolled.

H. Liquid Flashing - Tuff-Flash: An asphaltic-polyurethane, low odor, liquid flashing material designed for specialized details unable to be waterproofed with typical modified membrane flashings.
   1. Tensile Strength, ASTM D 412: 400 psi
   2. Elongation, ASTM D 412: 300%
   3. Density @77 deg. F 8.5 lb/gal typical

I. Fabricated Flashings: Fabricated flashings and trim are specified in Section 07620.
   1. Fabricated flashings and trim shall conform to the detail requirements of SMACNA "Architectural Sheet Metal Manual" and/or the CDA Copper Development Association "Copper in Architecture - Handbook" as applicable.

J. Manufactured Roof Specialties: Shop fabricated copings, fascia, gravel stops, control joints, expansion joints, joint covers and related flashings and trim are specified in Section 07710.
   1. Manufactured roof specialties shall conform to the detail requirements of SMACNA "Architectural Sheet Metal Manual" and/or the NRCA "Roofing and Waterproofing Manual" as applicable.

PART 3 EXECUTION

3.1 EXAMINATION

A. Do not begin installation until substrates have been properly prepared.

B. Inspect and approve the deck condition, slopes and fastener backing if applicable, parapet walls, expansion joints, roof drains, stack vents, vent outlets, nailers and surfaces and elements.

C. Verify that work penetrating the roof deck, or which may otherwise affect the roofing, has been properly completed.

D. If substrate preparation and other conditions are the responsibility of another installer, notify Architect of unsatisfactory preparation before proceeding.

3.2 PREPARATION

A. General: Clean surfaces thoroughly prior to installation.
   1. Prepare surfaces using the methods recommended by the manufacturer for achieving the best result for the substrate under the project conditions.
   2. Fill substrate surface voids that are greater than 1/4 inch wide with an acceptable fill material.
   3. Roof surface to receive roofing system shall be smooth, clean, free from loose gravel, dirt and debris, dry and structurally sound.
   4. Wherever necessary, all surfaces to receive roofing materials shall be power broom
and vacuumed to remove debris and loose matter prior to starting work.
5. Do not apply roofing during inclement weather. Do not apply roofing membrane to damp, frozen, dirty, or dusty surfaces.
6. Fasteners and plates for fastening components mechanically to the substrate shall provide a minimum pull-out capacity of 300 lbs. (136 k) per fastener. Base or ply sheets attached with cap nails require a minimum pullout capacity of 40 lb. per nail.
7. Prime decks where required, in accordance with requirements and recommendations of the primer and deck manufacturer.

B. Lightweight Insulating Concrete Deck
1. Lightweight insulating concrete decks are required to have a minimum thickness of 2 inches (51 mm), a minimum compressive strength of 125 psi (0.86 MPa) and a minimum density of 22 pcf (352 kg/sm).
2. Install roof system immediately following deck curing to prevent damage from exposure to precipitation. The deck manufacturer determines the minimum curing time and maximum exposure limitations.
3. LWIC shall not be poured during rainy periods. Deck areas that have frozen before they have cured shall be removed and replaced. Decks which receive precipitation prior to installation of the roof membrane shall be checked for moisture content and dryness.
4. Lightweight insulating concrete decks are acceptable only on slopes up to 1 inch per foot (83 mm/m).

3.3 INSTALLATION - GENERAL
A. Install modified bitumen membranes and flashings in accordance with manufacturer’s instructions and with the recommendations provided by the National Roofing Contractors Association’s Roofing & Waterproofing Manual, the Asphalt Roofing Manufacturers Association, and applicable codes.

B. General: Avoid installation of modified bitumen membranes at temperatures lower than 40-45 degrees F. When work at such temperatures unavoidable use the following precautions:
1. Take extra care during cold weather installation and when ambient temperatures are affected by wind or humidity, to ensure adequate bonding is achieved between the surfaces to be joined. Use extra care at material seam welds and where adhesion of the applied product to the appropriately prepared substrate as the substrate can be affected by such temperature constraints as well.
2. Unrolling of cold materials, under low ambient conditions must be avoided to prevent the likelihood of unnecessary stress cracking. Rolls must be at least 40 degrees F at the time of application. If the membrane roll becomes stiff or difficult to install, it must be replaced with roll from a heated storage area.

C. Commence installation of the roofing system at the lowest point of the roof (or roof area), working up the slope toward the highest point. Lap sheets shingle fashion so as to constantly shed water.

3.4 INSTALLATION HOT APPLIED ROOF SYSTEM
A. Base/Felt Ply(s): Install base sheet or felt plies in twenty five (25) lbs (11.3kg) per square of bitumen shingled uniformly to achieve one or more plies over the entire prepared substrate. Shingle in direction of slope of roof to shed water on each area of roof. Do not step on base rolls until asphalt has cooled, fish mouths should be cut and patched.
1. Lap ply sheet ends 8 inches (203 mm). Stagger end laps 2 inches (304mm) minimum.
2. Install base flashing ply to all perimeter and projection details after membrane application.
3. Extend plies 2 inches beyond top edges of cants at wall and projection bases.
4. Install base flashing ply to all perimeter and projection details.
5. Allow the one ply of base sheet to cure at least 30 minutes before installing the modified membrane. However, the modified membrane must be installed the same day as the base plies.

B. Modified Cap Ply(s): Solidly bond the modified membrane to the base layers with specified material at the rate of 25 to thirty 30 lbs. (11-13kg) per 100 square feet.
   1. Roll must push a puddle of hot material in front of it with material slightly visible at all side laps. Use care to eliminate air entrainment under the membrane. Exercise care during application to eliminate air entrainment under the membrane.
   2. Apply pressure to all seams to ensure that the laps are solidly bonded to substrate.
   3. Install subsequent rolls of modified membrane as above with a minimum of 4 inch (101 mm) side laps and 8 inch (203 mm) end laps. Stagger end laps. Apply membrane in the same direction as the previous layers but stagger the laps so they do not coincide with the laps of the base layers.
   4. Apply hot material no more than 5 feet (1.5 m) ahead of each roll being embedded.
   5. Extend membrane 2 inches (50 mm) beyond top edge of all cants in full moppings of the specified hot material.

C. Fibrous Cant Strips: Provide non-combustible perlite or glass fiber cant strips at all wall/curb detail treatments where angle changes are greater than 45 degrees. Cant may be set in approved cold adhesives, hot asphalt or mechanically attached with approved plates and fasteners.

D. Wood Blocking, Nailers and Cant Strips: Provide wood blocking, nailers and cant strips as specified in Section 06114.
   1. Provide nailers at all roof perimeters and penetrations for fastening membrane flashings and sheet metal components.
   2. Wood nailers should match the height of any LWC insulation, providing a smooth and even transition between flashing and insulation areas.
   3. Nailer lengths should be spaced with a minimum 1/8 inch gap for expansion and contraction between each length or change of direction.
   4. Nailers and flashings should be fastened in accordance with Factory Mutual "Loss Prevention Data Sheet 1-49, Perimeter Flashing" and be designed to be capable of resisting a minimum force of 200 lbs/lineal foot in any direction.

E. Metal Work: Provide metal flashings, counter flashings, parapet coping caps and thru-wall flashings as specified in Section 07620 or Section 07710. Install in accordance with the SMACNA "Architectural Sheet Metal Manual" or the NRCA Roofing Waterproofing manual.

F. Termination Bar: Provide a metal termination bar or approved top edge securement at the terminus of all flashing sheets at walls and curbs. Fasten the bar a minimum of 8 inches (203 mm) o/c to achieve constant compression. Provide suitable, sealant at the top edge if required.

G. Flashing Base Ply: Install flashing sheets by the same application method used for the base ply.
   1. Seal curb, wall and parapet flashings with an application of mastic and mesh on a daily basis. Do not permit conditions to exist that will allow moisture to enter behind, around or under the roof or flashing membrane.
   2. Prepare all walls, penetrations, expansion joints and surfaces to be flashed with required primer at the rate of 100 square feet per gallon. Allow primer to dry tack free.
   3. Adhere to the underlying base flashing ply with specified hot material unless otherwise noted in these specifications. Nail off at a minimum of 8 inches (203 mm) o/c from the finished roof at all vertical surfaces.
   4. Solidly adhere the entire sheet of flashing membrane to the substrate.
   5. Seal all vertical laps of flashing membrane with a three-course application of trowel-
grade mastic and mesh.

6. Coordinate counter flashing, cap flashings, expansion joints, and similar work with modified bitumen roofing work as specified.

7. Coordinate roof accessories, miscellaneous sheet metal accessory items, including piping vents and other devices with the roofing system work.

H. Flashing Cap Ply: Install flashing cap sheets by the same application method used for the cap ply.
1. Seal curb, wall and parapet flashings with an application of mastic and mesh on a daily basis. Do not permit conditions to exist that will allow moisture to enter behind, around or under the roof or flashing membrane.

2. Prepare all walls, penetrations, expansion joints and where shown on the Drawings to be flashed with required primer at the rate of 100 square feet per gallon. Allow primer to dry tack free.

3. Adhere to the underlying base flashing ply with specified flashing ply adhesive unless otherwise specified. Nail off at a minimum of 8 inches (203 mm) o.c. from the finished roof at all vertical surfaces.

4. Coordinate counter flashing, cap flashings, expansion joints and similar work with modified bitumen roofing work as specified.

5. Coordinate roof accessories, miscellaneous sheet metal accessory items with the roofing system work.

6. All stripping shall be installed prior to flashing cap sheet installation.

7. Heat and scrape granules when welding or adhering at cut areas and seams to granular surfaces at all flashings.

8. Secure the top edge of the flashing sheet using a termination bar only when the wall surface above is waterproofed, or nailed 4 inches on center and covered with an acceptable counter flashing.

I. Roof Walkways: Provide walkways in areas indicated on the Drawings.

3.5 INSTALLATION EDGE TREATMENT AND ROOF PENETRATION FLASHING

A. Fabricated Flashings: Fabricated flashings and trim are provided as specified in Section 07620.

1. Fabricated flashings and trim shall conform to the detail requirements of SMACNA "Architectural Sheet Metal Manual" and/or the Copper Development Association "Copper in Architecture - Handbook" as applicable.

B. Scupper Through Wall (Overflow):

1. Inspect the nailer to assure proper attachment and configuration.

2. Run one ply over nailer up the overflow, into the scupper hole and up flashing as in typical wall flashing detail. Assure coverage of all wood nailers.

3. Install scupper box in a 1/4 inch (6 mm) bed of mastic. Assure all box seams are soldered and have a minimum 4 inch (101 mm) flange. Make sure all corners are closed and soldered. Prime scupper at a rate of 100 square feet per gallon and allow to dry.

4. Fasten flange of scupper box every 3 inches (76 mm) o.c. staggered.

5. Strip in flange scupper box with base flashing ply covering entire area with 6 inch (152 mm) overlap on to the field of the roof and wall flashing.

6. Install a second ply of modified flashing ply in bitumen over the base flashing ply, 9 inches (228 mm) on to the field of the roof. Apply a three-course application of mastic and mesh at all seams.

C. Pre-manufactured Snap-On Coping Cap:

1. Install miters first.

2. Position base flashing of the Built-Up and/or Modified Roofing membrane over the
wall edge covering nailers completely, fastening 8 inches on center. Install membrane and cap sheet with proper material and procedure according to manufacturer's recommendations.

3. Install minimum 16 gauge, 16 inch long by specified width anchor chair at [Contact Garland Representative] feet on center.

4. Install 6 inch wide splice plate by centering over 16 inch long by specified width anchor chair. Apply two beads of sealant to either side of the splice plate's center. Approximately 2 inches from the coping cap joint. Install Coping Cap by hooking outside hem of coping on outside face of anchor chair. Press downward on inside edge of coping until "snap" occurs and hem is engaged on the entire chair.

D. Curb Detail/Air Handling Station:
1. Minimum curb height is 8 inches (203 mm) above finished roof height. Prime vertical at a rate of 100 square feet per gallon and allow to dry.
2. Set cant in bitumen. Run all field plies over cant a minimum of 2 inches (50 mm).
3. Install base flashing ply covering curb set in bitumen with 6 inches (152 mm) on to field of the roof.
4. Install a second ply of modified flashing ply in bitumen over the base flashing ply, 9 inches (228 mm) on to the field of the roof. Apply a three-course application of mastic and mesh at all vertical seams and allow to cure and aluminize.
5. Install pre-manufactured counterflashing with fasteners and neoprene washers or per manufacturer's recommendations.
6. Set equipment on neoprene pad and fasten as required by equipment manufacturer.

E. Pre-manufactured Curb For Equipment Support:
1. Minimum curb height is 8 inches (203 mm) above finished roof height. Prime vertical at a rate of 100 square feet per gallon and allow to dry.
2. Run all field plies over cant of the pre-manufactured equipment support a minimum of 2 inches.
3. Install base flashing ply covering pre-manufactured curb with 6 inches (152 mm) on to field of the roof.
4. Install a second ply of modified flashing ply installed over the base flashing ply, 9 inches (228 mm) on to field of the roof. Attach top of membrane to top of wood curb and nail at 8 inches (203 mm) o.c. Apply a three-course application of mastic and mesh at all vertical seams and allow to cure and aluminize.
5. Install pre-manufactured cover. Fasten sides at 24 inches (609 mm) o.c. with fasteners and neoprene washers. Furnish all joint cover laps with butyl tape between metal covers.
6. Set equipment on neoprene pad and fasten as required by equipment manufacturer.

F. Exhaust Fan:
1. Minimum curb height is 8 inches (203 mm) above finished roof height. Prime vertical at a rate of 100 square feet per gallon and allow to dry.
2. Set cant in bitumen. Run all plies over cant a minimum of 2 inches (50 mm).
3. Install base flashing ply covering curb with 6 inches (152 mm) on to field of the roof.
4. Install a second ply of modified flashing ply installed over the base flashing ply, 9 inches (228 mm) on to field of the roof. Attach top of membrane to top of wood curb and nail at 8 inches (203 mm) o.c. Apply a three-course application of mastic and mesh at all vertical seams and allow to cure and aluminize.
5. Install metal exhaust fan over the wood nailers and flashing to act as counterflashing. Fasten per manufacturer's recommendation.

G. Roof Drain:
1. Plug drain to prevent debris from entering plumbing.
2. Taper LWC insulation to drain minimum of 24 inches (609 mm) from center of drain.
3. Run roof system plies over drain. Cut out plies inside drain bowl.
4. Set lead/copper flashing (30 inch square minimum) in 1/4 inch bed of mastic. Run lead/copper into drain a minimum of 2 inches (50 mm). Prime lead/copper at a rate of 100 square feet per gallon and allow to dry.
5. Install base flashing ply (40 inch square minimum) in bitumen.
6. Install modified membrane (48 inch square minimum) in bitumen.
7. Install clamping ring and assure that all plies are under the clamping ring.
8. Remove drain plug and install strainer.

H. Plumbing Stack:
1. Minimum stack height is 12 inches (609 mm).
2. Run roof system over the entire surface of the roof. Seal the base of the stack with elastomeric sealant.
3. Prime flange of new sleeve. Install properly sized sleeves set in 1/4 inch (6 mm) bed of roof cement.
4. Install base flashing ply in bitumen.
5. Install membrane in bitumen.
6. Caulk the intersection of the membrane with elastomeric sealant.
7. Turn sleeve a minimum of 1 inch (25 mm) down inside of stack.

I. Pitch Pocket Umbrella:
1. Run all plies up to the penetration.
2. Place the pitch pocket over the penetration and prime all flanges.
3. Strip in flange of pitch pocket with one ply of base flashing ply. Extend 6 inches (152 mm) onto field of roof.
4. Install second layer of modified membrane extending 9 inches (228 mm) onto field of the roof.
5. Fill pitch pocket half full with non-shrink grout. Let this cure and top off with pourable sealant.
6. Caulk joint between roof system and pitch pocket with roof cement.
7. Place a watershedding type bonnet over the top of the pitch pocket and clamp the top with a drawband collar. Caulk the upper edge of the band with an elastomeric sealant.

3.6 CLEANING
A. Clean-up and remove daily from the site all wrappings, empty containers, paper, loose particles and other debris resulting from these operations.
B. Remove asphalt markings from finished surfaces.
C. Repair or replace defaced or disfigured finishes caused by Work of this section.

3.7 PROTECTION
A. Provide traffic ways, erect barriers, fences, guards, rails, enclosures, chutes and the like to protect personnel, roofs and structures, vehicles and utilities.
B. Protect exposed surfaces of finished walls with tarps to prevent damage.
C. Plywood for traffic ways required for material movement over existing roofs shall be not less than 5/8 inch (16 mm) thick.
D. In addition to the plywood listed above, an underlayment of minimum 1/2 inch (13 mm) recover board is required on new roofing.
E. Special permission shall be obtained from the Manufacturer before any traffic shall be permitted over new roofing.
3.8 FIELD QUALITY CONTROL

A. Inspection: Provide manufacturer's field observations a minimum of three times per week while progress is being made on the project. Provide a final inspection upon completion of the Work.
   1. Warranty shall be issued upon manufacturer's acceptance of the installation.
   2. Field observations shall be performed by a Sales Representative employed full-time by the manufacturer for a minimum of 5 Years, and whose primary job description is to assist, inspect and approve membrane installations for the manufacturer.
   3. Provide observation reports from the Sales Representative indicating procedures followed, weather conditions and any discrepancies found during inspection.
   4. Provide a final report from the Sales Representative, certifying that the roofing system has been satisfactorily installed according to the project specifications, approved details and good general roofing practice.

3.9 SCHEDULES

A. Base (Ply) Sheet:
   1. StressBase 80: 80 mil SBS (Styrene-Butadiene-Styrene) rubber modified roofing base sheet reinforced with a fiberglass scrim, performance requirements according to ASTM D 5147.
      a. Tensile Strength, ASTM D 5147
         1) 2 in/min. @ 0 +/- 3.6 deg. F MD 100 lbf/in XD 100 lbf/in
         2) 50 mm/min. @ -17.78 +/- 2 deg. C MD 17.5 kN/m XD 17.5 kN/m
      b. Tear Strength, ASTM D 5147
         1) 2 in/min. @ 73.4 +/- 3.6 deg. F MD 110 lbf XD 100 lbf
         2) 50 mm/min. @ 23 +/- 2 deg. C MD 489 N XD 444 N
      c. Elongation at Maximum Tensile, ASTM D 5147
         1) 2 in/min. @ 0 +/- 3.6 deg. F MD 4 % XD 4 %
         2) 50 mm/min@ -17.78 +/- 2 deg. C MD 4 % XD 4 %
      d. Low Temperature Flexibility, ASTM D 5147, Passes -40 deg. F (-40 deg. C)

B. Thermoplastic/Modified Cap (Ply) Sheet:
   1. StressPly E FR Mineral (Environmental): 160 mil SBS and SIS (Styrene-Butadiene-Styrene and Styrene-Isoprene-Styrene) mineral surfaced rubber modified roofing membrane with fire retardant characteristics and reinforced with a dual fiberglass scrim and polyester scrim. ASTM D 6162, Type III Grade G
      a. Tensile Strength, ASTM D 5147
         1) 2 in/min. @ 73.4 +/- 3.6 deg. F MD 500 lbf/in XD 550 lbf/in
         2) 50 mm/min. @ 23 +/- 2 deg. C MD 87.5 kN/m XD 96.25 kN/m
      b. Tear Strength, ASTM D 5147
         1) 2 in/min. @ 73.4 +/- 3.6 deg. F MD 900 lbf XD 950 lbf
         2) 50 mm/min. @ 23 +/- 2 deg. C MD 4003 N XD 4226 N
      c. Elongation at Maximum Tensile, ASTM D 5147
         1) 2 in/min. @ 73.4 +/- 3.6 deg. F MD 6.0% XD 6.0%
         2) 50 mm/min. @ 23 +/- 2 deg. C MD 6.0% XD 6.0%
      d. Low Temperature Flexibility, ASTM D 5147, Passes -40 deg. F (-40 deg. C)

C. Interply Adhesive:
   1. HPR All-Temp Asphalt: Hot Bitumen, high penetration, high softening point mopping asphalt having the following characteristics:
      a. Softening Point 225 deg. F - 235 deg. F
      b. Flash Point 525 deg. F
      c. Penetration @ 77 deg. F 16-20 units
      d. Ductility @ 77 deg. F 1.5-2.0 cm
D. Flashing Base Ply:
  1. StressBase 80: 80 mil SBS (Styrene-Butadiene-Styrene) rubber modified roofing base sheet reinforced with a fiberglass scrim, performance requirements according to ASTM D 5147.
     a. Tensile Strength, ASTM D 5147
        1) 2 in/min. @ 0 +/- 3.6 deg. F MD 100 lbf/in XD 100 lbf/in
        2) 50 mm/min. @ -17.78 +/- 2 deg. C MD 17.5 kN/m XD 17.5 kN/m
     b. Tear Strength, ASTM D 5147
        1) 2 in/min. @ 73.4 +/- 3.6 deg. F MD 110 lbf XD 100 lbf
        2) 50 mm/min. @ 23 +/- 2 deg. C MD 489 N XD 444 N
     c. Elongation at Maximum Tensile, ASTM D 5147
        1) 2 in/min. @ 0 +/- 3.6 deg. F MD 4 % XD 4 %
        2) 50 mm/min. @ -17.78 +/- 2 deg. C MD 4 % XD 4 %
     d. Low Temperature Flexibility, ASTM D 5147
        1) Passes -40 deg. F (-40 deg. C)

E. Flashing Ply Adhesive:
  1. HPR All-Temp Asphalt: Hot Bitumen, high penetration, high softening point mopping asphalt having the following characteristics:
     a. Softening Point 225 deg. F - 235 deg. F
     b. Flash Point 525 deg. F
     c. Penetration @ 77 deg. F 16-20 units
     d. Ductility @ 77 deg. F 1.5-2.0 cm

F. Surfacing:
  1. Flashing Cap (Ply) Sheet:
     a. StressPly E FR Mineral (Environmental): 160 mil SBS and SIS (Styrene-Butadiene-Styrene and Styrene-Isoprene-Styrene) mineral surfaced rubber modified roofing membrane with fire retardant characteristics and reinforced with a dual fiberglass scrim and polyester scrim. ASTM D 6162, Type III Grade G
        1) Tensile Strength, ASTM D 5147
           a) 2 in/min. @ 73.4 +/- 3.6 deg. F MD 500 lbf/in XD 550 lbf/in
           b) 50 mm/min. @ 23 +/- 2 deg. C MD 87.5 kN/m XD 96.25 kN/m
        2) Tear Strength, ASTM D 5147
           a) 2 in/min. @ 73.4 +/- 3.6 deg. F MD 900 lbf XD 950 lbf
           b) 50 mm/min. @ 23 +/- 2 deg. C MD 4003 N XD 4226 N
        3) Elongation at Maximum Tensile, ASTM D 5147
           a) 2 in/min. @ 73.4 +/- 3.6 deg. F MD 6.0% XD 6.0%
           b) 50 mm/min. @ 23 +/- 2 deg. C MD 6.0% XD 6.0%
        4) Low Temperature Flexibility, ASTM D 5147, Passes -40 deg. F ( -40 deg. C)

END OF SECTION
SECTION 07 71 00
ROOF SPECIALTIES

PART 1  GENERAL

1.01  SECTION INCLUDES
A. Manufactured roof specialties, including copings, fascias, and gravel stops.
B. Roof control and expansion joint covers.
C. Roof membrane vents.

1.02  RELATED REQUIREMENTS
A. Section 07 72 00 - Roof Accessories: Manufactured curbs, roof hatches, and snow guards.

1.03  REFERENCE STANDARDS

1.04  SUBMITTALS
A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.
B. Product Data: Provide data on shape of components, materials and finishes, anchor types and locations.
C. Shop Drawings: Indicate configuration and dimension of components, adjacent construction, required clearances and tolerances, and other affected work.
D. Samples: Submit two appropriately sized samples of coping and gravel stop.
E. Manufacturer's Installation Instructions: Indicate special procedures, fasteners, supporting members, and perimeter conditions requiring special attention.

PART 2  PRODUCTS

2.01  COMPONENTS
A. Roof edge, fascia, flashing, coping, etc. to be of the same manufacturer as the roofing system to allow for a full system warranty.
B. Roof Edge Flashings: Factory fabricated to sizes required; corners mitered; concealed fasteners.
   2. Pull-Off Resistance: Tested in accordance with ANSI/SPRI/FM 4435/ES-1 using test methods RE-1 and RE-2 to positive and negative design wind pressure as defined by applicable local building code.
   3. Exposed Face Height: As indicated on drawings.
   4. Material: Extruded aluminum, 0.08 inch thick, minimum.
5. Finish: 70 percent polyvinylidene fluoride.
6. Color: As indicated on drawings.

C. Copings: Factory fabricated to sizes required; corners mitered; concealed fasteners.
   1. Configuration: Concealed continuous hold down cleat at both legs; internal splice piece at joints of same material, thickness, and finish as cap; concealed stainless steel fasteners.
   2. Pull-Off Resistance: Tested in accordance with ANSI/SPRI/FM 4435/ES-1 using test method RE-3 to positive and negative design wind pressure as defined by applicable local building code.
   3. Wall Width: As indicated on drawings.
   4. Outside Face Height: As indicated on drawings.
   5. Inside Face Height: 4 inches.
   6. Material: Formed aluminum sheet, 0.050 inch thick, minimum.
   7. Finish: 70 percent polyvinylidene fluoride.
   8. Color: As indicated on drawings.

D. Control and Expansion Joint Covers: Composite construction of .040 inch wide flexible EPDM flashing of white color with closed cell urethane foam backing, each edge seamed to aluminum sheet metal flanges, designed for nominal joint width of 1 inch. Include special formed corners, tees, intersections, and wall flashings, each sealed watertight.

E. Roofing Vents: Formed aluminum .040 inch thick, with watertight construction to allow construction below roof membrane to breathe; with attachment flanges .040 inch wide.
   1. Finish: Mill finish.
   2. Color: To be selected by Architect from manufacturer's standard range.

F. Pipe and Penetration Flashing: Base of rounded aluminum, compatible with sheet metal roof systems, and capable of accommodating pipes sized between 3/8 inch and 12 inch.

G. Roof Penetration Sealing Systems: Premanufactured components and accessories as required to preserve integrity of roofing system and maintain roof warranty; suitable for conduits and roofing system to be installed; designed to accommodate existing penetrations where applicable.

H. Pipe Penetration Wall Seal: Seal for HVAC piping wall penetrations with wall mounted rigid plastic outlet cover and elastomeric wall seal gasket.
   1. Wall Outlet Size, Stucco and Masonry Applications: 7-1/2 inch wide by 10 inch high.
   2. Outlet Cover Color: White.
   3. Wall Outlet Water Penetration: Complies with ASTM E331 performance tests.
   5. Wall Outlet Air Permeance: Complies with ASTM E2178 performance tests.

I. Pipe Penetration Wall Seal and Insulated Piping Protection System: Seal for HVAC piping wall penetrations with wall mounted rigid plastic outlet cover and elastomeric wall seal gasket and having mechanical line insulation with PVC protective cover.
   1. Wall Outlet Size, Stucco and Masonry Applications: 7-1/2 inch wide by 10 inch high.
      a. Elastomeric Sleeve Diameter: 1-11/16 inch with applicable insulation thickness and PVC protective cover.
   2. Outlet Cover Color: Gray.
   3. PVC Insulation Cover Color: Black with full-length velcro fastener.
   4. Wall Outlet Water Penetration: Complies with ASTM E331 performance tests.
   5. Wall Outlet Air Leakage: Complies with ASTM E283 performance tests.

2.02 FINISHES

A. Color Anodized Finish: AAMA 611 AA-M12C22A42/44 Class I integrally or electrolytically colored anodic coating not less than 0.7 mils thick.
B. PVDF (Polyvinylidene Fluoride) Coating: Superior Performance Organic Finish, AAMA 2605; multiple coat, thermally cured fluoropolymer finish system; color as indicated.

2.03 ACCESSORIES
A. Sealant for Joints in Linear Components: As recommended by component manufacturer.
B. Adhesive for Anchoring to Roof Membrane: Compatible with roof membrane and approved by roof membrane manufacturer.
C. Insulation Board Adhesive: Two-component, low-rise polyurethane foam adhesive used for adhering insulation to low slope roof deck materials.
D. Roof Cement: ASTM D4586/D4586M, Type II.

PART 3 EXECUTION

3.01 EXAMINATION
A. Verify that deck, curbs, roof membrane, base flashing, and other items affecting work of this Section are in place and positioned correctly.
1. Refer to Section 07 72 00 for information on roofing related accessories.

3.02 INSTALLATION
A. Install components in accordance with manufacturer's instructions and NRCA (RM) applicable requirements.
B. Seal joints within components when required by component manufacturer.
C. Anchor components securely.
D. Coordinate installation of components of this section with installation of roofing membrane and base flashings.
E. Coordinate installation of sealants and roofing cement with work of this section to ensure watertightness.
F. Coordinate installation of flashing flanges into reglets.

END OF SECTION 07 71 00
SECTION 07 72 00
ROOF ACCESSORIES

PART 1 GENERAL

1.01 SECTION INCLUDES
A. Curbs.
B. Roof penetrations mounting curbs.
C. Roof hatches.

1.02 REFERENCE STANDARDS

1.03 SUBMITTALS
A. See Section 01 30 00 - Administrative Requirements for submittal procedures.
B. Product Data: Manufacturer's data sheets on each product to be used.
   1. Preparation instructions and recommendations.
   2. Storage and handling requirements and recommendations.
   3. Installation methods.
   4. Maintenance requirements.
C. Shop Drawings: Submit detailed layout developed for this project and provide dimensioned location and number for each type of roof accessory.
D. Warranty Documentation:
   1. Submit manufacturer warranty.
   2. Ensure that forms have been completed in Owner's name and registered with manufacturer.
   3. Submit documentation that roof accessories are acceptable to roofing manufacturer, and do not limit the roofing warranty.

1.04 DELIVERY, STORAGE, AND HANDLING
A. Store products in manufacturer's unopened packaging until ready for installation.
B. Store products under cover and elevated above grade.

1.05 WARRANTY
A. See Section 01 78 00 - Closeout Submittals for additional warranty requirements.
B. Correct defective Work within a five year period after Date of Substantial Completion.

PART 2 PRODUCTS

2.01 ROOF CURBS
A. Roof Curbs Mounting Assemblies: Factory fabricated hollow sheet metal construction, internally reinforced, and capable of supporting superimposed live and dead loads and designated equipment load with fully mitered and sealed corner joints welded or mechanically fastened, and integral counterflushing with top and edges formed to shed water.
   1. Roof Curb Mounting Substrate: Curb substrate consists of standing seam metal roof panel system.
   2. Sheet Metal Material:
      a. Aluminum: 0.080 inch minimum thickness, with 3003 alloy, and H14 temper.
   3. Fabricate curb bottom and mounting flanges for installation directly on metal roof panel system to match slope and configuration of system.
a. Extend side flange to next adjacent roof panel seam and comply with seam configurations and seal connection, providing at least 6 inch clearance between curb and metal roof panel flange allowing water to properly flow past curb.
b. Where side of curb aligns with metal roof panel flange, attach fasteners on upper slope of flange to curb connection allowing water to flow past below fasteners, and seal connection.
c. Maintain at least 12 inch clearance from curb, and lap upper curb flange on underside of down sloping metal roof panel, and seal connection.
d. Lap lower curb flange overtop of down sloping metal roof panel and seal connection.

4. Provide layouts and configurations indicated on drawings.

2.02 ROOF HATCHES AND VENTS
A. Roof Hatch Manufacturers:
   5. Substitutions: See Section 01 60 00 - Product Requirements.
B. Frames and Curbs: One-piece curb and frame with integral cap flashing to receive roof flashings; extended bottom flange to suit mounting.
   1. Insulation: Manufacturer's standard; 1 inch rigid glass fiber, located on outside face of curb.
   2. Curb Height: 12 inches from finished surface of roof, minimum.
C. Safety Railing System: Roof hatch manufacturer's standard accessory safety rail system mounted directly to curb.
   2. Posts and Rails: Galvanized steel tubing.
   3. Finish: Manufacturer's standard, factory applied finish.
   5. Mounting Brackets: Hot dipped galvanized steel, 1/4 inch thick, minimum.
   6. Fasteners: Stainless steel, Type 316.
D. Hardware: Steel, zinc coated and chromate sealed, unless otherwise indicated or required by manufacturer.
   1. Lifting Mechanisms: Compression or torsion spring operator with shock absorbers that automatically opens upon release of latch; capable of lifting covers despite 10 psf load.
   2. Hinges: Heavy duty pintle type.
   3. Hold open arm with vinyl-coated handle for manual release.

PART 3 EXECUTION
3.01 EXAMINATION
A. Do not begin installation until substrates have been properly prepared.
B. If substrate preparation is the responsibility of another installer, notify Architect of unsatisfactory preparation before proceeding.

3.02 PREPARATION
A. Clean surfaces thoroughly prior to installation.
B. Prepare surfaces using methods recommended by manufacturer for achieving acceptable results for applicable substrate under project conditions.

3.03 INSTALLATION
A. Install in accordance with manufacturer's instructions, in manner that maintains roofing system weather-tight integrity.

3.04 CLEANING
A. Clean installed work to like-new condition.

3.05 PROTECTION
A. Protect installed products until completion of project.
B. Touch-up, repair or replace damaged products before Date of Substantial Completion.

END OF SECTION 07 72 00
SECTION 07 84 00
FIRESTOPPING

PART 1 GENERAL

1.01 SECTION INCLUDES
A. Firestopping of joints and penetrations in fire-resistance-rated and smoke-resistant assemblies, whether indicated on drawings or not, and other openings indicated.

1.02 REFERENCE STANDARDS

1.03 SUBMITTALS
A. See Section 01 30 00 - Administrative Requirements for submittal procedures.
B. Schedule of Firestopping: List each type of penetration, fire rating of the penetrated assembly, and firestopping test or design number.
C. Product Data: Provide data on product characteristics, performance ratings, and limitations.
D. Sustainable Design Submittal: Submit VOC content documentation for nonpreformed materials.
E. Manufacturer's Installation Instructions: Indicate preparation and installation instructions.
F. Manufacturer's Certificate: Certify that products meet or exceed specified requirements.
G. Certificate from authority having jurisdiction indicating approval of materials used.
H. Manufacturer's qualification statement.
I. Installer's qualification statement.

1.04 QUALITY ASSURANCE
A. Fire Testing: Provide firestopping assemblies of designs that provide the scheduled fire ratings when tested in accordance with methods indicated.
1. Listing in UL (FRD) or FM (AG) will be considered as constituting an acceptable test report.
2. Valid evaluation report published by ICC Evaluation Service, Inc. (ICC-ES) at www.icc-es.org will be considered as constituting an acceptable test report.
3. Submission of actual test reports is required for assemblies for which none of the above substantiation exists.

B. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum three years documented experience.

C. Installer Qualifications: Company specializing in performing the work of this section and:
1. Trained by manufacturer.
2. Approved by Factory Mutual Research Corporation under FM 4991, or meeting any two of the following requirements:
3. Verification of minimum three years documented experience installing work of this type.
4. Verification of at least five satisfactorily completed projects of comparable size and type.
5. Licensed by local authorities having jurisdiction (AHJ).

1.05 MOCK-UP
A. Install one firestopping assembly representative of each fire rating design required on project.
1. Where one design may be used for different penetrating items or in different wall constructions, install one assembly for each different combination.

B. Obtain approval of authorities having jurisdiction (AHJ) before proceeding.

C. If accepted, mock-up will represent minimum standard for this work.

D. If accepted, mock-up may remain as part of this work. Remove and replace mock-ups not accepted.

1.06 FIELD CONDITIONS
A. Comply with firestopping manufacturer’s recommendations for temperature and conditions during and after installation; maintain minimum temperature before, during, and for three days after installation of materials.

B. Provide ventilation in areas where solvent-cured materials are being installed.

PART 2 PRODUCTS
2.01 MANUFACTURERS
A. Firestopping Manufacturers:
1. 3M Fire Protection Products: www.3m.com/firestop/#sle.

2.02 MATERIALS
A. Firestopping Materials: Any materials meeting requirements.

B. Volatile Organic Compound (VOC) Content: Provide products having VOC content lower than that required by SCAQMD 1168.

C. Mold and Mildew Resistance: Provide firestopping materials with mold and mildew resistance rating of zero(0) in accordance with ASTM G21.

D. Primers, Sleeves, Forms, Insulation, Packing, Stuffing, and Accessories: Provide type of materials as required for tested firestopping assembly.
E. Fire Ratings: Refer to drawings for required systems and ratings.

2.03 FIRESTOPPING ASSEMBLY REQUIREMENTS

A. Perimeter Fire Containment Firestopping: Use system that has been tested according to ASTM E2307 to have fire resistance F Rating equal to required fire rating of floor assembly.
   1. Movement: Provide systems that have been tested to show movement capability as indicated.
   2. Temperature Rise: Provide systems that have been tested to show T Rating as indicated.
   3. Air Leakage: Provide systems that have been tested to show L Rating as indicated.
   4. Where floor assembly is not required to have a fire rating, provide systems that have been tested to show L Rating as indicated.

B. Head-of-Wall (HW) Joint System Firestopping at Joints Between Fire-Rated Wall Assemblies and Non-Rated Horizontal Assemblies: Use system that has been tested according to ASTM E2837 to have fire resistance F Rating equal to required fire rating of wall assembly.
   1. Movement: Provide systems that have been tested to show movement capability as indicated.

C. Floor-to-Floor (FF), Floor-to-Wall (FW), Head-of-Wall (HW), and Wall-to-Wall (WW) Joints, Except Perimeter, Where Both Are Fire-Rated: Use system that has been tested according to ASTM E1966 or UL 2079 to have fire resistance F Rating equal to required fire rating of the assembly in which the joint occurs.
   1. Movement: Provide systems that have been tested to show movement capability as indicated.
   2. Air Leakage: Provide systems that have been tested to show L Rating as indicated.
   3. Watertightness: Provide systems that have been tested to show W Rating as indicated.
   4. Listing by FM (AG), ITS (DIR), UL (DIR), or UL (FRD) in their certification directories will be considered evidence of successful testing.

D. Through Penetration Firestopping: Use system that has been tested according to ASTM E814 to have fire resistance F Rating equal to required fire rating of penetrated assembly.
   1. Temperature Rise: Provide systems that have been tested to show T Rating as indicated.
   2. Air Leakage: Provide systems that have been tested to show L Rating as indicated.
   3. Watertightness: Provide systems that have been tested to show W Rating as indicated.
   4. Listing by FM (AG), ITS (DIR), UL (DIR), or UL (FRD) in their certification directories will be considered evidence of successful testing.

2.04 FIRESTOPPING FOR PERIMETER CONTAINMENT

A. Perimeter Joint Systems That Have Not Been Tested For Movement Capabilities (Static-S):
   1. 2 Hour Construction: UL System CW-S-0002; Specified Technologies Inc. AS200 Elastomeric Spray.
   2. 2 Hour Construction: UL System CW-S-0002; Specified Technologies Inc. Fast Tack Firestop Spray.
   3. 2 Hour Construction: UL System CW-S-0003; Specified Technologies Inc. Fast Tack Firestop Spray.
   4. 2 Hour Construction: UL System CW-S-0007; Specified Technologies Inc. SpeedFlex TTG Track Top Gasket.

B. Perimeter Joint Systems That Have Movement Capabilities (Dynamic-D):
   1. 2 Hour Construction: UL System CW-D-1004; Specified Technologies Inc. AS200 Elastomeric Spray.
   2. 2 Hour Construction: UL System CW-D-1004; Specified Technologies Inc. Fast Tack Firestop Spray.
   3. 2 Hour Construction: UL System CW-D-1011; Specified Technologies Inc. Fast Tack Firestop Spray.
   4. 2 Hour Construction: UL System CW-D-2042; Specified Technologies Inc. Fast Tack Firestop Spray.
2.05 FIRESTOPPING FOR FLOOR-TO-FLOOR, FLOOR-TO-WALL, HEAD-OF-WALL, AND WALL-TO-WALL JOINTS

A. Concrete and Concrete Masonry Walls and Floors:
   1. Floor-to-Floor Joints:
      a. 2 Hour Construction: UL System FF-D-1013; Hilti CFS-SP WB Firestop Joint Spray and CP 672.
      b. 2 Hour Construction: UL System FF-D-1085; Tremco, TREMstop Acrylic Firestop Sealant.
   2. Head-of-Wall Joints at Concrete/Concrete Masonry Wall to Concrete Over Metal Deck Floor:
      a. 2 Hour Construction: UL System HW-D-0181; Hilti CFS-SP WB Firestop Joint Spray and CP 672.
      b. 2 Hour Construction: UL System HW-D-1037; Hilti CFS-SP WB Firestop Joint Spray and CP 672.
   3. Head-of-Wall Joints at Concrete/Concrete Masonry Wall to Concrete Floor:
      a. 2 Hour Construction: UL System HW-D-0268; Hilti CFS-SP WB Firestop Joint Spray and CP 672.
      b. 2 Hour Construction: UL System HW-D-0312; Specified Technologies Inc. SIL Silicone Sealant.
   4. Concrete/Concrete Masonry Wall-to-Wall Joint Systems That Have Movement Capabilities (Dynamic-D):
      a. 2 Hour Construction: UL System WW-D-0017; Hilti CFS-SP WB Firestop Joint Spray and CP 672.
      b. 2 Hour Construction: UL System WW-D-0032; Hilti CP 606 Flexible Firestop Sealant.

B. Gypsum Board Walls:
   1. Wall-to-Wall Joints That Have Not Been Tested For Movement Capabilities (Static-S):
      a. 2 Hour Construction: UL System WW-S-0063; Specified Technologies Inc. SpeedFlex TTG Track Top Gasket.
      b. 1 Hour Construction: UL System WW-S-0063; Specified Technologies Inc. SpeedFlex TTG Track Top Gasket.
   2. Wall-to-Wall Joints That Have Movement Capabilities (Dynamic-D):
      a. 2 Hour Construction: UL System WW-D-0180; Specified Technologies Inc. SpeedFlex TTG Track Top Gasket.
      b. 2 Hour Construction: UL System WW-D-0067; Hilti CP 606 Flexible Firestop Sealant.
      c. 1 Hour Construction: UL System WW-D-0067; Hilti CP 606 Flexible Firestop Sealant.
   3. Head-of-Wall Joints at Underside of Steel Beam and Concrete Over Metal Deck Floor with Sprayed On Fireproofing:
      a. 2 Hour Construction: UL System HW-D-0252; Specified Technologies Inc. AS200 Elastomeric Spray.
      b. 2 Hour Construction: UL System HW-D-0259; Hilti CFS-SP WB Firestop Joint Spray and CP 672.
      c. 1 Hour Construction: UL System HW-D-0259; Hilti CFS-SP WB Firestop Joint Spray and CP 672.
   4. Head-of-Wall Joints at Concrete Over Metal Deck:
      a. 2 Hour Construction: UL System HW-D-0034; Specified Technologies Inc. ES Elastomeric Firestop Sealant.
      b. 2 Hour Construction: UL System HW-D-0043; Specified Technologies Inc. AS200 Elastomeric Spray.
      c. 2 Hour Construction: UL System HW-D-0099; Specified Technologies Inc. SpeedFlex Joint Profile System.
      d. 2 Hour Construction: UL System HW-D-0363; Specified Technologies Inc. SpeedFlex Joint Profile System.
      e. 2 Hour Construction: UL System HW-D-0365; Specified Technologies Inc. SpeedFlex Joint Profile System.
f. 2 Hour Construction: UL System HW-D-0548; Specified Technologies Inc. SpeedFlex Joint Profile System.
g. 2 Hour Construction: UL System HW-D-0749; Specified Technologies Inc. SpeedFlex TTG Track Top Gasket.
h. 2 Hour Construction: UL System HW-D-0256; Tremco, TREMstop Acrylic Firestop Sealant.

5. Head-of-Wall Joints at Concrete Over Metal Deck, Wall Parallel to Ribs:
a. 2 Hour Construction: UL System HW-D-0049; Hilti CFS-SP WB Firestop Joint Spray and CP 672.
b. 2 Hour Construction: UL System HW-D-0184; Hilti CP 606 Flexible Firestop Sealant.

6. Head-of-Wall Joints at Concrete Over Metal Deck, Wall Perpendicular to Ribs, Cut to Fit Ribs:
a. 2 Hour Construction: UL System HW-D-0045; Hilti CP 606 Flexible Firestop Sealant.
b. 2 Hour Construction: UL System HW-D-0103; Specified Technologies Inc. ES Elastomeric Firestop Sealant.

7. Head-of-Wall Joints at Concrete Over Metal Deck, Wall Perpendicular to Ribs, Not Cut to Fit:
a. 2 Hour Construction: UL System HW-D-0042; Hilti CFS-SP WB Firestop Joint Spray and CP 672.
b. 2 Hour Construction: UL System HW-D-0045; Hilti CP 606 Flexible Firestop Sealant.

2.06 FIRESTOPPING PENETRATIONS THROUGH CONCRETE AND CONCRETE MASONRY CONSTRUCTION

A. Blank Openings:

1. In Floors or Walls:
a. 2 Hour Construction: UL System C-AJ-0090; Hilti FS-ONE MAX Intumescent Firestop Sealant.
b. 2 Hour Construction: UL System C-AJ-0015; Specified Technologies Inc. SSM Mortar.
c. 2 Hour Construction: UL System C-AJ-0116; Specified Technologies Inc. Composite Sheet.
d. 2 Hour Construction: UL System C-AJ-0136; Specified Technologies Inc. SSM Mortar.

B. Penetrations Through Floors or Walls By:

1. Multiple Penetrations in Large Openings:
a. 2 Hour Construction: UL System C-AJ-8143; Hilti FS-ONE MAX Intumescent Firestop Sealant.
b. 2 Hour Construction: UL System C-AJ-8035; Specified Technologies Inc. SSM Mortar.
c. 2 Hour Construction: UL System C-AJ-8055; Specified Technologies Inc. SSP Firestop Putty.
d. 2 Hour Construction: UL System C-AJ-8093; Specified Technologies Inc. SSB Intumescent Firestop Pillows.
e. 2 Hour Construction: UL System C-AJ-8114; Specified Technologies Inc. SSM Mortar.
f. 2 Hour Construction: UL System C-AJ-8115; Specified Technologies Inc. SSM Mortar.
g. 2 Hour Construction: UL System C-AJ-8181; Specified Technologies Inc. Composite Sheet.
h. 2 Hour Construction: UL System C-AJ-8220; Specified Technologies Inc. SSM Mortar.

2. Uninsulated Metallic Pipe, Conduit, and Tubing:
a. 2 Hour Construction: UL System C-AJ-1090; Specified Technologies Inc. SSP Firestop Putty.
b. 2 Hour Construction: UL System C-AJ-1198; Specified Technologies Inc. SIL Silicone Sealant.

c. 2 Hour Construction: UL System C-AJ-1226; Hilti FS-ONE MAX Intumescent Firestop Sealant.

d. 2 Hour Construction: UL System C-AJ-1240; Specified Technologies Inc. LC Endothermic Firestop Sealant.

e. 2 Hour Construction: UL System C-AJ-1425; Hilti CFS-S SIL GG Firestop Silicone Sealant Gun-Grade.

3. Uninsulated Non-Metallic Pipe, Conduit, and Tubing:

a. 2 Hour Construction: UL System C-AJ-2167; Hilti FS-ONE MAX Intumescent Firestop Sealant.

b. 2 Hour Construction: UL System C-AJ-2109; Hilti CP 643N/644 Firestop Collar.

c. 2 Hour Construction: UL System C-AJ-2106; Specified Technologies Inc. SSW Wrap Strips.

d. 2 Hour Construction: UL System C-AJ-2282; Specified Technologies Inc. SSW Wrap Strips.

e. 2 Hour Construction: UL System C-AJ-2297; Specified Technologies Inc. SSC Collars.

b. 2 Hour Construction: UL System C-AJ-2297; Specified Technologies Inc. SSW Wrap Strips.

g. 2 Hour Construction: UL System C-AJ-2298; Specified Technologies Inc. LCC Intumescent Firestop Collars.

h. 2 Hour Construction: UL System C-AJ-2588; Specified Technologies Inc. RTC Range-Taking Collar.

i. 2 Hour Construction: UL System C-AJ-2772; Specified Technologies Inc. SSW Wrap Strips.

j. 2 Hour Construction: UL System C-BJ-2021; Hilti CP 643N Firestop Collar.

4. Electrical Cables Not In Conduit:

a. 2 Hour Construction: UL System C-AJ-3213; Specified Technologies Inc. LCC Intumescent Firestop Collars.

b. 2 Hour Construction: UL System C-AJ-3213; Specified Technologies Inc. SSC Collars.

c. 2 Hour Construction: UL System W-J-3046; Specified Technologies Inc. SSP Firestop Putty.

d. 2 Hour Construction: UL System C-AJ-3154; Specified Technologies Inc. SSP Firestop Putty.

e. 2 Hour Construction: UL System C-AJ-3216; Hilti CFS-PL Firestop Plug.

f. 2 Hour Construction: UL System C-AJ-3283; Hilti CFS-SL SK Firestop Sleeve Kit.

g. 2 Hour Construction: UL System C-AJ-3283; Hilti CFS-SL SK Firestop Sleeve Kit with Hilti CFS-SL GP Gangplate.

h. 2 Hour Construction: UL System W-J-3198; Hilti CFS-SL RK Retrofit Sleeve Kit for Existing Cables.

i. 2 Hour Construction: UL System W-J-3199; Hilti CFS-SL SK Firestop Sleeve Kit.

5. Cable Trays with Electrical Cables:

a. 2 Hour Construction: UL System C-AJ-4094; Hilti CFS-BL Firestop Block.

6. Insulated Pipes:

a. 2 Hour Construction: UL System C-AJ-5087; Specified Technologies Inc. SSS Intumescent Firestop Sealant.

b. 2 Hour Construction: UL System C-AJ-5091; Hilti FS-ONE IMAX Intumescent Firestop Sealant.

c. 2 Hour Construction: UL System C-AJ-5138; Specified Technologies Inc. LCI Intumescent Firestop Sealant.

d. 2 Hour Construction: UL System C-AJ-5313; Specified Technologies Inc. LC Endothermic Firestop Sealant.

7. HVAC Ducts, Uninsulated:
a. 2 Hour Construction: UL System C-AJ-7111; Hilti FS-ONE MAX Intumescent Firestop Sealant.

C. Penetrations Through Floors By:

1. Multiple Penetrations in Large Openings:
   b. 2 Hour Construction: UL System F-A-1016; Hilti CP 680-P/M Cast-In Device.
   c. 2 Hour Construction: UL System F-A-1110; Specified Technologies Inc. CID Cast-In Device.

2. Uninsulated Metallic Pipe, Conduit, and Tubing:
   a. 2 Hour Construction: UL System F-A-1016; Hilti CP 680-P/M Cast-In Device.
   b. 2 Hour Construction: UL System F-A-1110; Specified Technologies Inc. CID Cast-In Device.

3. Uninsulated Non-Metallic Pipe, Conduit, and Tubing:
   a. 2 Hour Construction: UL System F-A-2065; Hilti CP 680-P Cast-In Device.
   b. 2 Hour Construction: UL System F-A-2213; Hilti CFS-DID Drop-In Device.
   c. 2 Hour Construction: UL System F-A-2053; Hilti CP 680-P Cast-In Device.
   d. 2 Hour Construction: UL System F-A-2216; Specified Technologies Inc. Closet Flange Firestop Gasket.
   e. 2 Hour Construction: UL System F-A-2246; Specified Technologies Inc. CID Cast-In Device.

4. Electrical Cables Not In Conduit:
   a. 2 Hour Construction: UL System F-A-3033; Hilti CP 680-P/M Cast-In Device.
   c. 2 Hour Construction: UL System F-A-3058; Specified Technologies Inc. EZ-Path Series 44 Fire-Rated Pathway.

5. Electrical Busways:

6. Insulated Pipes:
   a. 2 Hour Construction: UL System F-A-5015; Hilti CP 680-P/M Cast-In Device.
   b. 2 Hour Construction: UL System F-A-5017; Hilti CP 680-P/M Cast-In Device.
   c. 2 Hour Construction: UL System F-A-5041; Specified Technologies Inc. CID Cast-In Device.
   d. 2 Hour Construction: UL System F-A-5045; Specified Technologies Inc. CID Cast-In Device.

D. Penetrations Through Walls By:

1. Uninsulated Metallic Pipe, Conduit, and Tubing:
   a. 2 Hour Construction: UL System W-J-1067; Hilti FS-ONE MAX Intumescent Firestop Sealant.
   b. 1 Hour Construction: UL System W-J-1067; Hilti FS-ONE MAX Intumescent Firestop Sealant.

2. Electrical Cables Not In Conduit:
   a. 2 Hour Construction: UL System C-AJ-3095; Hilti FS-ONE MAX Intumescent Firestop Sealant.
   b. 2 Hour Construction: UL System C-AJ-3216; Hilti CFS-PL Firestop Plug.
   c. 2 Hour Construction: UL System W-J-3090; Specified Technologies Inc. SSP Firestop Putty.
   d. 2 Hour Construction: UL System W-J-3130; Specified Technologies Inc. EZ-Path Series 22 Fire-Rated Pathway.
   e. 2 Hour Construction: UL System W-J-3138; Specified Technologies Inc. EZ-Path Series 33 Fire-Rated Pathway.
   f. 2 Hour Construction: UL System W-J-3138; Specified Technologies Inc. EZ-Path Series 33 Fire-Rated Pathway.
g. 2 Hour Construction: UL System W-J-3141; Specified Technologies Inc. Ready-Sleeve.

h. 2 Hour Construction: UL System W-J-3156; Specified Technologies Inc. Ready Split Sleeve.

i. 2 Hour Construction: UL System W-J-3158; Specified Technologies Inc. EZ-Path Series 44 Fire-Rated Pathway.

j. 2 Hour Construction: UL System W-J-3180; Specified Technologies Inc. EZ-Path Series 44 Fire-Rated Pathway.

k. 2 Hour Construction: UL System W-J-3182; Specified Technologies Inc. Ready Split Sleeve.

l. 2 Hour Construction: UL System W-J-3182; Specified Technologies Inc. Ready-Sleeve.

3. Insulated Pipes:
   a. 2 Hour Construction: UL System C-AJ-5090; Hilti FS-ONE MAX Intumescent Firestop Sealant.
   b. 2 Hour Construction: UL System C-AJ-5091; Hilti FS-ONE MAX Intumescent Firestop Sealant.
   c. 1 Hour Construction: UL System C-AJ-5090; Hilti FS-ONE MAX Intumescent Firestop Sealant.
   d. 1 Hour Construction: UL System C-AJ-5091; Hilti FS-ONE MAX Intumescent Firestop Sealant.

4. HVAC Ducts, Uninsulated:
   a. 2 Hour Construction: UL System W-J-7092; Specified Technologies Inc. FyreFlange HVAC Firestop Angle.
   b. 2 Hour Construction: UL System W-J-7109; Hilti FS-ONE MAX Intumescent Firestop Sealant, or CP 606 Flexible Firestop Sealant.

5. HVAC Ducts, Insulated:
   a. 2 Hour Construction: UL System W-J-7112; Hilti FS-ONE MAX Intumescent Firestop Sealant.

2.07 FIRESTOPPING PENETRATIONS THROUGH GYPSUM BOARD WALLS

A. Blank Openings:
   1. 2 Hour Construction: UL System W-L-0020; Specified Technologies Inc. Composite Sheet.
   2. 2 Hour Construction: UL System W-L-0032; Specified Technologies Inc. FP Intumescent Firestop Plug.
   3. 2 Hour Construction: UL System W-L-0038; Specified Technologies Inc. FP Intumescent Firestop Plug.
   4. 2 Hour Construction: UL System W-L-3334; Hilti CP 653 Speed Sleeve.
   5. 1 Hour Construction: UL System W-L-0020; Specified Technologies Inc. Composite Sheet.
   6. 1 Hour Construction: UL System W-L-0032; Specified Technologies Inc. FP Intumescent Firestop Plug.
   7. 1 Hour Construction: UL System W-L-0038; Specified Technologies Inc. FP Intumescent Firestop Plug.
   8. 1 Hour Construction: UL System W-L-3334; Hilti CP 653 Speed Sleeve.

B. Penetrations By:
   1. Multiple Penetrations in Large Openings:
      a. 2 Hour Construction: UL System W-L-1408; Hilti FS-ONE MAX Intumescent Firestop Sealant.
      b. 2 Hour Construction: UL System W-L-8013; Hilti CFS-BL Firestop Block.
      c. 2 Hour Construction: UL System W-L-8025; Specified Technologies Inc. LCI Intumescent Firestop Sealant.
      d. 2 Hour Construction: UL System W-L-8050; Specified Technologies Inc. SSB Intumescent Firestop Pillows.
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2. Uninsulated Metallic Pipe, Conduit, and Tubing:
   a. 2 Hour Construction: UL System W-L-1033; Specified Technologies Inc. SIL Silicone Sealant.
   b. 2 Hour Construction: UL System W-L-1042; Specified Technologies Inc. WF300 Intumescent Firestop Caulk (For Wood Frame Construction).
   c. 2 Hour Construction: UL System W-L-1049; Specified Technologies Inc. SSS Intumescent Firestop Sealant.
   d. 2 Hour Construction: UL System W-L-1090; Specified Technologies Inc. LC Endothermic Firestop Sealant.
   e. 2 Hour Construction: UL System W-L-1054; Hilti FS-ONE MAX Intumescent Firestop Sealant.
   f. 2 Hour Construction: UL System W-L-1164; Hilti FS-ONE MAX Intumescent Firestop Sealant.
   g. 2 Hour Construction: UL System W-L-1222; Specified Technologies Inc. LCI Intumescent Firestop Sealant.
   h. 2 Hour Construction: UL System W-L-1477; Specified Technologies Inc. EZ Firestop Grommet.
   i. 2 Hour Construction: UL System W-L-1506; Hilti CFS-D Firestop Cable Disc.
   j. 1 Hour Construction: UL System W-L-1042; Specified Technologies Inc. WF300 Intumescent Firestop Caulk (For Wood Frame Construction).
   k. 1 Hour Construction: UL System W-L-1049; Specified Technologies Inc. SSS Intumescent Firestop Sealant.
   l. 1 Hour Construction: UL System W-L-1054; Hilti FS-ONE MAX Intumescent Firestop Sealant.
   m. 1 Hour Construction: UL System W-L-1090; Specified Technologies Inc. LC Endothermic Firestop Sealant.
   n. 1 Hour Construction: UL System W-L-1164; Hilti FS-ONE MAX Intumescent Firestop Sealant.
   o. 1 Hour Construction: UL System W-L-1222; Specified Technologies Inc. LCI Intumescent Firestop Sealant.
   p. 1 Hour Construction: UL System W-L-1477; Specified Technologies Inc. EZ Firestop Grommet.
   q. 1 Hour Construction: UL System W-L-1506; Hilti CFS-D Firestop Cable Disc.

3. Uninsulated Non-Metallic Pipe, Conduit, and Tubing:
   a. 2 Hour Construction: UL System W-L-2048; Specified Technologies Inc. SSW Wrap Strips.
b. 2 Hour Construction: UL System W-L-2074; Specified Technologies Inc. SSC Collars.
c. 2 Hour Construction: UL System W-L-2078; Hilti CP 643N/644 Firestop Collar.
d. 2 Hour Construction: UL System W-L-2128; Hilti FS-ONE MAX Intumescent Firestop Sealant.
e. 2 Hour Construction: UL System W-L-2237; Specified Technologies Inc. LCC Intumescent Firestop Collars.
f. 2 Hour Construction: UL System W-L-2241; Specified Technologies Inc. WF300 Intumescent Firestop Caulk (For Wood Frame Construction).
g. 2 Hour Construction: UL System W-L-2243; Specified Technologies Inc. SSW Wrap Strips.
h. 2 Hour Construction: UL System W-L-2493; Specified Technologies Inc. RTC Range-Taking Collar.
i. 1 Hour Construction: UL System W-L-2048; Specified Technologies Inc. SSW Wrap Strips.
j. 1 Hour Construction: UL System W-L-2074; Specified Technologies Inc. SSC Collars.
k. 1 Hour Construction: UL System W-L-2078; Hilti CP 643N/644 Firestop Collar.
l. 1 Hour Construction: UL System W-L-2128; Hilti FS-ONE MAX Intumescent Firestop Sealant.
m. 1 Hour Construction: UL System W-L-2237; Specified Technologies Inc. LCC Intumescent Firestop Collars.
n. 1 Hour Construction: UL System W-L-2241; Specified Technologies Inc. WF300 Intumescent Firestop Caulk (For Wood Frame Construction).
o. 1 Hour Construction: UL System W-L-2243; Specified Technologies Inc. SSW Wrap Strips.
p. 1 Hour Construction: UL System W-L-2493; Specified Technologies Inc. RTC Range-Taking Collar.

4. Electrical Cables Not In Conduit:
a. 2 Hour Construction: UL System W-L-3024; Specified Technologies Inc. SSP Firestop Putty.
b. 2 Hour Construction: UL System W-L-3065; Hilti FS-ONE MAX Intumescent Firestop Sealant, CP 606 Flexible Firestop Sealant, CD 601S Elastomeric Firestop Sealant, or CP 618 Firestop Putty Stick.
c. 2 Hour Construction: UL System W-L-3076; Specified Technologies Inc. SSS Intumescent Firestop Sealant.
d. 2 Hour Construction: UL System W-L-3084; Specified Technologies Inc. SSB Intumescent Firestop Pillows.
e. 2 Hour Construction: UL System W-L-3135; Specified Technologies Inc. SSP Firestop Putty.
f. 2 Hour Construction: UL System W-L-3169; Specified Technologies Inc. LCI Intumescent Firestop Sealant.
g. 2 Hour Construction: UL System W-L-3218; Specified Technologies Inc. EZ-Path Series 33 Fire-Rated Pathway.
h. 2 Hour Construction: UL System W-L-3255; Specified Technologies Inc. EZ-Path Series 22 Fire-Rated Pathway.
i. 2 Hour Construction: UL System W-L-3256; Specified Technologies Inc. EZ-Path Series 22 Fire-Rated Pathway.
j. 2 Hour Construction: UL System W-L-3257; Specified Technologies Inc. EZ-Path Series 33 Fire-Rated Pathway.
k. 2 Hour Construction: UL System W-L-3303; Specified Technologies Inc. Ready Split Sleeve.
l. 2 Hour Construction: UL System W-L-3306; Specified Technologies Inc. EZ-Path Series 44 Fire-Rated Pathway.
m. 2 Hour Construction: UL System W-L-3334; Hilti CP 653 Speed Sleeve.
n. 2 Hour Construction: UL System W-L-3350; Specified Technologies Inc. LC Endothermic Firestop Sealant.
o. 2 Hour Construction: UL System W-L-3357; Specified Technologies Inc. FP Intumescent Firestop Plug.
q. 2 Hour Construction: UL System W-L-3358; Specified Technologies Inc. Ready-Sleeve.
r. 2 Hour Construction: UL System W-L-3369; Specified Technologies Inc. EZ Firestop Grommet.
s. 2 Hour Construction: UL System W-L-3370; Specified Technologies Inc. EZ Firestop Grommet.
t. 2 Hour Construction: UL System W-L-3374; Specified Technologies Inc. FP Intumescent Firestop Plug.
u. 2 Hour Construction: UL System W-L-3376; Specified Technologies Inc. Ready-Sleeve.
v. 2 Hour Construction: UL System W-L-3377; Specified Technologies Inc. EZ-Path Series 22 Fire-Rated Pathway.
w. 2 Hour Construction: UL System W-L-3377; Specified Technologies Inc. EZ-Path Series 33 Fire-Rated Pathway.
x. 2 Hour Construction: UL System W-L-3378; Specified Technologies Inc. EZ Firestop Grommet.
y. 2 Hour Construction: UL System W-L-3379; Specified Technologies Inc. EZ Firestop Grommet.
z. 2 Hour Construction: UL System W-L-3390; Specified Technologies Inc. EZ-Path Series 44 Fire-Rated Pathway.
aa. 2 Hour Construction: UL System W-L-3393; Hilti CFS-SL RK Retrofit Sleeve Kit for Existing Cables.
bb. 2 Hour Construction: UL System W-L-3395; Hilti CFS-SL SK Firestop Sleeve Kit with Hilti CFS-SL GP Gangplate.
c. 2 Hour Construction: UL System W-L-3414; Hilti CFS-D Firestop Cable Disc.
d. 1 Hour Construction: UL System W-L-3024; Specified Technologies Inc. SSP Firestop Putty.

e. 1 Hour Construction: UL System W-L-3065; Hilti FS-ONE MAX Intumescent Firestop Sealant, CP 606 Flexible Firestop Sealant, CD 601S Elastomeric Firestop Sealant, or CP 618 Firestop Putty Stick.
ff. 1 Hour Construction: UL System W-L-3076; Specified Technologies Inc. SSS Intumescent Firestop Sealant.
gg. 1 Hour Construction: UL System W-L-3084; Specified Technologies Inc. SSB Intumescent Firestop Pillows.
hh. 1 Hour Construction: UL System W-L-3135; Specified Technologies Inc. SSP Firestop Putty.
ii. 1 Hour Construction: UL System W-L-3169; Specified Technologies Inc. LCI Intumescent Firestop Sealant.
jj. 1 Hour Construction: UL System W-L-3218; Specified Technologies Inc. EZ-Path Series 33 Fire-Rated Pathway.
kk. 1 Hour Construction: UL System W-L-3255; Specified Technologies Inc. EZ-Path Series 22 Fire-Rated Pathway.
ll. 1 Hour Construction: UL System W-L-3256; Specified Technologies Inc. EZ-Path Series 22 Fire-Rated Pathway.
mm. 1 Hour Construction: UL System W-L-3265; Specified Technologies Inc. EZ-Path Series 33 Fire-Rated Pathway.
nn. 1 Hour Construction: UL System W-L-3303; Specified Technologies Inc. Ready Split Sleeve.
oo. 1 Hour Construction: UL System W-L-3306; Specified Technologies Inc. EZ-Path Series 44 Fire-Rated Pathway.
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100% Construction Documents Phase  
January 5th, 2022

pp. 1 Hour Construction: UL System W-L-3334; Hilti CP 653 Speed Sleeve.
qq. 1 Hour Construction: UL System W-L-3350; Specified Technologies Inc. LC Endothermic Firestop Sealant.
rr. 1 Hour Construction: UL System W-L-3357; Specified Technologies Inc. FP Intumescent Firestop Plug.
s. 1 Hour Construction: UL System W-L-3358; Specified Technologies Inc. Ready Split Sleeve.
tt. 1 Hour Construction: UL System W-L-3358; Specified Technologies Inc. Ready-Sleeve.
uu. 1 Hour Construction: UL System W-L-3369; Specified Technologies Inc. EZ Firestop Grommet.
vv. 1 Hour Construction: UL System W-L-3370; Specified Technologies Inc. EZ Firestop Grommet.
ww. 1 Hour Construction: UL System W-L-3374; Specified Technologies Inc. FP Intumescent Firestop Plug.
xx. 1 Hour Construction: UL System W-L-3376; Specified Technologies Inc. Ready-Sleeve.
yy. 1 Hour Construction: UL System W-L-3377; Specified Technologies Inc. EZ-Path Series 22 Fire-Rated Pathway.
z. 1 Hour Construction: UL System W-L-3377; Specified Technologies Inc. EZ-Path Series 33 Fire-Rated Pathway.
aaa. 1 Hour Construction: UL System W-L-3378; Specified Technologies Inc. EZ Firestop Grommet.
bbl. 1 Hour Construction: UL System W-L-3379; Specified Technologies Inc. EZ Firestop Grommet.
ccc. 1 Hour Construction: UL System W-L-3390; Specified Technologies Inc. EZ-Path Series 44 Fire-Rated Pathway.
ddd. 1 Hour Construction: UL System W-L-3393; Hilti CFS-SL RK Retrofit Sleeve Kit for Existing Cables.
eee. 1 Hour Construction: UL System W-L-3414; Hilti CFS-D Firestop Cable Disc.

5. Cable Trays with Electrical Cables:
a. 2 Hour Construction: UL System W-L-4008; Specified Technologies Inc. SSB Intumescent Firestop Pillows.
b. 2 Hour Construction: UL System W-L-4011; Hilti CFS-BL Firestop Block.
c. 2 Hour Construction: UL System W-L-4060; Hilti FS-ONE MAX Intumescent Firestop Sealant.
d. 1 Hour Construction: UL System W-L-4008; Specified Technologies Inc. SSB Intumescent Firestop Pillows.
e. 1 Hour Construction: UL System W-L-4011; Hilti CFS-BL Firestop Block.
f. 1 Hour Construction: UL System W-L-4060; Hilti FS-ONE MAX Intumescent Firestop Sealant.

6. Insulated Pipes:
a. 2 Hour Construction: UL System W-L-5014; Specified Technologies Inc. SSS Intumescent Firestop Sealant.
b. 2 Hour Construction: UL System W-L-5028; Hilti FS-ONE MAX Intumescent Firestop Sealant.
c. 2 Hour Construction: UL System W-L-5029; Hilti FS-ONE Intumescent Firestop Sealant.
d. 2 Hour Construction: UL System W-L-5121; Specified Technologies Inc. LCI Intumescent Firestop Sealant.
e. 2 Hour Construction: UL System W-L-5273; Specified Technologies Inc. LC Endothermic Firestop Sealant.
f. 2 Hour Construction: UL System W-L-5298; Specified Technologies Inc. WF300 Intumescent Firestop Caulk (For Wood Frame Construction).
g. 1 Hour Construction: UL System W-L-5014; Specified Technologies Inc. SSS Intumescent Firestop Sealant.
h. 1 Hour Construction: UL System W-L-5028; Hilti FS-ONE MAX Intumescent Firestop Sealant.

i. 1 Hour Construction: UL System W-L-5029; Hilti FS-ONE Intumescent Firestop Sealant.

j. 1 Hour Construction: UL System W-L-5121; Specified Technologies Inc. LCI Intumescent Firestop Sealant.

k. 1 Hour Construction: UL System W-L-5273; Specified Technologies Inc. LC Endothermic Firestop Sealant.

l. 1 Hour Construction: UL System W-L-5298; Specified Technologies Inc. WF300 Intumescent Firestop Caulk (For Wood Frame Construction).

7. HVAC Ducts, Insulated:

   a. 2 Hour Construction: UL System W-L-7156; Hilti FS-ONE MAX Intumescent Firestop Sealant.

   b. 2 Hour Construction: UL System W-L-7164; Specified Technologies Inc. FyreFlange HVAC Firestop Angle.

   c. 2 Hour Construction: UL System W-L-7238; Specified Technologies Inc. FyreFlange HVAC Firestop Angle.

   d. 1 Hour Construction: UL System W-L-7164; Specified Technologies Inc. FyreFlange HVAC Firestop Angle.

   e. 1 Hour Construction: UL System W-L-7238; Specified Technologies Inc. FyreFlange HVAC Firestop Angle.

   f. 1 Hour Construction: UL System W-L-7156; Hilti FS-ONE MAX Intumescent Firestop Sealant.

PART 3 EXECUTION

3.01 EXAMINATION

   A. Verify openings are ready to receive the work of this section.

3.02 PREPARATION

   A. Clean substrate surfaces of dirt, dust, grease, oil, loose material, or other materials that could adversely affect bond of firestopping material.

   B. Remove incompatible materials that could adversely affect bond.

   C. Install backing materials to prevent liquid material from leakage.

3.03 INSTALLATION

   A. Install materials in manner described in fire test report and in accordance with manufacturer's instructions, completely closing openings.

   B. Do not cover installed firestopping until inspected by authorities having jurisdiction.

   C. Install labeling required by code.

3.04 FIELD QUALITY CONTROL

   A. Independent Testing Agency: Inspection agency employed and paid by Owner, will examine penetration firestopping in accordance with ASTM E2174 and ASTM E2393.

   B. Repair or replace penetration firestopping and joints at locations where inspection results indicate firestopping or joints do not meet specified requirements.

3.05 CLEANING

   A. Clean adjacent surfaces of firestopping materials.

3.06 PROTECTION

   A. Protect adjacent surfaces from damage by material installation.

END OF SECTION 07 84 00
SECTION 07 92 00
JOINT SEALANTS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Nonsag gunnable joint sealants.
B. Self-leveling pourable joint sealants.
C. Joint backings and accessories.

1.02 RELATED REQUIREMENTS

A. Section 01 61 16 - Volatile Organic Compound (VOC) Content Restrictions: Additional requirements for sealants and primers.
B. Section 07 84 00 - Firestopping: Firestopping sealants.
C. Section 08 71 00 - Door Hardware: Setting exterior door thresholds in sealant.
D. Section 09 30 00 - Tiling: Sealant between tile and plumbing fixtures and at junctions with other materials and changes in plane.
E. Section 23 31 00 - HVAC Ducts and Casings: Duct sealants.

1.03 REFERENCE STANDARDS


1.04 SUBMITTALS

A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.
B. Product Data for Sealants: Submit manufacturer's technical data sheets for each product to be used, that includes the following.
   1. Physical characteristics, including movement capability, VOC content, hardness, cure time, and color availability.
   2. List of backing materials approved for use with the specific product.
   3. Substrates that product is known to satisfactorily adhere to and with which it is compatible.
   4. Substrates the product should not be used on.
   5. Substrates for which use of primer is required.
   6. Substrates for which laboratory adhesion and/or compatibility testing is required.
C. Product Data for Accessory Products: Submit manufacturer's technical data sheet for each product to be used, including physical characteristics, installation instructions, and recommended tools.

D. Color Cards for Selection: Where sealant color is not specified, submit manufacturer's color cards showing standard colors available for selection.

E. Joint Sealant Schedule: Indicate joint sealant location, joint sealant type, color, manufacturer and product name for each application.

F. Preconstruction Laboratory Test Reports: Submit at least four weeks prior to start of installation.

G. Field Quality Control Plan: Submit at least two weeks prior to start of installation.

H. Field Quality Control Log: Submit filled out log for each length or instance of sealant installed, within 10 days after completion of inspections/tests; include bagged test samples and photographic records, if any.

I. Manufacturer's Qualification Statement.

J. Installer's Qualification Statement.

1.05 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum three years documented experience.

B. Installer Qualifications: Company specializing in performing the work of this section and with at least three years of documented experience.

C. Testing Agency Qualifications: Independent firm specializing in performing testing and inspections of the type specified in this section.

D. Preconstruction Laboratory Testing: Arrange for sealant manufacturer(s) to test each combination of sealant, substrate, backing, and accessories.
   3. Allow sufficient time for testing to avoid delaying the work.
   4. Deliver to manufacturer sufficient samples for testing.
   5. Report manufacturer's recommended corrective measures, if any, including primers or techniques not indicated in product data submittals.
   6. Testing is not required if sealant manufacturer provides data showing previous testing, not older than 24 months, that shows satisfactory adhesion, lack of staining, and compatibility.

E. Field Quality Control Plan:
   1. Visual inspection of entire length of sealant joints.
   2. Non-destructive field adhesion testing of sealant joints, except interior acrylic latex sealants.
      a. For each different sealant and substrate combination, allow for one test every 12 inches in the first 10 linear feet of joint and one test every 24 inches thereafter.
      b. If any failures occur in the first 10 linear feet, continue testing at 12 inches intervals at no extra cost to Owner.
   3. Destructive field adhesion testing of sealant joints, except interior acrylic latex sealant.
      a. For each different sealant and substrate combination, allow for one test every 100 feet in the first 1000 linear feet, and one test per 1000 linear feet thereafter, or once per floor on each elevation.
      b. If any failures occur in the first 1000 linear feet, continue testing at frequency of one test per 500 linear feet at no extra cost to Owner.
   4. Field testing agency's qualifications.
   5. Field Quality Control Log Form: Show same data fields as on Preinstallation Field Adhesion Test Log, with known information filled out and lines for multiple tests per sealant/substrate combinations; include visual inspection and specified field testing; allow for possibility that more tests than minimum specified may be necessary.
F. Field Adhesion Test Procedures:
   1. Allow sealants to fully cure as recommended by manufacturer before testing.
   2. Have a copy of the test method document available during tests.
   3. Record the type of failure that occurred, other information required by test method, and the information required on the Field Quality Control Log.
   4. When performing destructive tests, also inspect the opened joint for proper installation characteristics recommended by manufacturer, and report any deficiencies.
   5. Deliver the samples removed during destructive tests in separate sealed plastic bags, identified with project, location, test date, and test results, to Owner.
   6. If any combination of sealant type and substrate does not show evidence of minimum adhesion or shows cohesion failure before minimum adhesion, report results to Architect.

G. Non-Destructive Field Adhesion Test: Test for adhesion in accordance with ASTM C1521, using Nondestructive Spot Method.
   1. Record results on Field Quality Control Log.
   2. Repair failed portions of joints.

H. Destructive Field Adhesion Test: Test for adhesion in accordance with ASTM C1521, using Destructive Tail Procedure.
   1. Sample: At least 18 inches long.
   2. Minimum Elongation Without Adhesive Failure: Consider the tail at rest, not under any elongation stress; multiply the stated movement capability of the sealant in percent by two; then multiply 1 inch by that percentage; if adhesion failure occurs before the "1 inch mark" is that distance from the substrate, the test has failed.
   3. If either adhesive or cohesive failure occurs prior to minimum elongation, take necessary measures to correct conditions and re-test; record each modification to products or installation procedures.
   4. Record results on Field Quality Control Log.
   5. Repair failed portions of joints.

I. Field Adhesion Tests of Joints: Test for adhesion using most appropriate method in accordance with ASTM C1521, or other applicable method as recommended by manufacturer.

1.06 WARRANTY
A. See Section 01 78 00 - Closeout Submittals, for additional warranty requirements.
B. Correct defective work within a five year period after Date of Substantial Completion.
C. Warranty: Include coverage for installed sealants and accessories that fail to achieve watertight seal, exhibit loss of adhesion or cohesion, or do not cure.

PART 2 PRODUCTS
2.01 MANUFACTURERS
A. Non-Sag Sealants: Permits application in joints on vertical surfaces without sagging or slumping.
   7. Substitutions: See Section 01 60 00 - Product Requirements.
B. Self-Leveling Sealants: Pourable or self-leveling sealant that has sufficient flow to form a smooth, level surface when applied in a horizontal joint.

2.02 JOINT SEALANT APPLICATIONS

A. Scope:
1. Exterior Joints: Seal open joints, whether or not the joint is indicated on drawings, unless specifically indicated not to be sealed. Exterior joints to be sealed include, but are not limited to, the following items:
   a. Wall expansion and control joints.
   b. Joints between door, window, and other frames and adjacent construction.
   c. Joints between different exposed materials.
   d. Openings below ledge angles in masonry.
   e. Other joints indicated below.
2. Interior Joints: Do not seal interior joints unless specifically indicated to be sealed. Interior joints to be sealed include, but are not limited to, the following items:
   a. Joints between door, window, and other frames and adjacent construction.
   b. In sound-rated wall and ceiling assemblies, gaps at electrical outlets, wiring devices, piping, and other openings; between wall/ceiling and other construction; and other flanking sound paths.
      1) Exception: Through-penetrations in sound-rated assemblies that are also fire-rated assemblies.
   c. Other joints indicated below.
3. Do not seal the following types of joints.
   a. Intentional weepholes in masonry.
   b. Joints indicated to be treated with manufactured expansion joint cover or some other type of sealing device.
   c. Joints where sealant is specified to be provided by manufacturer of product to be sealed.
   d. Joints where installation of sealant is specified in another section.
   e. Joints between suspended panel ceilings/grid and walls.

B. Exterior Joints: Use non-sag non-staining silicone sealant, unless otherwise indicated.
1. Lap Joints in Sheet Metal Fabrications: Butyl rubber, non-curing.
2. Lap Joints between Manufactured Metal Panels: Butyl rubber, non-curing.
3. Control and Expansion Joints in Concrete Paving: Self-leveling polyurethane "traffic-grade" sealant.

C. Interior Joints: Use non-sag polyurethane sealant, unless otherwise indicated.
3. Floor Joints in Wet Areas: Non-sag polyurethane "non-traffic-grade" sealant suitable for continuous liquid immersion.
4. Joints between Fixtures in Wet Areas and Floors, Walls, and Ceilings: Mildew-resistant silicone sealant; white.
5. In Sound-Rated Assemblies: Acrylic emulsion latex sealant.
7. Other Floor Joints: Self-leveling polyurethane "traffic-grade" sealant.

D. Interior Wet Areas: Bathrooms, restrooms, and Break Rooms; fixtures in wet areas include plumbing fixtures, food service equipment, countertops, cabinets, and other similar items.

E. Sound-Rated Assemblies: Walls and ceilings identified as "STC-rated", "sound-rated", or "acoustical".

2.03 JOINT SEALANTS - GENERAL
A. Sealants and Primers: Provide products with levels of volatile organic compound (VOC) content as indicated in Section 01 61 16.

2.04 NONSAG JOINT SEALANTS

A. Non-Staining Silicone Sealant: ASTM C920, Grade NS, Uses M and A; not expected to withstand continuous water immersion or traffic.
1. Movement Capability: Plus and minus 50 percent, minimum.
2. Non-Staining To Porous Stone: Non-staining to light-colored natural stone when tested in accordance with ASTM C1248.
3. Dirt Pick-Up: Reduced dirt pick-up compared to other silicone sealants.
5. Color: Match adjacent finished surfaces.
6. Manufacturers:
   d. Tremco Commercial Sealants & Waterproofing; Spectrem 1: www.tremcosilicone.com/#sle.
   e. Substitutions: See Section 01 60 00 - Product Requirements.

B. Silicone Sealant: ASTM C920, Grade NS, Use T; single-component, explicitly approved by manufacturer for traffic exposure when recessed below traffic surface; not expected to withstand continuous water immersion.
1. Movement Capability: Plus 100 percent and minus 50 percent, minimum.
2. Color: Dark Gray.
3. Manufacturers:
   c. Tremco Commercial Sealants & Waterproofing; Spectrem 800: www.tremcosilicone.com/#sle.
   d. Substitutions: See Section 01 60 00 - Product Requirements.

C. Silicone Sealant: ASTM C920, Grade NS, Uses M and A; not expected to withstand continuous water immersion or traffic.
3. Color: Match adjacent finished surfaces.
4. Cure Type: Single-component, neutral moisture curing
5. Service Temperature Range: Minus 65 to 180 degrees F.
6. Manufacturers:
   d. Substitutions: See Section 01 60 00 - Product Requirements.

D. Mildew-Resistant Silicone Sealant: ASTM C920, Grade NS, Uses M and A; single component, mildew resistant; not expected to withstand continuous water immersion or traffic.
2. Manufacturers:
   c. Substitutions: See Section 01 60 00 - Product Requirements.

E. Polyurethane Sealant: ASTM C920, Grade NS, Uses M and A; single or multi-component; not expected to withstand continuous water immersion or traffic.
1. Movement Capability: Plus and minus [_____] percent, minimum.
3. Color: Match adjacent finished surfaces.
4. Manufacturers:
   b. Pecora Corporation; DynaFlex: www.pecora.com/#sle.
   c. Sika Corporation; Sikaflex-1a: www.usa-sika.com/#sle.
   d. Tremco Commercial Sealants & Waterproofing; Dymeric 240 FC: www.tremcosealants.com/#sle.
   f. Substitutions: See Section 01 60 00 - Product Requirements.

F. Polyurethane Sealant for Continuous Water Immersion: ASTM C920, Grade NS, Uses M and A; single or multi-component; explicitly approved by manufacturer for continuous water immersion; suitable for traffic exposure when recessed below traffic surface.
1. Movement Capability: Plus and minus 35 percent, minimum.
3. Color: Match adjacent finished surfaces.
4. Manufacturers:
   b. Substitutions: See Section 01 60 00 - Product Requirements.

G. Acrylic Emulsion Latex: Water-based; ASTM C834, single component, non-staining, non-bleeding, non-sagging; not intended for exterior use.
1. Color: Standard colors matching finished surfaces, Type OP (opaque).
2. Grade: ASTM C834; Grade Minus 18 Degrees C (0 Degrees F).
3. Manufacturers:
   d. Substitutions: See Section 01 60 00 - Product Requirements.

H. Non-Curing Butyl Sealant: Solvent-based, single component, non-sag, non-skinning, non-hardening, non-bleeding; non-vapor-permeable; intended for fully concealed applications.
1. Manufacturers:
   b. Substitutions: See Section 01 60 00 - Product Requirements.

2.05 SELF-LEVELING SEALANTS
A. Self-Leveling Polyurethane Sealant: ASTM C920, Grade P, Uses M and A; single or multi-component; explicitly approved by manufacturer for traffic exposure; not expected to withstand continuous water immersion.
2. Hardness Range: 35 to 55, Shore A, when tested in accordance with ASTM C661.
3. Color: To be selected by Architect from manufacturer's standard range.
4. Service Temperature Range: Minus 40 to 180 degrees F.
5. Manufacturers:
   c. Substitutions: See Section 01 60 00 - Product Requirements.

2. Hardness Range: 30 to 35, Shore A, when tested in accordance with ASTM C661.
3. Color: Limestone.
4. Manufacturers:
   c. Substitutions: See Section 01 60 00 - Product Requirements.

C. Self-Leveling Polyurethane Sealant for Continuous Water Immersion: Polyurethane; ASTM C920, Grade P, Uses M and A; single or multi-component; explicitly approved by manufacturer for traffic exposure and continuous water immersion.
   2. Hardness Range: 35 to 55, Shore A, when tested in accordance with ASTM C661.
   3. Color: To be selected by Architect from manufacturer’s standard range.
   4. Manufacturers:
      c. Substitutions: See Section 01 60 00 - Product Requirements.

D. Semi-Rigid Self-Leveling Epoxy Joint Filler: Epoxy or epoxy/polyurethane copolymer; intended for filling cracks and control joints not subject to significant movement; rigid enough to support concrete edges under traffic.
   1. Composition: Multi-component, 100 percent solids by weight.
   2. Durometer Hardness: Minimum of 85 for Type A or 35 for Type D, after seven days when tested in accordance with ASTM D2240.
   3. Color: Concrete gray.
   6. Joint Depth: Provide product suitable for joints from 1/8 inch to 2 inches in depth including space for backer rod.
   7. Manufacturers:
      b. Nox-Crete Inc; DynaFlex 502: www.nox-crete.com/#sle.
      d. Substitutions: See Section 01 60 00 - Product Requirements.

E. Semi-Rigid Self-Leveling Polyurea Joint Filler: Two-component, 100 percent solids; intended for filling cracks and control joints not subject to significant movement; rigid enough to support concrete edges under traffic.
   1. Durometer Hardness, Type A: 75, minimum, after seven days when tested in accordance with ASTM D2240.
   2. Color: Concrete gray.
   5. Joint Depth: Provide product suitable for joints from 1/8 inch to 1 inch in depth excluding space for backer rod.
   6. Manufacturers:
      a. ARDEX Engineered Cements; ARDEX ARDISeal Rapid Plus: www.ardexamericas.com/#sle.
      b. Euclid Chemical Company; EUCO QWIkJoint UVR: www.euclidchemical.com/#sle.
      c. Nox-Crete Inc; DynaFlex JF-85: www.nox-crete.com/#sle.
      d. Rust-Oleum Corporation; Concrete Saver Flexible Joint Sealant: www.rustoleum.com/#sle.
      e. Substitutions: See Section 01 60 00 - Product Requirements.

F. Semi-Self-Leveling Polyurethane Sealant: Intended for expansion joints in sidewalks, swimming pool decks, plazas, floors and other horizontal surfaces with up to 6 percent slope.
   1. Composition: Single or multi-component.
2. Durometer Hardness, Type A: 35 to 45, minimum, when tested in accordance with ASTM D2240.
3. Color: To be selected by Architect from manufacturer's standard colors.
4. Manufacturers:
   b. Substitutions: See Section 01 60 00 - Product Requirements.

G. Polyurethane-Methacrylate (PUMA) Expansion Joint System: Intended for expansion joints in exposed multi-story parking garages, and includes aluminum tape, primer, joint compound material, and top coat.
   1. Durometer Hardness, Shore A: 65 to 87, minimum, when tested in accordance with ASTM D2240.
   2. Top Coat Color: Gray.
   3. Tensile Strength: 752 psi, minimum, when tested in accordance with ASTM D412.
   4. Manufacturers:
      b. Substitutions: See Section 01 60 00 - Product Requirements.

2.06 ACCESSORIES
A. Backer Rod: Cylindrical cellular foam rod with surface that sealant will not adhere to, compatible with specific sealant used, and recommended by backing and sealant manufacturers for specific application.
   1. Type for Joints Not Subject to Pedestrian or Vehicular Traffic: ASTM C1330; Type O - Open Cell Polyurethane.
   2. Type for Joints Subject to Pedestrian or Vehicular Traffic: ASTM C1330; Type B - Bi-Cellular Polyethylene.
   3. Open Cell: 40 to 50 percent larger in diameter than joint width.
   4. Closed Cell and Bi-Cellular: 25 to 33 percent larger in diameter than joint width.
   5. Manufacturers:
      c. Substitutions: See Section 01 60 00 - Product Requirements.

B. Backing Tape: Self-adhesive polyethylene tape with surface that sealant will not adhere to and recommended by tape and sealant manufacturers for specific application.

C. Masking Tape: Self-adhesive, nonabsorbent, non-staining, removable without adhesive residue, and compatible with surfaces adjacent to joints and sealants.

D. Joint Cleaner: Non-corrosive and non-staining type, type recommended by sealant manufacturer; compatible with joint forming materials.

E. Primers: Type recommended by sealant manufacturer to suit application; non-staining.

PART 3 EXECUTION
3.01 EXAMINATION
A. Verify that joints are ready to receive work.
B. Verify that backing materials are compatible with sealants.
C. Verify that backer rods are of the correct size.

3.02 PREPARATION
A. Remove loose materials and foreign matter that could impair adhesion of sealant.
B. Clean joints, and prime as necessary, in accordance with manufacturer's instructions.
C. Perform preparation in accordance with manufacturer's instructions and ASTM C1193.
D. Mask elements and surfaces adjacent to joints from damage and disfigurement due to sealant work; be aware that sealant drips and smears may not be completely removable.
E. Concrete Floor Joints That Will Be Exposed in Completed Work: Test joint filler in inconspicuous area to verify that it does not stain or discolor slab.

3.03 INSTALLATION

A. Perform work in accordance with sealant manufacturer's requirements for preparation of surfaces and material installation instructions.
B. Perform installation in accordance with ASTM C1193.
C. Perform acoustical sealant application work in accordance with ASTM C919.
D. Measure joint dimensions and size joint backers to achieve width-to-depth ratio, neck dimension, and surface bond area as recommended by manufacturer, except where specific dimensions are indicated.
E. Install bond breaker backing tape where backer rod cannot be used.
F. Install sealant free of air pockets, foreign embedded matter, ridges, and sags, and without getting sealant on adjacent surfaces.
G. Do not install sealant when ambient temperature is outside manufacturer's recommended temperature range, or will be outside that range during the entire curing period, unless manufacturer's approval is obtained and instructions are followed.
H. Nonsag Sealants: Tool surface concave, unless otherwise indicated; remove masking tape immediately after tooling sealant surface.
I. Concrete Floor Joint Filler: After full cure, shave joint filler flush with top of concrete slab.

3.04 FIELD QUALITY CONTROL

A. Perform field quality control inspection/testing as specified in PART 1 under QUALITY ASSURANCE article.
B. Non-Destructive Adhesion Testing: If there are any failures in first 100 linear feet, notify Architect immediately.
C. Destructive Adhesion Testing: If there are any failures in first 1000 linear feet, notify Architect immediately.
D. Remove and replace failed portions of sealants using same materials and procedures as indicated for original installation.
E. Repair destructive test location damage immediately after evaluation and recording of results.

3.05 POST-OCCUPANCY

A. Post-Occupancy Inspection: Perform visual inspection of entire length of project sealant joints at a time that joints have opened to their greatest width; i.e. at low temperature in thermal cycle. Report failures immediately and repair.

END OF SECTION 07 92 00
PART 1 GENERAL

1.01 SECTION INCLUDES
A. Expansion joint cover assemblies for floor, wall, and ceiling surfaces.

1.02 RELATED REQUIREMENTS
A. Section 03 10 00 - Concrete Forming and Accessories: Placement of joint cover assembly frames in formwork.
B. Section 07 62 00 - Sheet Metal Flashing and Trim: Roof expansion and control joint covers.
C. Section 07 71 00 - Roof Specialties: Roof expansion and control joint covers.
D. Section 07 92 00 - Joint Sealants: Sealing expansion and control joints using gunnable and pourable sealants.
E. Section 09 21 16 - Gypsum Board Assemblies: Placement of expansion joint assemblies in gypsum board walls and ceilings.

1.03 REFERENCE STANDARDS

1.04 ADMINISTRATIVE REQUIREMENTS
A. Installation Templates: For frames and anchors to be embedded in concrete or masonry, furnish templates to relevant installers; include installation instructions and tolerances.

1.05 SUBMITTALS
A. See Section 01 30 00 - Administrative Requirements for submittal procedures.
B. Product Data: Provide joint assembly profiles, profile dimensions, anchorage devices and available colors and finish.
C. Shop Drawings: Indicate joint and splice locations, miters, layout of the work, affected adjacent construction and anchorage locations.
D. Samples: Submit two samples 4 inch long, illustrating profile, dimension, color, and finish selected.
E. Manufacturer's Installation Instructions: Indicate rough-in sizes and required tolerances for item placement.

PART 2 PRODUCTS

2.01 MANUFACTURERS
A. Expansion Joint Cover Assemblies:
   6. Substitutions: See Section 01 60 00 - Product Requirements.

2.02 EXPANSION JOINT COVER ASSEMBLY APPLICATIONS
A. Interior Floor Joints Subject to Thermal Movement:
   1. Manufacturers:
a. BASF Watson Bowman Acme Corporation; Wabo CorridorWrap Floor: www.wbacorp.com/#sle.
c. Substitutions: See Section 01 60 00 - Product Requirements.

B. Interior Wall/Ceiling Joints Subject to Thermal Movement:
   1. Manufacturers:
      b. Substitutions: See Section 01 60 00 - Product Requirements.

C. Exterior Wall Joints Subject to Thermal Movement:
   1. Manufacturers:
      a. Construction Specialties, Inc; Exterior Wall Covers: www.c-sgroup.com/#sle.
      c. Substitutions: See Section 01 60 00 - Product Requirements.

D. Parking/Bridge Deck Joints:
   1. Manufacturers:
      d. Substitutions: See Section 01 60 00 - Product Requirements.

2.03 EXPANSION JOINT COVER ASSEMBLIES

A. Expansion Joint Cover Assemblies - General: Factory-fabricated and assembled; designed to completely fill joint openings, sealed to prevent passage of air, dust, water, smoke; suitable for traffic expected.
   1. Joint Dimensions and Configurations: As indicated on drawings.
   2. Joint Cover Sizes: Selected to suit joint width and configuration, based on manufacturer's published recommendations and limitations.
   3. Joint Movement Capability: If not indicated, provide minimum plus/minus 25 percent joint movement capability.
   4. Lengths: Provide covers in full lengths required; avoid splicing wherever possible.
   5. Anchors, Fasteners, and Fittings: Provided by cover manufacturer.

B. Floor Joint Covers: Coordinate with indicated floor coverings.
   1. If style is not indicated, provide extruded aluminum frame both sides, resilient seals, and minimize exposed metal.

C. Resilient Seal Type Covers: Having flat exposed surface without crevices that could collect dirt; designed to withstand expected movement without extrusion of seal from joint assembly; for floors, provide style that is flush with top of floor covering; for exterior joints, weathertight.

D. Sliding Cover Plate Type Covers: Provide plate with beveled edges and neat fit that does not collect dirt.

E. Covers In Gypsum Board Assemblies: Provide style with anchoring wings that can be completely covered by joint compound.

F. Covers In Fire Rated Assemblies: Provide cover assembly having fire rating equivalent to that of assembly into which it is installed.

2.04 MATERIALS

A. Extruded Aluminum: ASTM B221 (ASTM B221M), 6063 alloy, T6 temper; or ASTM B308/B308M, 6061 alloy, T6 temper.
   1. Exposed Finish Outdoors: Natural anodized.
   2. Exposed Finish at Floors: Mill finish or natural anodized.
3. Exposed Finish at Walls and Ceilings: Natural anodized.

B. Resilient Seals:
   1. For Ceilings: Any resilient material, flush, pleated, or hollow gasket.
   2. For Pedestrian Traffic Applications: EPDM rubber, Neoprene, or Santoprene; no PVC; Shore A hardness of 40 to 50 Durometer.
   3. For Vehicular Traffic Applications: EPDM rubber, Neoprene, or Santoprene; no PVC; Shore A hardness of 40 to 50 Durometer.

C. Anchors and Fasteners: As recommended by cover manufacturer.

D. Ferrous Metal Anchors: Galvanized where embedded in concrete or in contact with cementitious materials.

E. Threaded Fasteners: Aluminum.

F. Backing Paint for Aluminum Components in Contact with Cementitious Materials: Asphaltic type.

PART 3 EXECUTION

3.01 EXAMINATION
   A. Verify that joint preparation and dimensions are acceptable and in accordance with manufacturer's requirements.

3.02 INSTALLATION
   A. Install components and accessories in accordance with manufacturer's instructions.
   B. Align work plumb and level, flush with adjacent surfaces.
   C. Rigidly anchor to substrate to prevent misalignment.

3.03 PROTECTION
   A. Do not permit traffic over unprotected floor joint surfaces.
   B. Provide strippable coating to protect finish surface.

END OF SECTION 07 95 13
SECTION 08 11 13
HOLLOW METAL DOORS AND FRAMES

PART 1 GENERAL

1.01 SECTION INCLUDES
A. Non-fire-rated hollow metal doors and frames.
B. Hollow metal frames for wood doors.
C. Fire-rated hollow metal doors and frames.
D. Thermally insulated hollow metal doors with frames.
E. Commercial security hollow metal doors and frames.
F. Hurricane-resistant hollow metal doors and frames.
G. Hollow metal borrowed lites glazing frames.

1.02 RELATED REQUIREMENTS
A. Section 08 71 00 - Door Hardware.
B. Section 08 80 00 - Glazing: Glass for doors and borrowed lites.
C. Section 09 91 13 - Exterior Painting: Field painting.
D. Section 09 91 23 - Interior Painting: Field painting.

1.03 REFERENCE STANDARDS
C. ANSI/SDI A250.6 - Recommended Practice for Hardware Reinforcing on Standard Steel Doors and Frames 2015.
S. Miami (APD) - Approved Products Directory; Miami-Dade County Current Edition.
U. NAAMM HMMA 831 - Hardware Locations for Hollow Metal Doors and Frames 2011.

1.04 SUBMITTALS
A. See Section 01 30 00 - Administrative Requirements for submittal procedures.
B. Product Data: Materials and details of design and construction, hardware locations, reinforcement type and locations, anchorage and fastening methods, and finishes; and one copy of referenced standards/guidelines.
C. Shop Drawings: Details of each opening, showing elevations, glazing, frame profiles, and any indicated finish requirements.
D. Design Submittals: Manufacturer to submit anchor design analysis calculations for blast-resistant doors signed and sealed by specialty design engineer experienced in this type of work and licensed in Florida.
E. Installation Instructions: Manufacturer's published instructions, including any special installation instructions relating to this project.
F. Manufacturer's Certificate: Certification that products meet or exceed specified requirements.
G. Manufacturer's Qualification Statement.
H. Installer's Qualification Statement.

1.05 QUALITY ASSURANCE
A. Manufacturer Qualifications: Company specializing in manufacturing products specified in this section, with not less than three years documented experience.
B. Installer Qualifications: Company specializing in performing work of the type specified and with at least three years of documented experience.
C. Maintain at project site copies of reference standards relating to installation of products specified.

1.06 DELIVERY, STORAGE, AND HANDLING
A. Comply with NAAMM HMMA 840 or ANSI/SDI A250.8 (SDI-100) in accordance with specified requirements.
B. Protect with resilient packaging; avoid humidity build-up under coverings; prevent corrosion and adverse effects on factory applied painted finish.

PART 2 PRODUCTS
2.01 MANUFACTURERS
A. Hollow Metal Doors and Frames:
  5. Steelcraft, an Allegion brand: www.allegion.com/#sle.

2.02 PERFORMANCE REQUIREMENTS

A. Requirements for Hollow Metal Doors and Frames:
  1. Steel Sheet: Comply with one or more of the following requirements; galvannealed steel complying with ASTM A1008/A1008M, hot-rolled pickled and oiled (HRPO) steel complying with ASTM A1011/A1011M, commercial steel (CS) Type B, for each.
  2. Accessibility: Comply with ICC A117.1 and ADA Standards.
  3. Exterior Door Top Closures: Flush end closure channel, with top and door faces aligned.
  4. Door Edge Profile: Manufacturers standard for application indicated.
  5. Typical Door Face Sheets: Flush.
  7. Hardware Preparations, Selections and Locations: Comply with NAAMM HMMA 830 and NAAMM HMMA 831 or BHMA A156.115 and ANSI/SDI A250.8 (SDI-100) in accordance with specified requirements.
  8. Zinc Coating for Typical Interior and/or Exterior Locations: Provide metal components zinc-coated (galvanized) and/or zinc-iron alloy-coated (galvannealed) by the hot-dip process in accordance with ASTM A653/A653M, with manufacturer’s standard coating thickness, unless noted otherwise for specific hollow metal doors and frames.
    a. Based on SDI Standards: Provide at least A40/ZF120 (galvannealed) when necessary, coating not required for typical interior door applications, and at least A60/ZF180 (galvannealed) for corrosive locations.

B. Hollow Metal Panels: Same construction, performance, and finish as doors.

C. Combined Requirements: If a particular door and frame unit is indicated to comply with more than one type of requirement, comply with the specified requirements for each type; for instance, an exterior door that is also indicated as being sound-rated must comply with the requirements specified for exterior doors and for sound-rated doors; where two requirements conflict, comply with the most stringent.

2.03 HOLLOW METAL DOORS

A. Exterior Doors: Thermally insulated.
  1. Based on SDI Standards: ANSI/SDI A250.8 (SDI-100).
    a. Level 1 - Standard-duty.
    b. Physical Performance Level C, 250,000 cycles; in accordance with ANSI/SDI A250.4.
    c. Model 1 - Full Flush.
    d. Door Face Metal Thickness: 20 gauge, 0.032 inch, minimum.

B. Interior Doors, Non-Fire-Rated:
  1. Based on SDI Standards: ANSI/SDI A250.8 (SDI-100).
    a. Level 1 - Standard-duty.
    b. Physical Performance Level C, 250,000 cycles; in accordance with ANSI/SDI A250.4.
    c. Model 1 - Full Flush.
    d. Door Face Metal Thickness: 20 gauge, 0.032 inch, minimum.

C. Fire-Rated Doors:
  1. Based on SDI Standards: ANSI/SDI A250.8 (SDI-100).
    a. Level 1 - Standard-duty.
b. Physical Performance Level C, 250,000 cycles; in accordance with ANSI/SDI A250.4.
c. Model 1 - Full Flush.
d. Door Face Metal Thickness: 20 gauge, 0.032 inch, minimum.

2. Fire Rating: As indicated on Door Schedule, tested in accordance with UL 10C and NFPA 252 ("positive pressure fire tests").
3. Provide units listed and labeled by UL (DIR) or ITS (DIR).
   a. Attach fire rating label to each fire rated unit.

D. Hurricane-Resistant Doors:
1. Comply with Florida Building Code (FBC) test protocols for High Velocity Hurricane Zone (HVHZ) FBC TAS 201, FBC TAS 202 and FBC TAS 203.
2. Design and size door and frame components to withstand the specified load requirements without damage or permanent set, when tested in accordance with ASTM E330/E330M.
   a. Design Wind Loads: Comply with requirements of authorities having jurisdiction.
   b. Wind-Borne Debris Resistance: Door and frame components shall have FLA (PAD) approval or Miami (APD) approval for Large and Small Missile impact and pressure cycling at design wind loads.
3. Based on SDI Standards: ANSI/SDI A250.8 (SDI-100).
   a. Level 3 - Extra Heavy-duty.
   b. Physical Performance Level A, 1,000,000 cycles; in accordance with ANSI/SDI A250.4.
   c. Model 1 - Full Flush.
   d. Door Face Metal Thickness: 16 gauge, 0.053 inch, minimum.
4. Door Core Material: Manufacturers standard core material/construction and in compliance with requirements.

2.04 HOLLOW METAL FRAMES

A. Comply with standards and/or custom guidelines as indicated for corresponding door in accordance with applicable door frame requirements.

B. Frame Finish: Factory primed and field finished.

C. Exterior Door Frames: Knock-down type.
   1. Weatherstripping: Separate, see Section 08 71 00.

D. Interior Door Frames, Non-Fire Rated: Full profile/continuously welded type.
   1. Terminated Stops: Provide at interior doors; closed end stop terminated 6 inch, maximum, above floor at 45 degree angle.
   2. Frame Metal Thickness: 18 gauge, 0.042 inch, minimum.

E. Door Frames, Fire-Rated: Knock-down type.
   1. Fire Rating: Same as door, labeled.
   2. Terminated Stops: Provide at interior doors; closed end stop terminated 6 inch, maximum, above floor at 45 degree angle.
   3. Frame Metal Thickness: 18 gauge, 0.042 inch, minimum.

F. Hurricane-Resistant Door Frames: With same hurricane resistance as door; face welded or full profile/continuously welded construction, ground smooth, fully prepared and reinforced for hardware installation.
   1. Frame Metal Thickness: 16 gauge, 0.053 inch, minimum.
   2. Stainless-Steel Finish: Same as stainless-steel door finish.

G. Frames for Wood Doors: Comply with frame requirements in accordance with corresponding door.

H. Borrowed Lites Glazing Frames: Construction and face dimensions to match door frames, and as indicated on drawings.

I. Frames Wider than 48 inches: Reinforce with steel channel fitted tightly into frame head, flush with top.
2.05 FINISHES
   A. Primer: Rust-inhibiting, complying with ANSI/SDI A250.10, door manufacturer's standard.

2.06 ACCESSORIES
   A. Louvers: Roll formed steel with overlapping frame; finish same as door components; factory-installed.
      1. In Fire-Rated Doors: UL (DIR) or ITS (DIR) listed fusible link louver, same rating as door.
      2. Style: Standard straight slat blade.
      3. Fasteners: Concealed fasteners.
   B. Glazing: As specified in Section 08 80 00, factory installed.
   C. Grout for Frames: Mortar grout complying with ASTM C476 with maximum slump of 4 inches as measured in accordance with ASTM C143/C143M for hand troweling in place; plaster grout and thinner pumpable grout are prohibited.
   D. Silencers: Resilient rubber, fitted into drilled hole; provide three on strike side of single door, three on center mullion of pairs, and two on head of pairs without center mullions.
   E. Temporary Frame Spreaders: Provide for factory- or shop-assembled frames.

PART 3 EXECUTION

3.01 EXAMINATION
   A. Verify existing conditions before starting work.
   B. Verify that opening sizes and tolerances are acceptable.
   C. Verify that finished walls are in plane to ensure proper door alignment.

3.02 PREPARATION
   A. Coat inside of frames to be installed in masonry or to be grouted, with bituminous coating, prior to installation.

3.03 INSTALLATION
   A. Install doors and frames in accordance with manufacturer's instructions and related requirements of specified door and frame standards or custom guidelines indicated.
   B. Install fire rated units in accordance with NFPA 80.
   C. Coordinate frame anchor placement with wall construction.
   D. Grout frames in masonry construction, using hand trowel methods; brace frames so that pressure of grout before setting will not deform frames.
   E. Install door hardware as specified in Section 08 71 00.
      1. Comply with recommended practice for hardware placement of doors and frames in accordance with ANSI/SDI A250.6 or NAAMM HMMA 861.
   F. Comply with glazing installation requirements of Section 08 80 00.
   G. Coordinate installation of electrical connections to electrical hardware items.
   H. Touch up damaged factory finishes.

3.04 TOLERANCES
   A. Clearances Between Door and Frame: Comply with related requirements of specified frame standards or custom guidelines indicated in accordance with SDI 117 or NAAMM HMMA 861.
   B. Maximum Diagonal Distortion: 1/16 inch measured with straight edge, corner to corner.

3.05 ADJUSTING
   A. Adjust for smooth and balanced door movement.

END OF SECTION 08 11 13
SECTION 08 17 00
INTEGRATED DOOR OPENING ASSEMBLIES

PART 1 GENERAL

1.01 SECTION INCLUDES
A. Factory-assembled and factory-finished hollow metal doors and frames, including hardware for door opening assemblies.

1.02 REFERENCE STANDARDS
E. BHMA A156.3 - American National Standard for Exit Devices 2014.
F. BHMA A156.4 - American National Standard for Door Controls - Closers 2013.

1.03 SUBMITTALS
A. See Section 01 30 00 - Administrative Requirements for submittal procedures.
B. Product Data: Materials and details of design and construction, hardware locations, reinforcement type and locations, anchorage and fastening methods, and finishes.
C. Shop Drawings: Indicate details of each opening showing elevations, glazing, frame profiles, hardware, and different finish locations, if any.
D. Samples: Submit two samples of exposed door finish materials, in manufacturer's standard sizes, showing factory finishes and colors as selected.
E. Certificate: Certify that products of this section meet or exceed specified requirements.
F. Installation Instructions: Manufacturer's published instructions, including any special installation instructions relating to this project.
G. Manufacturer's qualification statement.
H. Installer's qualification statement.
I. Warranty Documentation: Submit manufacturer warranty and ensure that forms have been completed in Owner's name and registered with manufacturer.

1.04 QUALITY ASSURANCE
A. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum three years documented experience.

B. Installer Qualifications: Company specializing in performing work of the type specified and with minimum three years of documented experience.

1.05 DELIVERY, STORAGE, AND HANDLING

A. Deliver units preassembled and prefinished, with door hardware mounted and functioning, and packaged to protect contents from damage.
   1. Supply double door units without prehung doors, unless otherwise indicated.

B. Store in a clean, dry, and ventilated space having controlled temperature and relative humidity between 30 and 60 percent and in accordance with manufacturer's written instructions.

C. Stack doors flat and off the floor to prevent warping.

1.06 WARRANTY

A. See Section 01 78 00 - Closeout Submittals for additional warranty requirements.

B. Provide manufacturer's standard warranty against defects in material and workmanship:
   1. For entire door opening assembly, provide five year warranty period after Date of Substantial Completion.
   2. Warranty shall be void unless units are stored in accordance with manufacturer's instructions prior to installation.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Basis of Design - Integrated Door Opening Assemblies:

B. Other Acceptable Integrated Door Opening Assemblies Manufacturers:

C. Substitutions: See Section 01 60 00 - Product Requirements.

2.02 ASSEMBLIES

A. Door, Frame, and Hardware Assemblies: Provide fully functional, factory-assembled and factory-finished door opening units, complete with door, frame, and hardware; complying with BHMA A156.32 and specified requirements.
   1. Accessibility: Comply with ICC A117.1 and ADA Standards.

B. Applications:
   1. Door opening assemblies include elevator lobby and stairwell as indicated on drawings.
      a. Provide double door openings as indicated on drawings.
      b. Provide independent latching pairs.

C. Electric Operated Doors:
   1. Operation: Fail Secure (locked when power is removed), relative to secure side.

2.03 PERFORMANCE REQUIREMENTS

A. Comply with requirements of local building code and authorities having jurisdiction, and the following:
   1. Force to Open Interior Swinging Egress Doors, Non-Fire Doors: Not more than 5 lb.
   2. Force to Release Latch for Other Swinging Doors: Not more than 15 lb to release latch, not more than 30 lb to set door in motion, and not more than 15 lb to swing door to full open position.
   3. Fire-Rated Doors: Comply with NFPA 80 and NFPA 252.
   4. Temperature Rise Across Fire Doors in Interior Exit Stairways: Maximum of 250 degrees F above ambient at end of 30 minutes standard fire test exposure.
   5. Provide fire-rated units listed and labeled by UL (DIR).
a. Attach fire rating label to each fire-rated unit in compliance with NFPA 80.

2.04 COMPONENTS

A. Hollow Metal Doors: Doors complying with ANSI/SDI A250.8 construction requirements exceeding Level 3 and Physical Performance Level A, Model 1 - Full Flush; electrogalvanized prior to finishing; manufacturer's standard core and reinforcements.
   2. Fire-Rated Doors: 16 gauge, 0.053 inch thick faces and edges.

B. Hollow Metal Door Frames: Formed steel cased opening complying with ANSI/SDI A250.8 construction requirements exceeding Level 3 and Physical Performance Level A; electrogalvanized prior to finishing.
   1. Type: Full profile welded, 16 gauge, 0.053 inch, primed for field finishing.
   2. Provide frame anchors for secure installation and to comply with opening performance requirements.

2.05 DOOR HARDWARE

A. Manufacturers: Door hardware manufacturers are as determined by manufacturer of Integrated Door Opening Assemblies in compliance with BHMA A156.32 requirements for applications indicated.

B. Continuous Hinges: Full height; complying with BHMA A156.26, Grade 1.
   1. Type: Pin and barrel.
   2. Base Metal: Aluminum.
   3. Finish: As selected by Architect.

C. Mortise Locks: Complying with BHMA A156.13, Grade 1.
   1. Locking Functions: Provide to suit door occupancy, and selected from door manufacturer's standard functions.

D. Lock Cylinders: Provide standard type cylinders, with six-pin core in compliance with BHMA A156.5, Grade 1, at locations indicated.
   1. Provide key access on outside of each lock, unless otherwise indicated.
   2. Provide high security mechanical type cylinders, with six-pin core in compliance with BHMA A156.30, Grade 1, at locations indicated.
   3. Provide cylinders from same manufacturer as locking device.
   4. Provide cams and/or tailpieces as required for locking devices.

E. Concealed Pocket Door Closers: Provide concealed wall mounted pocket door closer with cover, 180 degree swing, positive stop, adjustable sizing, latching, and closing speed; complying with BHMA A156.4, Grade 1.
   1. Normally Open Doors: Provide concealed closer and arm, when door is open.
   2. Provide for fire-rated integrated doors and other doors as indicated in schedule.

F. Flush Panic Exit Devices: Provide flush panel exit device, recessed into door; extruded aluminum, natural anodized finish; complying with BHMA A156.3, Grade 1.
   1. Projection From Face of Door: Maximum of 3/16 inch when door is open, minimum of 1-1/8 inch when closed.
   2. Face Insert: To match door finish.

G. Door Pulls, Lever Handle Trim: Provide lever handle trim to operate locksets or latchsets; lever design selected from door manufacturer's full line; rectangular escutcheon.
   2. Finish: Satin.

H. Electromagnetic Door Holders: Complying with BHMA A156.15.
   3. Voltage: 12 VDC.

2.06 FINISHES
A. Doors and Frames:
      a. Color: As selected by Architect from manufacturer's standard range.
   4. Applied Vinyl: As selected by Architect from manufacturer's standard list.

B. Door Hardware: Provide door hardware of same finish, unless otherwise indicated.
   1. Finish: 630; satin stainless steel, with stainless steel 300 series base material (former US equivalent US32D); BHMA A156.18.

**2.07 ACCESSORIES**

A. Frame Spreader Bar: Provide for preassembled welded frames, unless otherwise indicated.

**PART 3 EXECUTION**

**3.01 EXAMINATION**

A. Verify existing conditions before starting this Work.
B. Verify that opening sizes and tolerances are acceptable.

**3.02 INSTALLATION**

A. Install doors in accordance with manufacturer's requirements and the specified performance requirements.
B. Install fire rated units in accordance with NFPA 80.
C. Coordinate frame anchor placement with wall construction.
D. Coordinate installation of electrical connections to electrical hardware items.
E. Touch up damaged factory finishes.

**3.03 TOLERANCES**

A. Clearances Between Door and Frame: As specified in ANSI/SDI A250.8.
B. Maximum Diagonal Distortion: 1/16 in measured with straight edge, corner to corner.

**3.04 ADJUSTING**

A. Adjust for smooth and balanced door movement.

**HARDWARE SET - CROSS CORRIDOR, SAME SWING PAIRS, ELECTRIFIED EXIT DEVICE, AUTOMATIC OPERATOR**

Provide the following for each Pair (PR) doors.

<table>
<thead>
<tr>
<th>UNITS</th>
<th>ITEM</th>
<th>DESCRIPTION</th>
<th>FINISH</th>
<th>MFR</th>
</tr>
</thead>
<tbody>
<tr>
<td>2 Each</td>
<td>CONT. HINGE, EDGE MOUNT</td>
<td>EM</td>
<td>630</td>
<td>SYN</td>
</tr>
<tr>
<td>2 Each</td>
<td>ELECTRIFIED EXIT DEVICE X LEVER (Always Locked)</td>
<td>XT-LC-ML</td>
<td>630</td>
<td>SYN</td>
</tr>
<tr>
<td>2 Each</td>
<td>MORTISE CYLINDER</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1 Each</td>
<td>AUTO OPERATOR</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1 Set</td>
<td>SMOKE SEAL</td>
<td>SS</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2 Each</td>
<td>KICK PLATE</td>
<td>KP</td>
<td>630</td>
<td>SYN</td>
</tr>
<tr>
<td>1 Each</td>
<td>WIRE TRANSFER</td>
<td>EPT-EM-105</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1 Each</td>
<td>POWER SUPPLY</td>
<td>PS-1</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

END OF SECTION 08 17 00
SECTION 08 43 13
ALUMINUM-FRAMED STOREFRONTS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Aluminum-framed storefront, with vision glass.
B. Infill panels of metal and glass.
C. Aluminum doors and frames.
D. Weatherstripping.

1.02 RELATED REQUIREMENTS

A. Section 05 12 00 - Structural Steel Framing: Steel attachment members.
B. Section 07 92 00 - Joint Sealants: Sealing joints between frames and adjacent construction.
C. Section 08 44 13 - Glazed Aluminum Curtain Walls.
D. Section 08 71 00 - Door Hardware: Hardware items other than specified in this section.
E. Section 08 80 00 - Glazing: Glass and glazing accessories.

1.03 REFERENCE STANDARDS

A. AAMA CW-10 - Care and Handling of Architectural Aluminum from Shop to Site 2015.
P. ASTM E1105 - Standard Test Method for Field Determination of Water Penetration of Installed Exterior Windows, Skylights, Doors, and Curtain Walls, by Uniform or Cyclic Static Air Pressure
1.04 ADMINISTRATIVE REQUIREMENTS
A. Coordinate with installation of other components that comprise the exterior enclosure.
B. Preinstallation Meeting: Conduct a preinstallation meeting one week before starting work of this section; require attendance by all affected installers.

1.05 SUBMITTALS
A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.
B. Product Data: Provide component dimensions, describe components within assembly, anchorage and fasteners, glass and infill, door hardware, and internal drainage details.
C. Shop Drawings: Indicate system dimensions, framed opening requirements and tolerances, affected related work, expansion and contraction joint location and details, and field welding required.
   1. Structural component details are to be signed and stamped by a registered engineer licensed in the State of Florida.
D. Manufacturer's Certificate: Certify that the products supplied meet or exceed the specified requirements.
E. Design Data: Provide framing member structural and physical characteristics, engineering calculations, and dimensional limitations.
F. Hardware Schedule: Complete itemization of each item of hardware to be provided for each door, cross-referenced to door identification numbers in Contract Documents.
G. Field Quality Control Submittals: Report of field testing for water penetration and air leakage.
H. Designer's Qualification Statement.
I. Manufacturer's Qualification Statement.
J. Installer's Qualification Statement.
K. Warranty: Submit manufacturer warranty and ensure forms have been completed in Owner's name and registered with manufacturer.

1.06 QUALITY ASSURANCE
A. Designer Qualifications: Design structural support framing components under direct supervision of a Professional Structural Engineer experienced in design of this Work and licensed in Florida.
B. Manufacturer Qualifications: Company specializing in performing work of type specified and with at least three years of documented experience.
   1. Provide certified glass products through ANSI accredited certifications that include plant audits and independent laboratory performance testing.
      a. Insulating Glass Certification Council (IGCC).
      b. Safety Glazing Certification Council (SGCC).
C. Installer Qualifications: Company specializing in performing work of type specified and with at least three years of documented experience.
   1. Provide company, field supervisors, and installers that hold active ANSI accredited certifications in appropriate categories for work specified.
      a. North American Contractor Certification (NACC) for glazing contractors.

1.07 DELIVERY, STORAGE, AND HANDLING
A. Handle products of this section in accordance with AAMA CW-10.
B. Protect finished aluminum surfaces with wrapping. Do not use adhesive papers or sprayed coatings that bond to aluminum when exposed to sunlight or weather.
1.08 FIELD CONDITIONS

A. Do not install sealants when ambient temperature is less than 40 degrees F. Maintain this minimum temperature during and 48 hours after installation.

1.09 WARRANTY

A. See Section 01 78 00 - Closeout Submittals, for additional warranty requirements.
B. Correct defective Work within a five year period after Date of Substantial Completion.
C. Provide five year manufacturer warranty against failure of glass seal on insulating glass units, including interpane dusting or misting. Include provision for replacement of failed units.
D. Provide five year manufacturer warranty against excessive degradation of exterior finish. Include provision for replacement of units with excessive fading, chalking, or flaking.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Aluminum-Framed Storefronts Manufacturers:

2.02 BASIS OF DESIGN -- FRAMING FOR INSULATING GLAZING

A. Center-Set Style, Wind-Borne-Debris Resistance Tested:
   2. Vertical Mullion Dimensions: 2-1/2 inches wide by 5 inches deep.

2.03 BASIS OF DESIGN -- SWINGING DOORS

A. Wind-Borne-Debris Resistance Tested:

2.04 ALUMINUM-FRAMED STOREFRONT

A. Aluminum-Framed Storefront: Factory fabricated, factory finished aluminum framing members with infill, and related flashings, anchorage and attachment devices.
   1. Unitized, shop assembly.
   2. Glazing Rabbet: For 1 inch insulating glazing.
      a. Factory finish all surfaces that will be exposed in completed assemblies.
      b. Touch-up surfaces cut during fabrication so that no natural aluminum is visible in completed assemblies, including joint edges.
      c. Coat concealed metal surfaces that will be in contact with cementitious materials or dissimilar metals with bituminous paint.
   4. Finish Color: As selected by Architect from manufacturer's standard line.
   5. Fabrication: Joints and corners flush, hairline, and weatherproof, accurately fitted and secured; prepared to receive anchors and hardware; fasteners and attachments concealed from view; reinforced as required for imposed loads.
   7. System Internal Drainage: Drain to the exterior by means of a weep drainage network any water entering joints, condensation occurring in glazing channel, and migrating moisture occurring within system.
   8. Expansion/Contraction: Provide for expansion and contraction within system components caused by cycling temperature range of 170 degrees F over a 12 hour period without
causing detrimental effect to system components, anchorages, and other building elements.

9. Movement: Allow for movement between storefront and adjacent construction, without damage to components or deterioration of seals.

10. Perimeter Clearance: Minimize space between framing members and adjacent construction while allowing expected movement.

11. Air and Vapor Seal: Maintain continuous air barrier and vapor retarder throughout assembly, primarily in line with inside pane of glazing and inner sheet of infill panel and heel bead of glazing compound.

B. Performance Requirements

1. Wind Loads: Design and size components to withstand the specified load requirements without damage or permanent set, when tested in accordance with ASTM E330/E330M, using loads 1.5 times the design wind loads and 10 second duration of maximum load.
   c. Member Deflection: Limit member deflection to flexure limit of glass in any direction, with full recovery of glazing materials.

2. Wind-Borne-Debris Resistance: Identical full-size glazed assembly without auxiliary protection, having Florida Building Code FLA (PAD) approval for Large and Small Missile impact and pressure cycling at design wind pressure.

3. Water Penetration Resistance on Manufactured Assembly: No uncontrolled water on interior face, when tested in accordance with ASTM E331 at pressure differential of 8 psf.

4. Air Leakage: 0.06 cfm/sq ft maximum leakage of storefront wall area when tested in accordance with ASTM E283/E283M at 1.57 psf pressure difference.

5. Condensation Resistance Factor of Framing: 50, minimum, measured in accordance with AAMA 1503.

2.05 COMPONENTS

A. Aluminum Framing Members: Tubular aluminum sections, thermally broken with interior section insulated from exterior, drainage holes and internal weep drainage system.
   2. Cross-Section: 2-1/2 by 2-1/2 inch nominal dimension.

B. Glazing: As specified in Section 08 80 00.

C. Swing Doors: Glazed aluminum.
   2. Top Rail: 4 inches wide.
   5. Glazing Stops: Square.
   6. Finish: Same as storefront.

D. Sun Screens: Shop fabricated, shop finished, extruded aluminum outriggers, louvers, and fascia, free of defects impairing strength, durability or appearance.
   1. Configuration: As indicated on drawings.
   2. Louver Type: Bar.
   3. Sun Screen Angle: 90 degrees from horizontal.
   4. Outrigger Shape: Straight.
   5. Design Criteria: Design and fabricate to resist the same loads as storefront system as well as the following loads without failure, damage, or permanent deflection:
      a. Live: [_____] psf; minimum.
   6. Sizes: As indicated on drawings.

2.06 MATERIALS

C. Structural Steel Sections:  ASTM A36/A36M; galvanized in accordance with requirements of ASTM A123/A123M.
D. Structural Supporting Anchors Attached to Structural Steel:  Design for bolted attachment.
E. Structural Supporting Anchors Attached to Reinforced Concrete Members:  Design for welded attachment to weld plates embedded in concrete.
F. Fasteners:  Stainless steel.
G. Exposed Flashings:  Aluminum sheet, 20 gauge, 0.032 inch minimum thickness; finish to match framing members.
H. Concealed Flashings:  Galvanized steel, 26 gauge, 0.0179 inch minimum base metal thickness.
I. Sealant for Setting Thresholds:  Non-curing butyl type.
J. Glazing Gaskets:  Type to suit application to achieve weather, moisture, and air infiltration requirements.
K. Glazing Accessories:  As specified in Section 08 80 00.
L. Shop and Touch-Up Primer for Steel Components:  Zinc oxide, alkyd, linseed oil primer appropriate for use over hand cleaned steel.
M. Touch-Up Primer for Galvanized Steel Surfaces:  SSPC-Paint 20, zinc rich.

2.07 FINISHES
A. Class I Natural Anodized Finish:  AAMA 611 AA-M12C22A41 Clear anodic coating not less than 0.7 mils thick.
B. Superior Performing Organic Coatings System:  Manufacturer's standard multi-coat superior performing organic coatings system complying with AAMA 2605, including at least 70 percent polyvinylidene fluoride (PVDF) resin, and at least 80 percent of aluminum extrusion and panels surfaces having minimum total dry film thickness (DFT) of 1.2 mils, 0.0012 inch.
C. Color:  As selected by Architect from manufacturer's standard range.
D. Touch-Up Materials:  As recommended by coating manufacturer for field application.

2.08 HARDWARE
A. For each door, include weatherstripping, sill sweep strip, and threshold.
B. Other Door Hardware:  As specified in Section 08 71 00.
C. Weatherstripping:  Wool pile, continuous and replaceable; provide on all doors.
D. Sill Sweep Strips:  Resilient seal type, retracting, of neoprene; provide on all doors.
E. Threshold:  Extruded aluminum, one piece per door opening, ribbed surface; provide on all doors.

PART 3 EXECUTION
3.01 EXAMINATION
A. Verify dimensions, tolerances, and method of attachment with other work.
B. Verify that wall openings and adjoining air and vapor seal materials are ready to receive work of this section.

3.02 INSTALLATION
A. Install wall system in accordance with manufacturer's instructions.
B. Attach to structure to permit sufficient adjustment to accommodate construction tolerances and other irregularities.
C. Provide alignment attachments and shims to permanently fasten system to building structure.
D. Align assembly plumb and level, free of warp or twist.  Maintain assembly dimensional tolerances, aligning with adjacent work.
E. Provide thermal isolation where components penetrate or disrupt building insulation.
F. Install sill flashings. Turn up ends and edges; seal to adjacent work to form water tight dam.
G. Where fasteners penetrate sill flashings, make watertight by seating and sealing fastener heads to sill flashing.
H. Pack fibrous insulation in shim spaces at perimeter of assembly to maintain continuity of thermal barrier.
I. Set thresholds in bed of sealant and secure.
J. Touch-up minor damage to factory applied finish; replace components that cannot be satisfactorily repaired.

3.03 TOLERANCES
A. Maximum Variation from Plumb: 0.06 inch per 3 feet non-cumulative or 0.06 inch per 10 feet, whichever is less.
B. Maximum Misalignment of Two Adjoining Members Abutting in Plane: 1/32 inch.

3.04 FIELD QUALITY CONTROL
A. Provide services of storefront manufacturer's field representative to observe for proper installation of system and submit report.
B. Provide field testing of installed storefront system by independent laboratory in accordance with AAMA 503 during construction process and before installation of interior finishes.
   1. Perform a minimum of two tests in each designated area as indicated on drawings.
   2. Conduct tests in each area prior to 10 percent and 50 percent completion of this work.
   3. Field test for water penetration in accordance with ASTM E1105 with uniform static air pressure difference (Procedure A) not less than 4.18 psf.
      a. Maximum allowable rate of water penetration in 15-minute test is 0.5 ounce that is not contained in an area with provisions to drain to exterior, or collected on surface of interior horizontal framing member.
C. Repair or replace storefront components that have failed designated field testing, and retest to verify performance complies with specified requirements.

3.05 ADJUSTING
A. Adjust operating hardware and sash for smooth operation.

3.06 CLEANING
A. Remove protective material from pre-finished aluminum surfaces.
B. Wash down surfaces with a solution of mild detergent in warm water, applied with soft, clean wiping cloths, and take care to remove dirt from corners and to wipe surfaces clean.
C. Upon completion of installation, thoroughly clean aluminum surfaces in accordance with AAMA 609 & 610.

3.07 PROTECTION
A. Protect installed products from damage until Date of Substantial Completion.

END OF SECTION 08 43 13
SECTION 08 71 00
FINISH HARDWARE

PART I - GENERAL

1.01 WORK INCLUDED
   A. The work in this section shall include furnishing of all items of finish hardware as hereinafter specified or obviously necessary to complete the building, except those items that are specifically excluded from this section of the specification.

1.02 RELATED WORK SPECIFIED ELSEWHERE
   A. Casework, Millwork, Cabinets
   B. Hollow Metal Doors and Frames
   C. Aluminum Doors and Frames
   D. Wood Doors

1.03 DESCRIPTION OF WORK
   A. Furnish labor and material to complete hardware work indicated, as specified herein, or as may be required by actual conditions at building.
   B. Include all necessary screws, bolts, expansion shields, other devices, if necessary, as required for proper hardware application. The hardware supplier shall assume all responsibility for correct quantities.
   C. All hardware shall meet the requirements of Federal, State and Local codes having jurisdiction over this project, notwithstanding any real or apparent conflict therewith in these specifications.

1.04 FIRE-RATED OPENINGS:
   A. Provide hardware for fire-rated openings in compliance with A.I.A. (NBFU) Pamphlet No. 80, NFPA Standards NO. 101, UBC 702 (1997) and UL10C. This requirement takes precedence over other requirements for such hardware. Provide only hardware that has been tested and listed by UL for the types and sizes of doors required and complies with the requirements of the door and door frame labels.
   B. Where panic exit devices are required on fire-rated doors, provide supplementary marking on door UL label indicating Fire Door to be equipped with fire exit hardware and provide UL label on exit device indicating “Fire Exit Hardware”.

1.05 FASTENERS:
   A. Hardware as furnished shall conform to published templates generally prepared for machine screw installation.
   B. Furnish each item complete with all screws required for installation. Typically, all exposed screws installation.
   C. Insofar as practical, furnished concealed type fasteners for hardware units that have exposed screws shall be furnished with Phillips flat head screws, finished to match adjacent hardware.
   D. Door closers and exit devices to be installed with closed head through bolts (sex bolts).

1.06 QUALITY ASSURANCE
   A. The supplier to be a directly franchised distributor of the products to be furnished and have in their employ an AHC (Architectural Hardware Consultant). This person is to be available for consultation to the architect, owner and the general contractor at reasonable times during the course of work.
   B. The finish hardware supplier shall prepare and submit to the architect six (6) copies of a complete schedule identifying each door and each set number, following the numbering system and not creating any separate system himself. He shall submit the schedule for review, make corrections as directed and resubmit the corrected schedule for final approval. Approval of schedule will not relieve Contractor of the responsibility for furnishing all necessary hardware, including the responsibility for furnishing correct quantities.
C. No manufacturing orders shall be placed until detailed schedule has been submitted to the architect and written approval received.

D. After hardware schedule has been approved, furnish templates required by manufacturing contractors for making proper provisions in their work for accurate fitting, finishing hardware setting. Furnish templates in ample time to facilitate progress of work.

E. Hardware supplier shall have an office and warehouse facilities to accommodate the materials used on this project. The supplier must be an authorized distributor of the products specified.

F. The hardware manufactures are to supply both a pre-installation class as well as a post-installation walk thru. This is to ensure proper installation and provide for any adjustments or replacements of hardware as required.

1.07 DELIVERY, STORAGE, AND HANDLING

A. Wrap and protect finishing hardware items for shipment. Deliver to manufacturing contractor’s hardware items required by them for their application; deliver balance of hardware to job; store in designated location. Each item shall be clearly marked with its intended location.

1.08 WARRANTY

A. The material furnished shall be warranted for one year after installation or longer as the individual manufacturer’s warranty permits.

B. Overhead door closers shall be warranted in writing by the manufacturer against failure due to defective materials and workmanship for a period of ten (10) years commencing on the Date of Final Completion and Acceptance, and in the event of failure, the manufacture is to promptly repair or replace the defective with no additional cost to the Owner.

1.09 MAINTENANCE MATERIALS

A. Furnish the following for Owner's use in maintenance of project.
   1. Locks and Latches: One (1) of each type.
   2. Panic Bars: One (1) of each type.
   3. Closers: One (1) of each type.
   4. Stops: One (1) of each type.

PART II - PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS

A. To the greatest extent possible, obtain each kind of hardware from only one manufacturer.

B. All numbers and symbols used herein have been taken from the current catalogues of the following manufacturers.

<table>
<thead>
<tr>
<th>PRODUCT</th>
<th>ACCEPTABLE MANUFACTURER</th>
<th>ACCEPTABLE SUBSTITUTE</th>
</tr>
</thead>
<tbody>
<tr>
<td>1) Hinges</td>
<td>Ives</td>
<td>Hager, Stanley</td>
</tr>
<tr>
<td>2) Locks &amp; Latches</td>
<td>Schlage</td>
<td>None (Owners Standard)</td>
</tr>
<tr>
<td>3) Cabinet Locks</td>
<td>Schlage</td>
<td>None (Owners Standard)</td>
</tr>
<tr>
<td>4) Cylinders, Keys, Keying</td>
<td>Schlage</td>
<td>None (Owners Standard)</td>
</tr>
<tr>
<td>5) Exit Devices</td>
<td>Von Duprin</td>
<td>None (Owners Standard)</td>
</tr>
<tr>
<td>6) Door Closers</td>
<td>Lcn</td>
<td>None (Owners Standard)</td>
</tr>
<tr>
<td>7) Oh Stops/holders</td>
<td>Glynn Johnson</td>
<td>Rixson</td>
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<tr>
<td>8) Magnetic Hold Open</td>
<td>Lcn</td>
<td>Rixson</td>
</tr>
<tr>
<td>9) Wall Stops/Floor</td>
<td>Ives</td>
<td>Rockwood</td>
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<tr>
<td></td>
<td>Stops, Flushbolts</td>
<td></td>
</tr>
<tr>
<td>10) Kick Plates</td>
<td>Ives</td>
<td>Rockwood</td>
</tr>
</tbody>
</table>
11) **THRESHOLD/WEATHER-STRIP ZERO** PEMKO, NATIONAL GUARD

12) **SILENCERS** IVES ROCKWOOD

C. The Owner requires use of certain products for their unique characteristics and project suitability to ensure continuity of existing and future performance and maintenance standards. These products are specified with the notation: “Owners Standard”.

**2.02 FINISH OF HARDWARE:**

A. Exterior Hinges to be Stainless Steel (630/32D), Interior Hinges to be Satin Chrome (652/26D). Door Closers to be Aluminum 689. Cylindrical locks to be Satin Chrome (626/26D) and Exit Devices to be Satin Chrome/Stainless Steel (626/26D – 630/32D) as listed. Overhead Holders to be Stainless Steel (630/32D), Flat Goods to be Stainless Steel (630/32D) or Satin Chrome (626/26D) as listed and the Thresholds to be Mill Finish Aluminum.

**2.03 HINGES AND PIVOTS:**

A. Exterior butts shall be furnished with non-removable pins (NRP).

B. Interior butts shall be as listed.

C. Doors 5’ or less in height shall have two (2) butts. Furnish one (1) additional butt for each 2’6” in height or fraction thereof. Dutch door shall have two (2) butts per leaf. Doors 3’6” and over to have heavy weight hinges.

**2.04 KEYING:**

A. All locks and cylinders shall be furnished with full size removable cores with Everest Patented Restricted T keyway by Schlage Lock Company. All new bitting and keying shall be completed at the factory in order to maintain the integrity of the existing grand master key system.

B. Existing projects – Furnish cylinders compatible with existing key system – verify with Owner.

C. All locks and cylinders to be furnished with full size construction cores. The contractor is to change out the temporary cores for the permanent cores in accordance with the Owners instructions. Furnish two (2) ea. Construction Control keys, six (6) each Construction Master Keys and ten (10) ea. Construction Change keys.

D. Provide Three (3) each change keys per lock and Six (6) each grand master and master keys. Stamp “DO NOT DUPLICATE”.

E. Pre-Order Meeting: General Contractor shall coordinate a Keying meeting with the Owner, Architect, Hardware Supplier and all other parties as necessary within 10 working days after award of the Hardware contract. Hardware Supplier shall produce a Keying Schedule for approval incorporating all the Owners instructions. Deliver all final keys and construction key voiding devices to Owner by security shipment direct from the hardware supplier.

F. Supply and deliver two (2) copies of the factory key bitting schedules to the Owner in conjunction with the delivery of the final keys.

**2.05 LOCKSETS:**

A. Cylindrical Locks - ANSI A156.2 Series 4000, Grade 1 Strength and Operational requirements. Meets A117.1 Accessibility Codes. Latch bolts shall be steel with minimum 1/2” throw, deadlocking on keyed and exterior functions. 3/4” throw anti-friction latchbolt on pairs of fire doors. Strikes: Provide manufacturer's standard wrought box strike for each latch or lock bolt, with curved lip extended to protect frame. Locksets to be tested to exceed 3,000,000 cycles. Lock case shall be steel. Lock shall incorporate one-piece spring cage and spindle. Provide 5/8” minimum throw of latch and deadbolt used on pairs of doors. Provide Seven Year Warranty.

1. Lock design shall be Schlage ND series “RHO” design.

B. Mortise Locks – ANSI A156.13 Series 1000, Grade 1 Operational and Security, UL listed for 3-hour fire door. With Interchangeable core cylinders: Grade 2 Security. Levers shall be forged brass, bronze, or cast stainless steel. Steel Case with 3/4” throw stainless steel anti-friction latchbolt and a 1” throw stainless steel deadbolt. Lock case shall be field reversible, without
opening the lock chassis and universal chassis to accept both knob and lever functions. Lock trim shall incorporate individual lever support springs in each rose or escutcheon. Lever connection by attaching threaded bushings tightened by a spanner wrench. Threaded set screws will not be accepted. Lock spindles shall be two independent inside and outside spindles to prevent manipulation of lock. Strikes: Provide manufacturer's standard wrought box strike for each latch or lock bolt, with curved lip extended to protect frame.

1. Lock design shall be Schlage L9000 series 06A design.

C. Cabinet Locks, CL100 or CL200 as manufactured by Schlage Lock Company.

D. Stand-alone access locks to be Schlage CO100 series.

2.06 EXIT DEVICES:

A. All devices shall be Von Duprin 98 series in types and functions specified. All devices must be listed under “Panic Hardware” in accident equipment list of Underwriters Laboratories. All labeled doors with “Fire Exit Hardware” must have labels attached and be in strict accordance with Underwriters Laboratories.

2.07 DOOR CLOSERS:

A. All closers shall be LCN 4040XP series having non-ferrous covers, forged steel arms separate valves for adjusting backcheck, closing and latching cycles and adjustable spring to provide up to 50% increase in spring power. Closers shall be furnished with parallel arm mounted on all doors opening into corridors or other public spaces and shall be mounted to permit 180 degrees door swing wherever wall conditions permit. Furnish with non-hold open arms unless otherwise indicated.

B. Door closer cylinders shall be of high strength cast iron construction to provide low wear operating capabilities of internal parts throughout the life of the installation. All door closers shall be tested to ANSI/BHMA A156.4 test requirements by a BHMA certified testing laboratory. A written certification showing successful completion of a minimum of 10,000,000 cycles must be provided.

C. Door closers shall utilize temperature stable fluid capable of withstanding temperature ranges of 120 degrees Fahrenheit to -30 degrees Fahrenheit, without requiring seasonal adjustment of closer speed to properly close the door. Closers for fire-rated doors shall be provided with temperature stabilizing fluid that complies with the standards UBC 7-2 (1997) and UL 10C.

D. Door closers shall incorporate tamper resistant non-critical screw valves of V-slot design to reduce possible clogging from particles within the closer. Closers shall have separate and independent screw valve adjustments for latch speed, general speed, and hydraulic backcheck. Backcheck shall be properly located so as to effectively slow the swing of the door at a minimum of 10 degrees in advance of the dead stop location to protect the door frame and hardware from damage. Pressure relief valves (PRV) are not acceptable.

2.08 TRIM AND PLATES:

A. Kick plates, mop plates, and armor plates, shall be .050 gauge with 32D finish. Kick plates to be 10” high, mop plates to be 4” high. Plates shall be two (2) inches less full width of door on single doors and (1) inch less full width of door on pairs of doors.

B. Push plates, pull plates, door pulls, and miscellaneous door trim shall be shown in the hardware schedule.

2.09 DOOR STOPS:

A. Doorstops shall be furnished for all doors to prevent damage to doors or hardware from striking adjacent walls or fixtures. Wall bumpers equal to Ives WS407 series are preferred, but where not practical furnish floor stops equal to Ives FS446 or FS448 series. Where conditions prohibit the use of either wall or floor type stops, furnish surface mounted overhead stops equal to Glynn Johnson 900 series on exterior and 450 series on interior.

2.10 THRESHOLDS AND WEATHERSTRIP:

A. Thresholds and weatherstrip shall be as listed in the hardware schedule.

2.11 DOOR SILENCERS: 
A. Furnish rubber door silencers equal to Ives SR64 for all new interior hollow metal frames, (2) per pair and (3) per single door frame.

PART III - EXECUTION

3.01 INSTALLATION:
A. All hardware shall be applied and installed in accordance with the Finish Hardware schedule. Care shall be exercised not to mar or damage adjacent work.
B. Contractor to provide a secure lock-up for hardware delivered to the project but not yet installed. Control the handling and installation of hardware items that are not immediately replaceable, so that the completion of the work will not be delayed by hardware losses both before and after installation.
C. No hardware is to be installed until the hardware manufactures have provided a pre-installation class. This is to insure proper installation of the specified products.

3.02 ADJUSTING AND CLEANING:
A. Contractor shall adjust all hardware in strict compliance with manufacturer’s instructions. Prior to turning project to owner, contractor shall clean and make any final adjustments to the finish hardware.

3.03 PROTECTION:
A. Contractor shall protect the hardware, as it is stored on construction site in a covered and dry place.
B. Contractor shall protect exposed hardware installed on doors during the construction phase.

3.04 KEY CABINET:
A. Set up and index one (1) Key Cabinet that allows room for expansion for 150% of the number of keys for the project.

3.05 HARDWARE SCHEDULE:
A. The following schedule is furnished for whatever assistance it may afford the contractor; do not consider it as entirely inclusive. Should any particular door or item be omitted in any scheduled hardware group, provide door or item with hardware same as required for similar purposes. Quantities listed are for each pair of doors or for each single door.
B. This hardware schedule was prepared by.

ALLEGION, PLC
3451 TECHNOLOGICAL AVE, SUITE 7
ORLANDO FL 32817
PH: 407-571-2000
FAX 407-571-2006

END OF SECTION  08 71 00
HARDWARE SCHEDULE:

A. The following schedule is furnished for whatever assistance it may afford the contractor; do not consider it as entirely inclusive. Should any particular door or item be omitted in any scheduled hardware group, provide door or item with hardware same as required for similar purposes. Quantities listed are for each pair of doors; or for each single door.

B. This hardware schedule prepared by:

Allegion, PLC
3451 Technological Ave, Suite 7
Orlando FL 32817
Ph: 407-571-2000
Fax 407-571-2006

HARDWARE GROUP NO. 01 - EXTERIOR STOREFRONT - PAIR

Provide each PR door(s) with the following:

<table>
<thead>
<tr>
<th>QTY</th>
<th>DESCRIPTION</th>
<th>CATALOG NUMBER</th>
<th>FINISH</th>
<th>MFR</th>
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<tbody>
<tr>
<td>2</td>
<td>CYLINDER</td>
<td>PROVIDE CYLINDER(S) TO MATCH BUILDINGS MASTERKEY SYSTEM</td>
<td>626</td>
<td>FAL</td>
</tr>
</tbody>
</table>

ALL HARDWARE BY STOREFRONT SUPPLIER.
HARDWARE TO BE FBC NOA COMPLIANT

HARDWARE GROUP NO. 02 - EXTERIOR STOREFRONT - SGL

Provide each SGL door(s) with the following:

<table>
<thead>
<tr>
<th>QTY</th>
<th>DESCRIPTION</th>
<th>CATALOG NUMBER</th>
<th>FINISH</th>
<th>MFR</th>
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<tbody>
<tr>
<td>1</td>
<td>CYLINDER</td>
<td>PROVIDE CYLINDER(S) TO MATCH BUILDINGS MASTERKEY SYSTEM</td>
<td>626</td>
<td>FAL</td>
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ALL HARDWARE BY STOREFRONT SUPPLIER.
HARDWARE TO BE FBC NOA COMPLIANT
HARDWARE GROUP NO. 03 - EXTERIOR STAIRWELL

Provide each SGL door(s) with the following:

<table>
<thead>
<tr>
<th>QTY</th>
<th>DESCRIPTION</th>
<th>CATALOG NUMBER</th>
<th>FINISH</th>
<th>MFR</th>
</tr>
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<tbody>
<tr>
<td>3</td>
<td>HINGE</td>
<td>5BB1 4.5 X 4.5 NRP</td>
<td>630</td>
<td>IVE</td>
</tr>
<tr>
<td>1</td>
<td>PANIC HARDWARE</td>
<td>HH-25-R-L-NL-DANE-299F-SNB</td>
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<td>FAL</td>
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<td>MORTISE CYLINDER</td>
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<td>SURFACE CLOSER</td>
<td>SC71A DS</td>
<td>689</td>
<td>FAL</td>
</tr>
<tr>
<td>1</td>
<td>RAIN DRIP</td>
<td>11A</td>
<td>A</td>
<td>ZER</td>
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<td>A</td>
<td>ZER</td>
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<tr>
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<td>RAIN DRIP</td>
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<td>AA</td>
<td>ZER</td>
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<tr>
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<td>188SBK PSA</td>
<td>BK</td>
<td>ZER</td>
</tr>
<tr>
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<td>DOOR SWEEP</td>
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<td>ZER</td>
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<td>DOOR BOTTOM</td>
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<td></td>
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<td>566A-223</td>
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</tbody>
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FBC NOA FL-12400 BASIS OF DESIGN

HARDWARE GROUP NO. 04 - EXTERIOR TRASH ENCLOSURE

Provide each SGL door(s) with the following:

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<tr>
<th>QTY</th>
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<tr>
<td>3</td>
<td>HINGE</td>
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<td>630</td>
<td>IVE</td>
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<tr>
<td>1</td>
<td>STOREROOM LOCK</td>
<td>T581CP6 DAN</td>
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<td>1</td>
<td>SURFACE CLOSER</td>
<td>SC71A DS</td>
<td>689</td>
<td>FAL</td>
</tr>
<tr>
<td>1</td>
<td>RAIN DRIP</td>
<td>142AA</td>
<td>AA</td>
<td>ZER</td>
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<tr>
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<td>GASKETING</td>
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<td>ZER</td>
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<tr>
<td>1</td>
<td>DOOR SWEEP</td>
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<td>DOOR BOTTOM</td>
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FBC NOA FL-12400 BASIS OF DESIGN

HARDWARE GROUP NO. 05 - INTERIOR STAIRWELLS

Provide each SGL door(s) with the following:

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<td>HINGE</td>
<td>5BB1 4.5 X 4.5</td>
<td>652</td>
<td>IVE</td>
</tr>
<tr>
<td>1</td>
<td>FIRE EXIT HARDWARE</td>
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<td>WALL STOP</td>
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HARDWARE GROUP NO. 06 - SUITE ENTRY/MECH/CUSTODIAL/STORAGE

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<td>HINGE</td>
<td>5BB1 4.5 X 4.5</td>
<td>652</td>
<td>IVE</td>
</tr>
<tr>
<td>1</td>
<td>STOREROOM LOCK</td>
<td>B581CP6 DAN</td>
<td>626</td>
<td>FAL</td>
</tr>
<tr>
<td>1</td>
<td>SURFACE CLOSER</td>
<td>SC81A REG OR PA AS REQ</td>
<td>689</td>
<td>FAL</td>
</tr>
<tr>
<td>1</td>
<td>WALL STOP</td>
<td>WS406/407CCV</td>
<td>630</td>
<td>IVE</td>
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<tr>
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<td>GASKETING</td>
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HARDWARE GROUP NO. 07 - RESTROOMS

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<td>652</td>
<td>IVE</td>
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<td>PRIVACY LOCK</td>
<td>MA311 OCCUPIED/VACANT DGM</td>
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<td>FAL</td>
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<tr>
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<td>SURFACE CLOSER</td>
<td>SC81A REG OR PA AS REQ</td>
<td>689</td>
<td>FAL</td>
</tr>
<tr>
<td>1</td>
<td>WALL STOP</td>
<td>WS406/407CCV</td>
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<tr>
<td>1</td>
<td>GASKETING</td>
<td>488SBK PSA</td>
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</table>
SECTION 08 80 00
GLAZING

PART 1 GENERAL

1.01 SECTION INCLUDES
A. Insulating glass units.
B. Glazing units.
C. Glazing compounds.

1.02 RELATED REQUIREMENTS
A. Section 07 92 00 - Joint Sealants: Sealants for other than glazing purposes.
B. Section 08 11 13 - Hollow Metal Doors and Frames: Glazed lites in doors and borrowed lites.
C. Section 08 43 13 - Aluminum-Framed Storefronts: Glazing provided as part of storefront assembly.
D. Section 08 44 13 - Glazed Aluminum Curtain Walls: Glazing provided as part of wall assembly.

1.03 REFERENCE STANDARDS

1.04 ADMINISTRATIVE REQUIREMENTS
A. Preinstallation Meeting: Convene a preinstallation meeting one week before starting work of this section; require attendance by each of the affected installers.

1.05 SUBMITTALS
A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.
B. Product Data on Glazing Compounds and Accessories: Provide chemical, functional, and environmental characteristics, limitations, special application requirements, and identify available colors.

C. Samples: Submit two samples 4 by 4 inch in size of glass units.

D. Certificate: Certify that products of this section meet or exceed specified requirements.

E. Manufacturer's qualification statement.

F. Installer's qualification statement.

G. Warranty Documentation: Submit manufacturer warranty and ensure that forms have been completed in Owner's name and registered with manufacturer.

H. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
   1. See Section 01 60 00 - Product Requirements, for additional provisions.
   2. Extra Insulating Glass Units: One of each glass size and each glass type.

1.06 QUALITY ASSURANCE

A. Perform Work in accordance with GANA (GM), GANA (SM), GANA (LGRM), and IGMA TM-3000 for glazing installation methods.

B. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum three years of documented experience.
   1. Provide certified glass products through ANSI accredited certifications that include plant audits and independent laboratory performance testing.
      a. Insulating Glass Certification Council (IGCC).
      b. Safety Glazing Certification Council (SGCC).

C. Installer Qualifications: Company specializing in performing work of the type specified and with at least three years documented experience.
   1. Provide company, field supervisors, and installers that hold active ANSI accredited certifications in appropriate categories for work specified.
      a. North American Contractor Certification (NACC) for glazing contractors.
      b. Equivalent independent third-party ANSI accredited certification.

D. Testing Agency Qualifications: Independent firm specializing in performing testing and inspections of the type specified in this section.

1.07 MOCK-UPS

A. Provide on-site glazing mock-up with the specified glazing components.

B. Locate where directed.

C. Mock-ups may remain as part of the Work.

1.08 FIELD CONDITIONS

A. Do not install glazing when ambient temperature is less than 40 degrees F.

B. Maintain minimum ambient temperature before, during and 24 hours after installation of glazing compounds.

1.09 WARRANTY

A. See Section 01 78 00 - Closeout Submittals, for additional warranty requirements.

B. Insulating Glass Units: Provide a five (5) year manufacturer warranty to include coverage for seal failure, interpane dusting or misting, including providing products to replace failed units.

C. Laminated Glass: Provide a five (5) year manufacturer warranty to include coverage for delamination, including providing products to replace failed units.

D. Heat Soaked Tempered Glass: Provide a five (5) year manufacturer warranty to include coverage for spontaneous breakage of fully tempered glass caused by nickel sulfide (NiS) inclusions.

PART 2 PRODUCTS
2.01 PERFORMANCE REQUIREMENTS - EXTERIOR GLAZING ASSEMBLIES

A. Provide type and thickness of exterior glazing assemblies to support assembly dead loads, and to withstand live loads caused by positive and negative wind pressure acting normal to plane of glass.
   1. Design Pressure:
      b. Negative Design Pressure: -106 psf.
   2. Comply with ASTM E1300 for design load resistance of glass type, thickness, dimensions, and maximum lateral deflection of supported glass.
   3. Provide glass edge support system sufficiently stiff to limit the lateral deflection of supported glass edges to less than 1/175 of their lengths under specified design load.
   4. Glass thicknesses listed are minimum.

B. Vapor Retarder and Air Barrier Seals: Provide completed assemblies that maintain continuity of building enclosure vapor retarder and air barrier.
   1. In conjunction with vapor retarder and joint sealer materials described in other sections.

C. Thermal and Optical Performance: Provide exterior glazing products with performance properties as indicated. Performance properties are in accordance with manufacturer's published data as determined with the following procedures and/or test methods:
   1. Center of Glass U-Value: Comply with NFRC 100 using Lawrence Berkeley National Laboratory (LBNL) WINDOW 6.3 computer program.
   2. Center of Glass Solar Heat Gain Coefficient (SHGC): Comply with NFRC 200 using Lawrence Berkeley National Laboratory (LBNL) WINDOW 6.3 computer program.

2.02 GLASS MATERIALS

A. Float Glass: Provide float glass based glazing unless otherwise indicated.
   1. Annealed Type: ASTM C1036, Type I - Transparent Flat, Class 1 - Clear, Quality - Q3.
   4. Fully Tempered Safety Glass: Complies with ANSI Z97.1 or 16 CFR 1201 criteria for safety glazing used in hazardous locations.
   5. Heat-Soak Testing (HST): Provide HST of fully tempered glass used on canopy, point-supported, spider wall, high-risk, sloping overhead, horizontal overhead, free-standing glass protective barrier, or other demanding applications of project, to reduce risks of spontaneous breakage due to nickel sulfide (NiS) induced fractures in accordance with industry established testing requirements.

B. Laminated Glass: Float glass laminated in accordance with ASTM C1172.
   1. Laminated Safety Glass: Complies with ANSI Z97.1 - Class B or 16 CFR 1201 - Category I impact test requirements.

2.03 INSULATING GLASS UNITS

A. Insulating Glass Units: Types as indicated.
   1. Durability: Certified by an independent testing agency to comply with ASTM E2190.
   2. Coated Glass: Comply with requirements of ASTM C1376 for pyrolytic (hard-coat) or magnetic sputter vapor deposition (soft-coat) type coatings on flat glass; coated vision glass, Kind CV; coated overhead glass, Kind CO; or coated spandrel glass, Kind CS.
   3. Warm-Edge Spacers: Polypropylene warm-edge technology design.
      a. Spacer Width: As required for specified insulating glass unit.
      b. Spacer Height: Manufacturer's standard.
   5. Edge Seal:
      a. Dual-Sealed System: Provide polyisobutylene sealant as primary seal applied between spacer and glass panes, and silicone, polysulfide, or polyurethane sealant as secondary seal applied around perimeter.
b. Color: Black.
6. Purge interpane space with dry air, hermetically sealed.

**B. Insulating Glass Units: Vision glass, double glazed.**
1. Applications: Exterior glazing unless otherwise indicated.
2. Space between lites filled with air.
3. Outboard Lite: Annealed float glass, 1/4 inch thick, minimum.
   a. Tint: Gray.
   b. Coating: Self-cleaning type, on #1 surface.
   c. Coating: Low-E (passive type), on #2 surface.
4. Warm-edge spacer.
5. Inboard Lite: Laminated float glass, 1/4 inch thick, minimum.
   a. Tint: Clear.
6. Total Thickness: 1 inch.
7. Thermal Transmittance (U-Value): 0.57, maximum.

**C. Insulating Glass Units: Spandrel glazing.**
1. Applications: Exterior spandrel glazing unless otherwise indicated.
2. Space between lites filled with air.
3. Outboard Lite: Annealed float glass, 1/4 inch thick, minimum.
   a. Tint: Gray.
   b. Coating: Same as on vision units, on #2 surface.
   a. Tint: Clear.
   b. Opacifier: Ceramic frit, on #4 surface.
      1) Opacifier Color: Medium Gray.
5. Total Thickness: 1 inch.
6. Thermal Transmittance (U-Value): 0.57, maximum.

2.04 GLAZING UNITS

**A. Monolithic Interior Vision Glazing:**
1. Applications: Interior glazing unless otherwise indicated.
2. Glass Type: Annealed float glass.
3. Tint: Clear.
4. Thickness: 1/4 inch, nominal.

**B. Monolithic Safety Glazing: Non-fire-rated.**
1. Applications:
   a. Glazed lites in doors, except fire doors.
   b. Glazed sidelights to doors, except in fire-rated walls and partitions.
   c. Other locations required by applicable federal, state, and local codes and regulations.
   d. Other locations indicated on drawings.
2. Glass Type: Fully tempered safety glass as specified.
3. Tint: Clear.
4. Thickness: 1/4 inch, nominal.

2.05 ACCESSORIES

**A. Setting Blocks:** Silicone, with 80 to 90 Shore A durometer hardness; ASTM C864 Option II.
Length of 0.1 inch for each square foot of glazing or minimum 4 inch by width of glazing rabbet space minus 1/16 inch by height to suit glazing method and pane weight and area.

**B. Spacer Shims:** Neoprene, 50 to 60 Shore A durometer hardness; ASTM C864 Option II.
Minimum 3 inch long by one half the height of the glazing stop by thickness to suit application, self adhesive on one face.

**C. Glazing Tape, Back Bedding Mastic Type:** Preformed, butyl-based, 100 percent solids compound with integral resilient spacer rod applicable to application indicated; 5 to 30 cured
Shore A durometer hardness; coiled on release paper; black color.

D. Glazing Splines: Resilient silicone extruded shape to suit glazing channel retaining slot; ASTM C864 Option II; color black.

E. Glazing Clips: Manufacturer's standard type.

PART 3 EXECUTION

3.01 VERIFICATION OF CONDITIONS

A. Verify that openings for glazing are correctly sized and within tolerances, including those for size, squareness, and offsets at corners.

B. Verify that surfaces of glazing channels or recesses are clean, free of obstructions that may impede moisture movement, weeps are clear, and support framing is ready to receive glazing system.

C. Verify that sealing between joints of glass framing members has been completed effectively.

D. Proceed with glazing system installation only after unsatisfactory conditions have been corrected.

3.02 PREPARATION

A. Clean contact surfaces with appropriate solvent and wipe dry within maximum of 24 hours before glazing. Remove coatings that are not tightly bonded to substrates.

B. Seal porous glazing channels or recesses with substrate compatible primer or sealer.

C. Prime surfaces scheduled to receive sealant where required for proper sealant adhesion.

3.03 INSTALLATION, GENERAL

A. Install glazing in compliance with written instructions of glass, gaskets, and other glazing material manufacturers, unless more stringent requirements are indicated, including those in glazing referenced standards.

B. Install glazing sealants in accordance with ASTM C1193, GANA (SM), and manufacturer's instructions.

C. Do not exceed edge pressures around perimeter of glass lites as stipulated by glass manufacturer.

D. Set glass lites of system with uniform pattern, draw, bow, and similar characteristics.

E. Set glass lites in proper orientation so that coatings face exterior or interior as indicated.

F. Prevent glass from contact with any contaminating substances that may be the result of construction operations such as, and not limited to the following; weld splatter, fire-safing, plastering, mortar droppings, etc.

3.04 INSTALLATION - PLASTIC FILM

A. Install plastic film with adhesive, applied in accordance with film manufacturer's instructions.

B. Place without air bubbles, creases or visible distortion.

C. Install film tight to perimeter of glass and carefully trim film with razor sharp knife. Provide 1/16 inch to 1/8 inch gap at perimeter of glazed panel unless otherwise required. Do not score the glass.

3.05 CLEANING

A. Remove excess glazing materials from finish surfaces immediately after application using solvents or cleaners recommended by manufacturers.

B. Remove nonpermanent labels immediately after glazing installation is complete.

C. Clean glass and adjacent surfaces after sealants are fully cured.

D. Clean glass on both exposed surfaces not more than 4 days prior to Date of Substantial Completion in accordance with glass manufacturer's written recommendations.

3.06 PROTECTION
A. After installation, mark pane with an ‘X’ by using removable plastic tape or paste.
B. Remove and replace glass that is damaged during construction period prior to Date of Substantial Completion.

END OF SECTION 08 80 00
SECTION 09 05 61
COMMON WORK RESULTS FOR FLOORING PREPARATION

PART 1 GENERAL

1.01 SECTION INCLUDES

A. This section applies to floors identified in Contract Documents that are receiving the following types of floor coverings:
   1. Resilient tile and sheet.
   2. Carpet tile.

B. Preparation of new concrete floor slabs for installation of floor coverings.

C. Testing of concrete floor slabs for moisture and alkalinity (pH).

D. Remediation of concrete floor slabs due to unsatisfactory moisture or alkalinity (pH) conditions.
   1. Contractor shall perform all specified remediation of concrete floor slabs. If such remediation is indicated by testing agency’s report and is due to a condition not under Contractor's control or could not have been predicted by examination prior to entering into the contract, a contract modification will be issued.

E. Patching compound.

F. Remedial floor coatings.

1.02 RELATED REQUIREMENTS

A. Section 01 40 00 - Quality Requirements: Additional requirements relating to testing agencies and testing.

B. Section 03 30 00 - Cast-in-Place Concrete: Moisture emission reducing curing and sealing compound for slabs to receive adhered flooring, to prevent moisture content-related flooring failures; to remain in place, not to be removed.

C. Section 03 30 00 - Cast-in-Place Concrete: Concrete admixture for slabs to receive adhered flooring, to prevent moisture content-related flooring failures.

D. Section 03 30 00 - Cast-in-Place Concrete: Limitations on curing requirements for new concrete floor slabs.

1.03 REFERENCE STANDARDS


1.04 ADMINISTRATIVE REQUIREMENTS

A. Coordinate scheduling of cleaning and testing, so that preliminary cleaning has been completed for at least 24 hours prior to testing.

1.05 SUBMITTALS

A. Floor Covering and Adhesive Manufacturers' Product Literature: For each specific combination of substrate, floor covering, and adhesive to be used; showing:
   1. Moisture and alkalinity (pH) limits and test methods.
   2. Manufacturer's required bond/compatibility test procedure.

B. Remedial Materials Product Data: Manufacturer's published data on each product to be used for remediation.
C. Testing Agency's Report:
   1. Description of areas tested; include floor plans and photographs if helpful.
   2. Summary of conditions encountered.
   3. Moisture and alkalinity (pH) test reports.
   5. Recommendations for remediation of unsatisfactory surfaces.
   6. Product data for recommended remedial coating.
   7. Include certification of accuracy by authorized official of testing agency.
   8. Submit report to Architect.
   9. Submit report not more than two business days after conclusion of testing.

D. Adhesive Bond and Compatibility Test Report.


1.06 QUALITY ASSURANCE
A. Moisture and alkalinity (pH) testing shall be performed by an independent testing agency employed and paid by Contractor.
B. Contractor may perform adhesive and bond test with Contractor's own personnel or hire a testing agency.
C. Testing Agency Qualifications: Independent testing agency experienced in the types of testing specified.
   1. Submit evidence of experience consisting of at least 3 test reports of the type required, with project Owner's project contact information.
D. Contractor's Responsibility Relating to Independent Agency Testing:
   1. Provide access for and cooperate with testing agency.
   2. Confirm date of start of testing at least 10 days prior to actual start.
   3. Allow at least 4 business days on site for testing agency activities.
   4. Achieve and maintain specified ambient conditions.
   5. Notify Architect when specified ambient conditions have been achieved and when testing will start.
E. Floor Moisture Testing Technician Qualifications: International Concrete Repair Institute (ICRI) Concrete Slab Moisture Testing Technician Certification- Grade I.
F. Remedial Coating Installer Qualifications: Company specializing in performing work of the type specified in this section, trained by or employed by coating manufacturer, and able to provide at least 3 project references showing at least 3 years' experience installing moisture emission coatings.

1.07 DELIVERY, STORAGE, AND HANDLING
A. Deliver, store, handle, and protect products in accordance with manufacturer’s instructions and recommendations.
B. Deliver materials in manufacturer’s packaging; include installation instructions.
C. Keep materials from freezing.

1.08 FIELD CONDITIONS
A. Maintain ambient temperature in spaces where concrete testing is being performed, and for at least 48 hours prior to testing, at not less than 65 degrees F or more than 85 degrees F.
B. Maintain relative humidity in spaces where concrete testing is being performed, and for at least 48 hours prior to testing, at not less than 40 percent and not more than 60 percent.

PART 2  PRODUCTS
2.01 MATERIALS
A. Patching Compound: Floor covering manufacturer's recommended product, suitable for conditions, and compatible with adhesive and floor covering. In the absence of any
recommendation from flooring manufacturer, provide a product with the following characteristics:

1. Cementitious moisture-, mildew-, and alkali-resistant compound, compatible with floor, floor covering, and floor covering adhesive, and capable of being feathered to nothing at edges.
2. Latex or polyvinyl acetate additions are permitted; gypsum content is prohibited.
3. Compressive Strength: 3000 psi, minimum, after 28 days, when tested in accordance with ASTM C109/C109M or ASTM C472, whichever is appropriate.

B. Alternate Flooring Adhesive: Floor covering manufacturer's recommended product, suitable for the moisture and pH conditions present; low-VOC. In the absence of any recommendation from flooring manufacturer, provide a product recommended by adhesive manufacturer as suitable for substrate and floor covering and for conditions present.

C. Remedial Floor Coating: Single- or multi-layer coating or coating/overlay combination intended by its manufacturer to resist water vapor transmission to degree sufficient to meet flooring manufacturer's emission limits, resistant to the level of alkalinity (pH) found, and suitable for adhesion of flooring without further treatment.

1. Thickness: As required for application and in accordance with manufacturer's installation instructions.
2. Use product recommended by testing agency.

PART 3 EXECUTION

3.01 CONCRETE SLAB PREPARATION

A. Perform following operations in the order indicated:

1. Preliminary cleaning.
2. Moisture vapor emission tests; 3 tests in the first 1000 square feet and one test in each additional 1000 square feet, unless otherwise indicated or required by flooring manufacturer.
3. Internal relative humidity tests; in same locations as moisture vapor emission tests, unless otherwise indicated.
4. Alkalinity (pH) tests; in same locations as moisture vapor emission tests, unless otherwise indicated.
5. Specified remediation, if required.
6. Patching, smoothing, and leveling, as required.
7. Other preparation specified.
9. Protection.

B. Remediations:

1. Active Water Leaks or Continuing Moisture Migration to Surface of Slab: Correct this condition before doing any other remediation; re-test after correction.
2. Excessive Moisture Emission or Relative Humidity: If an adhesive that is resistant to the level of moisture present is available and acceptable to flooring manufacturer, use that adhesive for installation of the flooring; if not, apply remedial floor coating or remedial sheet membrane over entire suspect floor area.
3. Excessive Alkalinity (pH): If remedial floor coating is necessary to address excessive moisture, no additional remediation is required; if not, if an adhesive that is resistant to the level present is available and acceptable to the flooring manufacturer, use that adhesive for installation of the flooring; otherwise, apply a skim coat of specified patching compound over entire suspect floor area.

3.02 PRELIMINARY CLEANING

A. Clean floors of dust, solvents, paint, wax, oil, grease, asphalt, residual adhesive, adhesive removers, film-forming curing compounds, sealing compounds, alkaline salts, excessive laitance, mold, mildew, and other materials that might prevent adhesive bond.

B. Do not use solvents or other chemicals for cleaning.

3.03 MOISTURE VAPOR EMISSION TESTING
A. Where the floor covering manufacturer's requirements conflict with either the referenced test method or this specification, comply with the manufacturer's requirements.

B. Where this specification conflicts with the referenced test method, comply with the requirements of this section.

C. Test in accordance with ASTM F1869 and as follows.

D. Plastic sheet test and mat bond test may not be substituted for the specified ASTM test method, as those methods do not quantify the moisture content sufficiently.

E. In the event that test values exceed floor covering manufacturer's limits, perform remediation as indicated. In the absence of manufacturer limits, perform remediation if test values exceed 3 pounds per 1000 square feet per 24 hours.

F. Report: Report the information required by the test method.

3.04 INTERNAL RELATIVE HUMIDITY TESTING

A. Where the floor covering manufacturer's requirements conflict with either the referenced test method or this specification, comply with the manufacturer's requirements.

B. Where this specification conflicts with the referenced test method, comply with the requirements of this section.

C. Test in accordance with ASTM F2170 Procedure A and as follows.

D. Testing with electrical impedance or resistance apparatus may not be substituted for the specified ASTM test method, as the values determined are not comparable to the ASTM test values and do not quantify the moisture content sufficiently.

E. In the event that test values exceed floor covering manufacturer's limits, perform remediation as indicated. In the absence of manufacturer limits, perform remediation if any test value exceeds 75 percent relative humidity.

F. Report: Report the information required by the test method.

3.05 ALKALINITY TESTING

A. Where the floor covering manufacturer's requirements conflict with either the referenced test method or this specification, comply with the manufacturer's requirements.

B. The following procedure is the equivalent of that described in ASTM F710, repeated here for the Contractor's convenience.
   1. Use a wide range alkalinity (pH) test paper, its associated chart, and distilled or deionized water.
   2. Place several drops of water on a clean surface of concrete, forming a puddle approximately 1 inch in diameter. Allow the puddle to set for approximately 60 seconds, then dip the alkalinity (pH) test paper into the water, remove it, and compare immediately to chart to determine alkalinity (pH) reading.
   3. Use of a digital pH meter with probe is acceptable; follow meter manufacturer's instructions.

C. In the event that test values exceed floor covering manufacturer's limits, perform remediation as indicated. In the absence of manufacturer limits, perform remediation if alkalinity (pH) test value is over 10.

3.06 PREPARATION

A. See individual floor covering section(s) for additional requirements.

B. Comply with recommendations of testing agency.

C. Comply with requirements and recommendations of floor covering manufacturer.

D. Fill and smooth surface cracks, grooves, depressions, control joints and other non-moving joints, and other irregularities with patching compound.

E. Do not fill expansion joints, isolation joints, or other moving joints.

3.07 ADHESIVE BOND AND COMPATIBILITY TESTING
A. Comply with requirements and recommendations of floor covering manufacturer.

3.08 APPLICATION OF REMEDIAL FLOOR COATING
A. Comply with requirements and recommendations of coating manufacturer.

3.09 PROTECTION
A. Cover prepared floors with building paper or other durable covering.

END OF SECTION 09 05 61
SECTION 09 21 16
GYPSUM BOARD ASSEMBLIES

PART 1 GENERAL
1.01 SECTION INCLUDES
A. Performance criteria for gypsum board assemblies.
B. Metal stud wall framing.
C. Metal channel ceiling framing.
D. Acoustic insulation.
E. Cementitious backing board.
F. Gypsum wallboard.
G. Joint treatment and accessories.
H. Textured finish system.

1.02 RELATED REQUIREMENTS
A. Section 01 61 16 - Volatile Organic Compound (VOC) Content Restrictions.
B. Section 06 10 00 - Rough Carpentry: Wood blocking product and execution requirements.
C. Section 07 84 00 - Firestopping: Top-of-wall assemblies at fire-resistance-rated walls.
D. Section 07 92 00 - Joint Sealants: Sealing acoustical gaps in construction other than gypsum board or plaster work.
E. Section 09 30 00 - Tiling: Tile backing board.
F. Section 31 31 16 - Termite Control: Field-applied termiticide and mildewcide for metal framing.

1.03 REFERENCE STANDARDS
M. ASTM C954 - Standard Specification for Steel Drill Screws for the Application of Gypsum Panel Products or Metal Plaster Bases to Steel Studs From 0.033 in. (0.84 mm) to 0.112 in. (2.84 mm) in Thickness 2018.
T. ASTM E413 - Classification for Rating Sound Insulation 2016.

1.04 SUBMITTALS
A. See Section 01 30 00 - Administrative Requirements for submittal procedures.
B. Product Data: Provide data on metal framing, gypsum board, accessories, and joint finishing system.
C. Product Data: Provide manufacturer's data on partition head to structure connectors, showing compliance with requirements.

1.05 QUALITY ASSURANCE
A. Installer Qualifications: Company specializing in performing gypsum board installation and finishing, with minimum 3 years of experience.

PART 2 PRODUCTS
2.01 GYPSUM BOARD ASSEMBLIES
A. Provide completed assemblies complying with ASTM C840 and GA-216.
B. Interior Partitions, Indicated as Acoustic: Provide completed assemblies with the following characteristics:
   1. Acoustic Attenuation: STC of 45-49 calculated in accordance with ASTM E413, based on tests conducted in accordance with ASTM E90.
C. Shaft Walls at Elevator Shafts: Provide completed assemblies with the following characteristics:
   1. Air Pressure Within Shaft: Intermittent loads of 5 lbf/sq ft with maximum mid-span deflection of L/240.
   2. Acoustic Attenuation: STC of 35-39 calculated in accordance with ASTM E413, based on tests conducted in accordance with ASTM E90.

2.02 METAL FRAMING MATERIALS
A. Non-structural Framing System Components: ASTM C645; galvanized sheet steel, of size and properties necessary to comply with ASTM C754 for the spacing indicated, with maximum deflection of wall framing of L/120 at 5 psf.
   1. Studs: C-shaped with knurled or embossed faces.
   2. Runners: U shaped, sized to match studs.
B. Shaft Wall Studs and Accessories: ASTM C645; galvanized sheet steel, of size and properties necessary to comply with ASTM C754 and specified performance requirements.
C. Partition Head to Structure Connections: Provide mechanical anchorage devices that accommodate deflection using slotted holes, screws, and anti-friction bushings, preventing rotation of studs while maintaining structural performance of partition.
   1. Structural Performance: Maintain lateral load resistance and vertical movement capacity required by applicable code, when evaluated in accordance with AISI S100.
3. Provide components UL-listed for use in UL-listed fire-resistance-rated head of partition joint systems indicated on drawings.
4. Provide mechanical anchorage devices as described above that accommodate deflection while maintaining the fire-resistance rating of the wall assembly.
5. Provide top track preassembled with connection devices spaced to fit stud spacing indicated on drawings; minimum track length of 12 feet.

D. Non-structural Framing Accessories:
1. Ceiling Hangers: Type and size as specified in ASTM C754 for spacing required.
2. Partial Height Wall Framing Support: Provides stud reinforcement and anchored connection to floor.
   b. Height: 35-3/4 inches.
3. Framing Connectors: ASTM A653/A653M G90 galvanized steel clips; secures cold rolled channel to wall studs for lateral bracing.

E. Grid Suspension Systems: Steel grid system of main tees and support bars connected to structure using hanging wire.

2.03 BOARD MATERIALS

A. Gypsum Wallboard: Paper-faced gypsum panels as defined in ASTM C1396/C1396M; sizes to minimize joints in place; ends square cut.
   1. Application: Use for vertical surfaces and ceilings, unless otherwise indicated.
   2. At Assemblies Indicated with Fire-Resistance Rating: Use type required by indicated tested assembly; if no tested assembly is indicated, use Type X board, UL or WH listed.
   3. Thickness:
      b. Ceilings: 1/2 inch.
      c. Multi-Layer Assemblies: Thicknesses as indicated on drawings.

B. Backing Board For Wet Areas: One of the following products:
   1. Application: Surfaces behind tile in wet areas including tub and shower surrounds and shower ceilings.
   2. Mold Resistance: Score of 10, when tested in accordance with ASTM D3273.
   3. ANSI Cement-Based Board: Non-gypsum-based; aggregated Portland cement panels with glass fiber mesh embedded in front and back surfaces complying with ANSI A118.9 or ASTM C1325.
      a. Thickness: 1/2 inch.

C. Ceiling Board: Special sag resistant gypsum ceiling board as defined in ASTM C1396/C1396M; sizes to minimize joints in place; ends square cut.
   1. Application: Ceilings, unless otherwise indicated.
   2. Thickness: 1/2 inch.

2.04 GYPSUM WALLBOARD ACCESSORIES

A. Acoustic Insulation: ASTM C665; preformed glass fiber, friction fit type, unfaced. Thickness: 3-1/2 inch.
B. Acoustic Sealant: Acrylic emulsion latex or water-based elastomeric sealant; do not use solvent-based non-curing butyl sealant.
C. Finishing Accessories: ASTM C1047, extruded aluminum alloy (6063 T5) or galvanized steel sheet ASTM A924/A924M G90, unless noted otherwise.
   1. Types: As detailed or required for finished appearance.
   2. Special Shapes: In addition to conventional corner bead and control joints, provide U-bead at exposed panel edges.
D. Decorative Metal Trim:
   1. Material: Extruded aluminum alloy 6063-T5 temper.
   2. Finish: Anodized, clear.
   3. Type: Profile as selected from manufacturer's standard range.

E. Joint Materials: ASTM C475/C475M and as recommended by gypsum board manufacturer for project conditions.
   1. Fiberglass Tape: 2 inch wide, coated glass fiber tape for joints and corners.
   2. Joint Compound: Setting type, field-mixed.

F. Finishing Compound: Surface coat and primer, takes the place of skim coating.

G. Textured Finish Materials: Latex-based compound; plain.

H. Screws for Fastening of Gypsum Panel Products to Cold-Formed Steel Studs Less than 0.033 inches in Thickness and Wood Members: ASTM C1002; self-piercing tapping screws, corrosion-resistant.

I. Screws for Fastening of Gypsum Panel Products to Steel Members from 0.033 to 0.112 inch in Thickness: ASTM C954; steel drill screws, corrosion-resistant.


K. Anchorage to Substrate: Tie wire, nails, screws, and other metal supports, of type and size to suit application; to rigidly secure materials in place.

PART 3  EXECUTION

3.01 EXAMINATION
   A. Verify that project conditions are appropriate for work of this section to commence.

3.02 SHAFT WALL INSTALLATION
   A. Shaft Wall Framing: Install in accordance with manufacturer's installation instructions.
      1. Fasten runners to structure with short leg to finished side, using appropriate power-driven fasteners at not more than 24 inches on center.
      2. Install studs at spacing required to meet performance requirements.

   B. Shaft Wall Liner: Cut panels to accurate dimensions and install sequentially between special friction studs.
      1. On walls over sixteen feet high, screw-attach studs to runners top and bottom.
      2. Seal perimeter of shaft wall and penetrations with acoustical sealant.

3.03 FRAMING INSTALLATION
   A. Metal Framing: Install in accordance with ASTM C754 and manufacturer's instructions.

   B. Suspended Ceilings and Soffits: Space framing and furring members as indicated.
      1. Level ceiling system to a tolerance of 1/1200.
      2. Laterally brace entire suspension system.

   C. Studs: Space studs at 16 inches on center.
      1. Extend partition framing to structure where indicated and to ceiling in other locations.
      2. Partitions Terminating at Ceiling: Attach ceiling runner securely to ceiling track in accordance with manufacturer's instructions.

   D. Openings: Reinforce openings as required for weight of doors or operable panels, using not less than double studs at jambs.

   E. Standard Wall Furring: Install at concrete walls scheduled to receive gypsum board, not more than 4 inches from floor and ceiling lines and abutting walls. Secure in place on alternate channel flanges at maximum 24 inches on center.
3.04 ACOUSTIC ACCESSORIES INSTALLATION
   A. Acoustic Insulation: Place tightly within spaces, around cut openings, behind and around
electrical and mechanical items within partitions, and tight to items passing through partitions.
   B. Acoustic Sealant: Install in accordance with manufacturer's instructions.

3.05 BOARD INSTALLATION
   A. Comply with ASTM C840, GA-216, and manufacturer's instructions. Install to minimize butt end
joints, especially in highly visible locations.
   B. Single-Layer Nonrated: Install gypsum board in most economical direction, with ends and
edges occurring over firm bearing.
      1. Exception: Tapered edges to receive joint treatment at right angles to framing.
   C. Fire-Resistance-Rated Construction: Install gypsum board in strict compliance with
requirements of assembly listing.
   D. Exposed Gypsum Board in Interior Wet Areas: Seal joints, cut edges, and holes with water-
resistant sealant.
   E. Cementitious Backing Board: Install over steel framing members and plywood substrate where
indicated, in accordance with ANSI A108.11 and manufacturer's instructions.
   F. Installation on Metal Framing: Use screws for attachment of gypsum board except face layer of
nonrated double-layer assemblies, which may be installed by means of adhesive lamination.
   G. Installation on Wood Framing: For rated assemblies, comply with requirements of listing
authority. For nonrated assemblies, install as follows:

3.06 INSTALLATION OF TRIM AND ACCESSORIES
   A. Control Joints: Place control joints consistent with lines of building spaces and as indicated.
      1. Not more than 30 feet apart on walls and ceilings over 50 feet long.
   B. Corner Beads: Install at external corners, using longest practical lengths.
   C. Edge Trim: Install at locations where gypsum board abuts dissimilar materials.
   D. Decorative Trim: Install at locations shown on drawings and in accordance with manufacturer's
instructions.

3.07 JOINT TREATMENT
   A. Glass Mat Faced Gypsum Board and Exterior Glass Mat Faced Sheathing: Use fiberglass joint
tape, embed and finish with setting type joint compound.
   B. Paper Faced Gypsum Board: Use paper joint tape, embed with drying type joint compound
and finish with drying type joint compound.
   C. Finish gypsum board in accordance with levels defined in ASTM C840, as follows:
      1. Level 4: Walls and ceilings to receive paint finish or wall coverings, unless otherwise
indicated.
      2. Level 2: In utility areas, behind cabinetry, and on backing board to receive tile finish.
      3. Level 1: Fire-resistance-rated wall areas above finished ceilings, whether or not
accessible in the completed construction.
   D. Tape, fill, and sand exposed joints, edges, and corners to produce smooth surface ready to
receive finishes.
      1. Feather coats of joint compound so that camber is maximum 1/32 inch.
      2. Taping, filling, and sanding are not required at surfaces behind adhesive applied ceramic
tile and fixed cabinetry.
      3. Taping, filling, and sanding are not required at base layer of double-layer applications.
   E. Where Level 5 finish is indicated, spray apply high build drywall surfacer over entire surface
after joints have been properly treated; achieve a flat and tool mark-free finish.
F. Fill and finish joints and corners of cementitious backing board as recommended by manufacturer.

3.08 TEXTURE FINISH

A. Apply finish texture coating by means of trowel in accordance with manufacturer's instructions.
B. Texture Required: Knockdown.

3.09 TOLERANCES

A. Maximum Variation of Finished Gypsum Board Surface from True Flatness: 1/8 inch in 10 feet in any direction.

END OF SECTION 09 21 16
SECTION 09 30 00
TILING

PART 1  GENERAL

1.01  SECTION INCLUDES

A. Tile for floor applications.
B. Tile for wall applications.
C. Tile for shower receptors.
D. Cementitious backer board as tile substrate.
E. Stone thresholds.
F. Ceramic trim.
G. Non-ceramic trim.

1.02  REFERENCE STANDARDS

O. ANSI A118.4 - American National Standard Specifications for Modified Dry-Set Cement Mortar 2012 (Revised).
1.03 ADMINISTRATIVE REQUIREMENTS

A. Preinstallation Meeting: Convene a preinstallation meeting one week before starting work of this section; require attendance by affected installers.

1.04 SUBMITTALS

A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.

B. Product Data: Provide manufacturers' data sheets on tile, mortar, grout, and accessories. Include instructions for using grouts and adhesives.

C. Shop Drawings: Indicate tile layout, patterns, color arrangement, perimeter conditions, junctions with dissimilar materials, control and expansion joints, thresholds, and setting details.

D. Samples: Mount tile and apply grout on two plywood panels, minimum 18 by 18 inches in size illustrating pattern, color variations, and grout joint size variations.

E. Manufacturer's Certificate: Certify that products meet or exceed specified requirements.

F. Installer's Qualification Statement:
   1. Submit documentation of National Tile Contractors Association (NTCA) or Tile Contractors' Association of America (TCAA) accreditation.

G. Maintenance Data: Include recommended cleaning methods, cleaning materials, and stain removal methods.

H. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
   1. See Section 01 60 00 - Product Requirements, for additional provisions.
   2. Extra Tile: 3 percent of each size, color, and surface finish combination.
   3. Extra Grout: 5% of each color.

1.05 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing the types of products specified in this section, with minimum five years of documented experience.

B. Installer Qualifications:
   1. Company specializing in performing tile installation, with minimum of five years of documented experience.
      a. Accredited Five-Star member of the National Tile Contractors Association (NTCA) or Trowel of Excellence member of the Tile Contractors' Association of America (TCAA).
1.06 MOCK-UP
   A. See Section 01 40 00 - Quality Requirements, for general requirements for mock-up.
   B. Construct tile mock-up where indicated on drawings, incorporating all components specified for the location.
      1. Minimum size of mock-up is indicated on drawings.
      2. Approved mock-up may remain as part of the Work.

1.07 DELIVERY, STORAGE, AND HANDLING
   A. Protect adhesives from freezing or overheating in accordance with manufacturer's instructions.

1.08 FIELD CONDITIONS
   A. Do not install solvent-based products in an unventilated environment.
   B. Maintain ambient and substrate temperature above 50 degrees F and below 100 degrees F during installation and curing of setting materials.

PART 2 PRODUCTS
2.01 TILE
   A. Porcelain Tile: ANSI A137.1 standard grade.
      1. Moisture Absorption: 0 to 0.5 percent as tested in accordance with ASTM C373.
      2. Thickness: 3/8 inch.
      3. Edges: Cushioned.
      5. Color(s): As indicated on drawings.

2.02 TRIM AND ACCESSORIES
   A. Ceramic Trim: Matching bullnose, double bullnose, cove base, and cove ceramic shapes in sizes coordinated with field tile.
      1. Applications:
         a. Open Edges: Bullnose.
         b. Inside Corners: Jointed.
         c. Floor to Wall Joints: Cove base.
      2. Manufacturers: Same as for tile.
   B. Non-Ceramic Trim: Brushed stainless steel, style and dimensions to suit application, for setting using tile mortar or adhesive.
      1. Applications:
         a. Open edges of wall tile.
         b. Open edges of floor tile.
         c. Wall corners, outside and inside.
         d. Transition between floor finishes of different heights.
         e. Expansion and control joints, floor and wall.
         f. Floor to wall joints.
         g. Borders and other trim as indicated on drawings.
   C. Thresholds: 2 inches wide by full width of wall or frame opening; beveled edge on both long edges; without holes, cracks, or open seams.
      1. Thickness: 1/2 inch.
      3. Applications:
         a. At doorways where tile terminates.

2.03 SETTING MATERIALS
   A. Provide setting and grout materials from same manufacturer.
      1. Products:
         a. ARDEX Engineered Cements; ARDEX X 5: www.ardexamericas.com/#sle.
b. Custom Building Products; ProLite Premium Rapid Setting Large Format Tile Mortar, with Multi-Surface Bonding Primer:  www.custombuildingproducts.com/#sle.


d. Merkrete, by Parex USA, Inc; Merkrete 735 Premium Flex:  www.merkrete.com/#sle.

C. Mortar Bed Materials:  Pre-packaged mix of Portland cement, sand, latex additive, and water.

2.04 GROUTS

A. Provide setting and grout materials from same manufacturer.

B. High Performance Polymer Modified Grout: ANSI A118.7 polymer modified cement grout.
   1. Applications: Use this type of grout where indicated and where no other type of grout is indicated.
   2. Use sanded grout for joints 1/8 inch wide and larger; use unsanded grout for joints less than 1/8 inch wide.
   3. Color(s): As selected by Architect from manufacturer's full line.

2.05 MAINTENANCE MATERIALS

A. Tile Sealant:  Gunnable, silicone, siliconized acrylic, or urethane sealant; moisture and mildew resistant type.
   1. Applications: Between tile and plumbing fixtures.
   2. Color(s): As selected by Architect from manufacturer's full line.

B. Grout Sealer: Liquid-applied, moisture and stain protection for existing or new Portland cement grout.
   1. Composition: Water-based colorless silicone.

2.06 ACCESSORY MATERIALS

A. Waterproofing Membrane at Floors: Specifically designed for bonding to cementitious substrate under thick mortar bed or thin-set tile; complying with ANSI A118.10.
   1. Crack Resistance: No failure at 1/16 inch gap, minimum; comply with ANSI A118.12.
   2. Fluid or Trowel Applied Type:
      a. Material: Synthetic rubber or Acrylic.
      b. Thickness: 25 mils, minimum, dry film thickness.

B. Waterproofing Membrane at Showers: Specifically designed for bonding to cementitious substrate under thick mortar bed or thin-set tile; complying with ANSI A118.10.
   1. Fluid or Trowel Applied Type:
      b. Thickness: 25 mils, minimum, dry film thickness.

C. Backer Board: Cementitious type complying with ANSI A118.9; high density, glass fiber reinforced, 1/2 inch thick; 2 inch wide coated glass fiber tape for joints and corners.

D. Mesh Tape: 2 inch wide self-adhesive fiberglass mesh tape.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that subfloor surfaces are smooth and flat within the tolerances specified for that type of work and are ready to receive tile.

B. Verify that wall surfaces are smooth and flat within the tolerances specified for that type of work, are dust-free, and are ready to receive tile.

C. Verify that subfloor surfaces are dust free and free of substances that could impair bonding of setting materials to subfloor surfaces.

D. Cementitious Subfloor Surfaces: Verify that substrates are ready for tiling installation by testing for moisture and alkalinity (pH).
   1. Test as Follows:
      b. Internal Relative Humidity: ASTM F2170.

2. Obtain instructions if test results are not within limits recommended by tiling material manufacturer and setting material manufacturer.

E. Verify that required floor-mounted utilities are in correct location.

3.02 PREPARATION

A. Protect surrounding work from damage.
B. Vacuum clean surfaces and damp clean.
C. Seal substrate surface cracks with filler. Level existing substrate surfaces to acceptable flatness tolerances.
D. Install backer board in accordance with ANSI A108.11 and board manufacturer’s instructions. Tape joints and corners, cover with skim coat of setting material to a feather edge.
E. Prepare substrate surfaces for adhesive installation in accordance with adhesive manufacturer’s instructions.

3.03 INSTALLATION - GENERAL

A. Install tile, thresholds, and stair treads and grout in accordance with applicable requirements of ANSI A108.1a through ANSI A108.19, manufacturer’s instructions, and TCNA (HB) recommendations.
B. Lay tile to pattern indicated. Do not interrupt tile pattern through openings.
C. Cut and fit tile to penetrations through tile, leaving sealant joint space. Form corners and bases neatly. Align floor joints.
D. Place tile joints uniform in width, subject to variance in tolerance allowed in tile size. Make grout joints without voids, cracks, excess mortar or excess grout, or too little grout.
E. Form internal angles square and external angles bullnosed.
F. Install non-ceramic trim in accordance with manufacturer’s instructions.
G. Install thresholds where indicated.
H. Sound tile after setting. Replace hollow sounding units.
I. Keep control and expansion joints free of mortar, grout, and adhesive.
J. Prior to grouting, allow installation to completely cure; minimum of 48 hours.
K. Grout tile joints unless otherwise indicated. Use standard grout unless otherwise indicated.
L. At changes in plane and tile-to-tile control joints, use tile sealant instead of grout, with either bond breaker tape or backer rod as appropriate to prevent three-sided bonding.

3.04 INSTALLATION - FLOORS - THIN-SET METHODS

A. Over interior concrete substrates, install in accordance with TCNA (HB) Method F113, dry-set or latex-Portland cement bond coat, with standard grout, unless otherwise indicated.
   1. Use uncoupling membrane under all tile unless other underlayment is indicated.
   2. Where waterproofing membrane is indicated, install in accordance with TCNA (HB) Method F122, with latex-Portland cement grout.
B. Install tile-to-tile floor movement joints in accordance with TCNA (HB) Method EJ171F.

3.05 INSTALLATION - SHOWERS AND BATHTUB WALLS

A. At tiled shower receptors install in accordance with TCNA (HB) Method B415, mortar bed floor, and W244, thin-set over cementitious backer unit walls.
B. Grout with standard grout as specified above.

3.06 INSTALLATION - WALL TILE

A. Over cementitious backer units on studs, install in accordance with TCNA (HB) Method W244, using membrane at toilet rooms.
B. Over gypsum wallboard on wood or metal studs install in accordance with TCNA (HB) Method W243, thin-set with dry-set or latex-Portland cement bond coat, unless otherwise indicated.

3.07 CLEANING
   A. Clean tile and grout surfaces.

3.08 PROTECTION
   A. Do not permit traffic over finished floor surface for 4 days after installation.

END OF SECTION 09 30 00
SECTION 09 30 01
TILING

PART 1 - GENERAL

1.1 Qualified Labor (Because tile is a permanent finish, the lowest bid should not be the deciding factor but rather, but who is the most qualified to perform the scope of the work being specified. See TCNA Handbook for a list of recognized programs).

1.2 Pre-Installation Meeting. Field mock-up recommended scaled to appropriate size of the scope of the work 9 sq ft.

1.3 Large format tile is normally considered as tiles with at least one edge 15” in length or greater in combination narrow grout joints may require improvement of the substrate.

PART 2 – PRODUCTS

2.1 Porcelain or ceramic tile shall be of standard/first grade quality as manufactured by Crossville Inc. of Tennessee, and shall conform to requirements of ANSI A-137.1-2021.

Type: Porcelain tile surface shall be (Insert)

Size: Porcelain tile shall be manufactured to specific size after firing and shall be Nominal- (Insert) all measurements are in inches unless otherwise specified.

Thickness: Porcelain tile shall be manufactured to specific thickness after firing and shall be nominal ([8.0 mm or greater] for large unit tile or [6.0 mm or greater] for mosaics).

Color: Porcelain tile shall be furnished in (Insert Crossville color name and number)

Trim: According to availability, provide matching trim shapes such as bullnose corners, cove base and borders when specified.

2.2 Setting Materials: Use appropriate installation mortars according to ANSI A118-2021.

2.3 Grouting Materials: Select grouting materials according to the following types: Tile setting and grouting epoxy: A118.6 Standard Cement Grout, A118.7, High Performance Cement Grout or A118.8, Modified Epoxy Emulsion Grout. Provide grout in colors selected by the Architect from standard colors available from the approved manufacturers.

2.4 Waterproofing/Anti Fracture Membrane: Select per ANSI A118.10 as required.

2.5 Jobsite Blending: Blend tiles before installing in accordance with reference standards to produce an even range and distribution of color and finish.
PART 3 – EXECUTION

3.1 EXAMINATION

A. Examine substrates where tile will be installed for compliance with requirements for installation tolerances and other conditions effecting performance of installed tile. Before tiling concrete surfaces saturated dry (SSD), free of standing water verify that substrates for setting tile are well cured, structurally sound dry, clean, and free from oil or waxy films, curing compounds or other coatings and surface treatments. Nonstructural shrinkage cracks should be pretreated with a crack suppression membrane (to prevent telegraphing of cracks through the finished tile installation) ANSI A118.12.

B. Do not proceed with installation until unsatisfactory conditions have been corrected. Commencement of work signifies acceptance of substrate and installation conditions.

PART 4 - INSTALLATION

4.1 Acceptability of Surfaces

A. Before tiling, verify that all surfaces to be tiled are structurally sound true to plane, and fall within maximum variations shown below:

<table>
<thead>
<tr>
<th>Walls</th>
<th>Floors</th>
</tr>
</thead>
<tbody>
<tr>
<td>1/4” in 10’*</td>
<td>1/4” in 10’</td>
</tr>
</tbody>
</table>

* When using large format tile, normally considered as tiles with at least one edge 15” in length or greater; a more stringent tolerance 1/8” in 10’ or 1/16” in 24” when measure from the high points on the surface is required.

Report all unacceptable surfaces to the architect in writing, and do not tile such surfaces until they are leveled enough to meet above requirements.

B. Before tiling, all surfaces must be free of curing compounds, oil, grease, wax, dirt, dust, form releases or other substances that would interfere with proper bond of setting materials.

C. Illuminate the work area during installation providing the same level and angle of illumination as will be available for final inspection. The use of grazing or cove type lighting where lights are located either at the wall/ceiling interface, or mounted directly to the wall prompts the light to strike the tile finish at a straight down angle, creating unwanted shadows from grout lines giving the tile layout an un-flat irregular appearance. Installing overhead lighting at a wide downward angle 18”-24” away from the tiled wall, will optimize a flatter more uniform appearance to the tiled surface.
4.2 Setting Methods

Comply with appropriate ANSI A108-2021 specification and current Tile Council of North America Handbook (TCNA) for appropriate method of installation for each specification. For thin set adhesive mortar application use following technique:

- With the flat side of trowel, key mortar into substrate.
- Using the appropriate size trowel, comb mortar in one direction with notched side of the trowel.
- Set tile with a sliding motion, perpendicular to the mortar ridges.
- Obtain as near 100% coverage as possible of mortar to tile.
- Mortar coverage shall be no less than 85% and shall be sufficiently distributed to give full support under all corners and edges of the tile.
- Note: 95-100% coverage is mandatory for wet and exterior areas. Periodically, remove sheets or individual tiles to assure proper bond coverage consistent with industry specifications.

Ensure there is a minimum 1/8” of mortar between tile and substrate after proper bedding. Installer must periodically remove sheets or individual tiles to assure proper bond coverage consistent with industry specifications. If coverage is found to be insufficient, use a larger size notch trowel.

For running bond/brick joint patterns utilizing tiles (square or rectangular) where the side being offset is greater than 18” (nominal dimension), the running bond offset will be a maximum of 33% unless otherwise specified by the tile manufacturer. If an offset greater than 33% is specified, specifier and owner must approve mock-up.

4.3 Expansion Joints

Install architecturally designed expansion joints as per current TCNA Detail EJ171. Prefabricated expansion joint strips can also be used when suitable.

4.4 Grouting Methods

Follow exactly grout manufacturer’s instructions and comply with appropriate ANSI A108-2021 specification depending on type of grout selected. Grouting is not complete until all grout haze and residues are removed from the surface of the tile.

4.5 Cleaning and Protection

A. Leave finished installation free of cracked, chipped, broken, un-bonded or otherwise defective tile work.

B. Protect all floor tile installations with clean construction paper or other heavy covering during construction period to prevent staining or damage. No foot or wheel traffic permitted on floor for at least 3 days after grouting. Owner/specifier is responsible for
protecting tile from damage including allowing sufficient time for installed materials to cure properly typically 30-45 days is required for full cure of thin set bonding mortars.

Inquiries – Crossville Incorporated – Technical Services (basis of design)

(931) 484-2110
(931) 484-8418 Fax
E-MAIL crossc@crossvilleinc.com
SECTION 09 50 00
INTEGRATED CEILING ASSEMBLIES

PART 1 – GENERAL

1.01 RELATED DOCUMENTS
A. Drawings and general conditions of Contract, including General and Supplementary Conditions and Divisions-1 Specification sections apply to work of this section.

1.02 SUMMARY
A. Section Includes
1. Acoustical ceiling panel
   a. Wire hangers, fasteners, main runners, cross tees, and wall angle moldings
   b. Perimeter Trim
B. Related Sections
1. Section 09 51 13 - Acoustical Fabric-Faced Panel Ceilings
2. Section 09 53 00 - Acoustical Ceiling Suspension Assemblies
3. Section 09 83 00 – Acoustical Finish
4. Section 09 20 00 - Plaster and Gypsum Board
5. Section 09 22 16 - Non-Structural Metal Framing
6. Section 01 81 13 - Sustainable Design Requirements
7. Section 01 81 19 - Indoor Air Quality Requirements
8. Section 02 42 00 - Removal and Salvage of Construction Materials
9. Divisions 23 - HVAC Air Distribution
10. Division 26 - Electrical

1.03 REFERENCES
A. American Society for Testing and Materials (ASTM):
   1. ASTM A 1008 Standard Specification for Steel, Sheet, Cold Rolled, Carbon, Structural, High-Strength Low-Alloy and High-Strength Low-Alloy with Improved Formability
   2. ASTM A 641 Standard Specification for Zinc-Coated (Galvanized) Carbon Steel Wire
   3. ASTM A 653 Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) by the Hot-Dip Process
   4. ASTM C 645 Standard Specification for Metal Suspension Systems
   5. ASTM C 636 Recommended Practice for Installation of Metal Ceiling Suspension Systems for Acoustical Tile and Lay-in Panels
   6. ASTM C754 AND C1858 All installations should be in compliance with these tests.
   9. ASTM E 580 Installation of Metal Suspension Systems in Areas Requiring Moderate Seismic Restraint
   10. ASTM C 423 Sound Absorption and Sound Absorption Coefficients by the Reverberation Room Method
   11. ASTM E 1414 Standard Test Method for Airborne Sound Attenuation between Rooms Sharing a Common Ceiling Plenum
   12. ASTM E 1264 Classification for Acoustical Ceiling Products
   13. ASTM E3090 All references to suspension component property testing per this test method.
B. International Building Code
D. NFPA 70 National Electrical Code
E. ASCE 7 American Society of Civil Engineers, Minimum Design Loads for Buildings and Other Structures
   a. 1. ESR 1289 - Armstrong Suspension Systems

1.04 SYSTEM DESCRIPTION

A. Continuous/Wall-to-Wall or Cloud installation

1.05 SUBMITTALS

A. Shop Drawings: Layout and details of ceilings. Show locations of items that are to be coordinated with, or supported by the ceilings.
B. Installation Instructions: Submit manufacturer’s installation instructions as referenced in Part three, Installation.
C. Product Data: Submit manufacturer’s technical data for each type of ceiling unit and suspension system required.
D. Samples: Minimum 6 x 6 inch samples of specified panel; 8 inch long samples of exposed wall molding and suspension system, including main runner and 4 foot cross tees.
E. Certifications: Manufacturer’s certifications that products comply with specified requirements, including laboratory reports showing compliance with specified tests and standards.
F. Non-Conformance: All products not conforming to the requirements of this specification and or the manufacturer’s published values are to be disposed. The Contractor performing the work will replace with approved product at their expense.

1.06 SUSTAINABLE MATERIALS

A. Transparency: Manufacturers will be given preference when they provide documentation to support sustainable requirements for the following: Material ingredient transparency, Removal of Red List Ingredients per LBCV3, Life Cycle impact information, Low-Emitting Materials, and Clean Air performance.
   1. Health Product Declaration. The end use product has a published, complete Health Product Declaration with disclosure at a minimum of 1000ppm of known hazards in compliance with the Health Product Declaration open Standard.
   2. Declare Label. The end use product has a published Declare label by the International Living Future Institute with disclosure of 100 ppm with a designation of Red List Free or Compliant (less than 1% proprietary ingredients).
   3. Low Emitting products with VOC emissions data. Preference will also be given to manufacturers that can provide emissions data showing their products meet CDPH Standard Method v1.1 (Section 01350).
   4. Life cycle analysis. Products that have communicated lifecycle data through Environmental Product Declarations (EPDs) will be preferred.
   5. End of Life Programs/Recycling: Where applicable, manufacturers that provide the option for recycling of their products into new products at end-of-life through take-back programs will be preferred.
   6. Products meeting LEED V4 requirements including:
      a. Storage & Collection of Recyclables
      b. Construction and Demolition Waste Management Planning
      c. Building Life-Cycle Impact Reduction
      d. Building Product Disclosure and Optimization Environmental Product Declarations
      e. Building Product Disclosure and Optimization Sourcing of Raw Materials
      f. Building Product Disclosure and Optimization Material Ingredients
      g. Construction and Demolition Waste Management

1.07 QUALITY ASSURANCE

A. Single-Source Responsibility: Provide acoustical panel units and grid components by a single manufacturer.
B. Fire Performance Characteristics: Identify acoustical ceiling components with appropriate markings of applicable testing and inspecting organization.

C. Surface Burning Characteristics: As follows, tested per ASTM E 84 and complying with ASTM E 1264 Classification.

D. Acoustical Panels: As with other architectural features located at the ceiling that may obstruct or skew the planned fire sprinkler pattern through possibly delay or accelerate the activation of the sprinkler or fire detection systems by channeling heat from a fire either toward or away from the device. Designers and installers are advised to consult a fire protection engineer, NFPA 13, or their local codes for guidance where automatic fire detection and suppression systems are present.

E. Coordination of Work: Coordinate acoustical ceiling work with installers of related work including, but not limited to building insulation, gypsum board, light fixtures, mechanical systems, electrical systems, and sprinklers. ACOSTIBuilt Panels are 7/8” thick.

F. Installer Qualification: Subcontractor is an experienced Installer that has reviewed and understands the system installation instructions thoroughly. Subcontractor will follow written installation instructions and utilize approved equipment and procedures for finishing installation.

1.08 DELIVERY, STORAGE AND HANDLING

A. Deliver acoustical ceiling units to project site in original, unopened packages and store them in a fully enclosed space where they will be protected against damage from moisture, direct sunlight, surface contamination, and other causes.

B. Before installing acoustical ceiling units, permit them to reach room temperature and a stabilized moisture content. Store all material within temperature limits required by manufacturer.

C. Handle acoustical ceiling units carefully to avoid chipping edges or damaged units in any way.

1.09 PROJECT CONDITIONS

A. Space Enclosure:
   1. Building areas to receive ceilings shall be free of construction dust and debris. ACOSTIBuilt panels should be installed in areas where the building is enclosed and the HVAC is continuously functioning. This product is not recommended for exterior applications, where standing water is present, or where moisture will come into direct contact with the ceiling.
      a. HVAC should be designed, installed, and operated in accordance with ASHRAE Standard 62.1. It is also necessary for the area to be enclosed, for the HVAC systems to be functioning, and in continuous operations for the life of the product. Product is not intended for use where natural ventilation is part of the ventilation strategy and not recommended in areas where a differential plenum pressure exists.

1.10 ALTERNATE CONSTRUCTION WASTE DISPOSAL

A. Reclaimed ceiling material must be kept dry and free from debris.

B. Contact the Armstrong Recycle Center a consultant will verify the condition of the material and that it meets the Armstrong requirements for recycling. The Armstrong consultant with provide assistance to facilitate the recycling of the ceiling.

1.11 WARRANTY

A. Acoustical Panel: Submit a written warranty executed by the manufacturer, agreeing to repair or replace panels that fail within the warranty period. Failures include, but are not limited to the following:
   1. Acoustical Panels: Manufacturer’s defects in material
   2. Grid System: Rusting and manufacturer’s defects

B. Warranty Period:
   1. Acoustical panels: Ten (10) years from date of substantial completion
   2. Suspension: Ten (10) years from date of substantial completion
C. The Warranty shall not deprive the Owner of other rights the Owner may have under other provisions of the Contract Documents and will be in addition to and run concurrent with other warranties made by the Contractor under the requirements of the Contract Documents.

1.12 MAINTENANCE
A. Extra Materials: Deliver extra materials to Owner. Furnish extra materials described below that match products installed. Packaged with protective covering for storage and identified with appropriate labels.
   1. Acoustical Ceiling Units: Furnish quality of full-size units equal to 5.0 percent of amount installed.
   2. Exposed Suspension System Components: Furnish quantity of each exposed suspension component equal to 2.0 percent of amount installed.

PART 2 - PRODUCTS
2.01 MANUFACTURERS
A. Basis of Design ACOUSTIBuilt:
   1. Armstrong World Industries, Inc.
      a. Finish
         1) Joint Compound Finish by Others
         2) Spray Applied Finish by Armstrong World Industries, Inc.
      b. Suspension Systems and Washers
         1) Armstrong World Industries, Inc.
      c. Perimeter Systems
         1) Armstrong World Industries, Inc.

2.02 ACOUSTICAL CEILING UNITS
A. Acoustical Panels
   1. Surface Texture: Fine
   2. Composition: Mineral Fiber
   3. Color: White (Fine Texture Finish for ACOUSTIBuilt panels)
   4. Size: 48 in x 72 in x 7/8 in - Item #2604
   5. Edge Profile: Tapered edges four sides
   6. Noise Reduction Coefficient (NRC): ASTM C 423; Panel 0.80 (UL)
   7. Ceiling Attenuation Class (CAC): ASTM C 1414; Panel 46 (UL), System up to 48
   8. Sabin: Cloud Applications: 0.80 Sabins/SF & 1.33 Sabins/SF with infill item 8200T10
   9. Articulation Class (AC): ASTM E 1111
   10. Flame Spread: ASTM E 1264; Class A
   11. Light Reflectance (LR) White Panel: ASTM E 1477; 0.87
   12. Dimensional Stability: HumiGuard Plus
   13. Recycle Content: Post-Consumer and Pre-Consumer – up to 75%
   14. Material Ingredient Transparency: Health Product Declaration (HPD); Declare Label
   15. Life Cycle Assessment: Third Party Certified Environment Product Declaration (EPD)
   16. Acceptable Product: ACOUSTIBuilt panels #2604 No added formaldehyde as manufactured by Armstrong World Industries
   17. Contact your local Armstrong Representative for required installation training at least 4-6 weeks before ordering materials and scheduling installation.
      a. Finish
         1) Joint Compound
         2) Setting Compound: Lightweight setting-type drywall joint compound, Ultra lightweight drying-type drywall joint compound
         3) Joint Tape: Self-Adhesive mesh drywall joint tape
         5) Suspension Systems and Washers
6) Armstrong Drywall Suspension Systems all main beams and cross tees shall be commercial quality hot-dipped galvanized steel

7) Main beam: manufactured main beam- 1-1/2” knurled face with ScrewStop™ reverse hem by 1-11/16 inches high. Drywall Main Beams are factory punched with cross tee routs, hanger wire holes, and SuperLock™ main beam clip for a strong secure connection and fast accurate alignment. Both ShortSpan and Drywall Main Beams are Heavy-duty performance per ASTM C635

8) HD8906 - 12ft HD Drywall Main Beam 1-1/2 in

9) Cross Tees: manufactured cross tee- 1-1/2” knurled face with ScrewStop™ reverse hem by 1-1/2 inches high with factory punched cross tee routs and hanger wire holes and XL stake on clip for a strong secure connection.

10) XL8945P - 4ft Drywall Cross Tee

11) XL8965 – 6ft Drywall Cross Tee

12) Wall Molding:

13) KAM12 - 12ft Knurled Angle Molding 1-1/4” Face

14) Hanger wire: a Class 1 zinc coating, soft temper, pre-stretched, with a yield stress load of at least time three times the design load, but not less than 12-gauge.

15) Fasteners (for Panel attachment)

16) #6 x 1-5/8” Fine thread or sharp point self-drilling drywall screws

17) Grip-Plate Washer for ACOUSTIBuilt panels (1-1/4”diameter) - #2119

18) Perimeter Systems

19) Commercial quality extruded aluminum alloy 6063 trim channel, factory finished in baked polyester paint. Commercial quality galvanized steel unfinished T-bar connection clips; galvanized steel splice plates.

20) Color: White

21) Size: 120 in X 4 in (also available in 6”)

22) Recycle Content: Post-Consumer - 50% Pre-Consumer - 0%

23) Acceptable Product: AXIOM One Piece for Drywall, 4in Straight – AX1PC4STR or Curved AX1PC4CUR as manufactured by Armstrong World Industries

24) Axiom Trim Channel:

25) AX4STR 4in Axiom Classic Straight

26) AX1PC4STR 4IN One –Piece Drywall Trim

27) Axiom Bottom Trim with taping flange

28) AXBTASTR – Bottom Trim for ACOUSTIBuilt (also available in curved)

29) Axiom Accessories:

30) AXSPLICE - Splice Plate

B. Material Ingredient Transparency: Health Product Declaration (HPD); Declare Label

C. Life Cycle Assessment: Third Party Certified Environmental Product Declaration (EPD)

PART 3 - EXECUTION

3.01 PRIOR TO INSTALLATION, CONTACT YOUR ARMSTRONG INSTALLATION SYSTEMS SPECIALIST (ISS). BEFORE INSTALLATION, INSPECT PREVIOUS WORK OF ALL OTHER TRADES. VERIFY THAT ALL WORK IS COMPLETE AND ACCURATE TO THE POINT WHERE THIS INSTALLATION MAY PROPERLY PROCEED IN STRICT ACCORDANCE WITH FRAMING SHOP DRAWINGS.

A. If framing preparation is the responsibility of another installer, notify Architect of unsatisfactory preparation before proceeding.

B. The system installation is similar to a conventional drywall installation. However, there are key differences in both material substrate and methods of finishing and installation that make this system unique. Installers should review and follow all written directions of the installation instructions and view the installation video.

C. Installation: In accordance with all approved plans, details, and manufacturer's installation guidelines located in the Armstrong ACOUSTIBuilt Assembly and Installation Instructions, and
Drywall Grid Systems Hanging and Framing Flat Ceilings Installation Guides.

D. Install seismic components if required by the building code. Seismic components to be specified on the architectural plans by the project engineer or design team.

E. Suspend main beam from overhead construction with hanger wires spaced 4-0 ft. or 6-0 ft. on center along the length of the main runner. Install hanger wires plumb and straight.

F. Cross tees shall be installed 16” on center.

G. Install wall moldings/perimeter trim at intersection of suspended ceiling and vertical surfaces.

H. Main runners and cross tees shall be attached at perimeter conditions.

I. When determining the grid layout, consider the long edges of the boards must run parallel with the cross tees.

J. This system relies on a square grid system to ensure panel edges align at centers of cross tees. If the installation does not meet these squareness requirements, the panel edges may run off the grid system.
   1. The system must be square to within 1/8” over a 48” x 48” module.
   2. The suspension system must be leveled to within 1/4” in 10’.
      a. Floating perimeters must be trimmed with either Axiom® One-Piece Drywall Trim or Axiom® Classic with Bottom Trim for ACOUSTIBuilt™. Refer to the installation instructions for integration with ACOUSTIBuilt installations.
      b. 3.2.1 PREPARATION
         1) Do not proceed with installation until all wet work such as concrete, terrazzo, plastering and painting has been completed and thoroughly dried out, unless expressly permitted by manufacturer's printed recommendations.
         2) Coordination: Furnish layouts for preset inserts, clips, and other ceiling anchors whose installation is specified in other sections.
         3) Furnish concrete inserts and similar devices to other trades for installation well in advance of time needed for coordination of other work.
         4) 3.2.3 INSTALLATION

K. Follow manufacturer installation instructions. Armstrong ACOUSTIBuilt Assembly and Installation Instrucitons.

L. Controls joints are required following the standards used for gypsum board listed in ASTM C840, Section 20.
   1. Ceilings with perimeter relief cannot exceed 50 LF and 2500 SF between control joints.
   2. Ceilings without perimeter relief cannot exceed 30 LF and 900 SF between control joints.

M. Panel joints and fasteners are finished with tape and compound to create a flat surface. While the materials used to finish ACOUSTIBuilt panels are also used to finish drywall, the procedure has unique requirements.

N. Joint compound coverage shall be limited to preserve the acoustical performance of the panels. Compound at panel joints shall not exceed 8 inch widths. Compound applied to field fasteners shall not exceed 4 inch by 4-inch areas. All compound shall be smooth and free of tool marks and ridges. Panels are to be finished with taping knives. Production tools, including boxes, are not permitted.

O. Sanding and inspection: Throughout the sanding process, inspect the surface frequently for flatness. Direct a light across the ceiling to highlight unevenness that requires attention.

P. Fine Texture Finish shall be applied in 4 coat process (additional coat may be used to achieve the desired finish) as called out in the installation instructions. Fine Texture Finish for ACOUSTIBuilt is applied in multiple coats, layered to achieve a uniform appearance and acoustical performance. It is strongly encouraged to practice spraying to ensure proper calibration and technique are achieved. Refer to the installation video.
   1. Must be applied with an air assist spray system (refer to manufacturers installation instructions for required equipment). The Fine texture finish is not intended for use with airless spay or to be manually applied by rolling.
2. See Manufacture's installation instructions for correct pressure settings for spray system, finish preparation, spray calibration and spray procedure and technique.
   a. 3.2.4 ADJUSTING AND CLEANING
3. To remove soot, dirt, and dust use a vacuum operating at low power with a soft brush or use a dry soot cleaning sponge.
4. Clean exposed surfaces of acoustical ceilings, including trim, edge moldings, and suspension members. Comply with manufacturer's instructions for cleaning and touch up of minor finish damage. Remove any ceiling products that cannot be successfully cleaned and or repaired. Replace with attic stock or new product to eliminate evidence of damage.
5. Before disposing of ceilings, contact the Armstrong Recycling Center at 877-276-7876, select option #1 then #8 to review with a consultant the condition and location of building where the ceilings will be removed. The consultant will verify the condition of the material and that it meets the Armstrong requirements for recycling. The Armstrong consultant will provide assistance to facilitate the recycle of the ceiling.

END OF SECTION 09 50 00
SECTION 09 51 00
ACOUSTICAL CEILINGS

PART 1 GENERAL

1.01 SECTION INCLUDES
A. Suspended metal grid ceiling system.
B. Acoustical units.

1.02 RELATED REQUIREMENTS
A. Section 01 61 16 - Volatile Organic Compound (VOC) Content Restrictions.

1.03 REFERENCE STANDARDS

1.04 ADMINISTRATIVE REQUIREMENTS
A. Sequence work to ensure acoustical ceilings are not installed until building is enclosed, sufficient heat is provided, dust generating activities have terminated, and overhead work is completed, tested, and approved.
B. Do not install acoustical units until after interior wet work is dry.

1.05 SUBMITTALS
A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.
B. Shop Drawings: Indicate grid layout and related dimensioning.
C. Product Data: Provide data on suspension system components and acoustical units.
D. Samples: Submit two full size samples illustrating material and finish of acoustical units.
E. Samples: Submit two samples each, 12 inches long, of suspension system main runner, cross runner, and perimeter molding.
F. Manufacturer's Installation Instructions: Indicate special procedures and perimeter conditions requiring special attention.
G. Manufacturer's Qualification Statement.
H. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
   1. See Section 01 60 00 - Product Requirements, for additional provisions.
   2. Extra Acoustical Units: Quantity equal to 5 percent of total installed each type and size.

1.06 QUALITY ASSURANCE
A. Suspension System Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum three years documented experience.
B. Acoustical Unit Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum three years documented experience.

1.07 FIELD CONDITIONS
A. Maintain uniform temperature of minimum 60 degrees F, and maximum humidity of 40 percent prior to, during, and after acoustical unit installation.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Acoustic Tiles/Panels:
5. Substitutions: See Section 01 60 00 - Product Requirements.

B. Suspension Systems:
1. Same as for acoustical units.

2.02 ACOUSTICAL UNITS

A. Acoustical Units - General: ASTM E1264, Class A.
1. VOC Content: As specified in Section 01 61 16.

B. Acoustical Panels, Type F: Painted mineral fiber, with the following characteristics:
1. Classification: ASTM E1264 Type III.
2. Size: 24 by 24 inches.
5. Suspension System: Exposed grid.
6. Products:
   b. USG Corporation; Astro Acoustical Panels: www.usg.com/ceilings/#sle.

C. Acoustical Panels, Type C & U: Mineral fiber with membrane-faced overlay, with the following characteristics:
1. Classification: ASTM E1264 Type IV.
2. Size: 24 by 24 inches.
5. Suspension System: Exposed grid.
6. Products:
   c. USG Corporation; Mars Acoustical Panels: www.usg.com/ceilings/#sle.

D. Acoustical Panels, Type O: Glass fiber with membrane-faced overlay, with the following characteristics:
1. Classification: ASTM E1264 Type XII.
2. Size: 24 by 24 inches.
5. Suspension System: Exposed.
6. Products:

E. Wood Fiber Acoustical Panels, Type [____]: Cementitious wood fiber.
1. Size: 24 by 24 inches.
2. Thickness: 1 inch.
3. Noise Reduction Coefficient (NRC): 0.90 when tested in accordance with ASTM C423 for Type E mounting, per ASTM E795.
5. Surface Pattern: Coarse.
7. Suspension System: Exposed grid.
8. Products:
   b. Substitutions: See Section 01 60 00 - Product Requirements.

2.03 SUSPENSION SYSTEM(S)

A. Metal Suspension Systems - General: Complying with ASTM C635/C635M; die cut and interlocking components, with perimeter moldings, hold down clips, stabilizer bars, clips, and splices as required.

B. Exposed Suspension System: Hot-dipped galvanized steel grid with aluminum cap.
   1. Structural Classification: Intermediate-duty, when tested in accordance with ASTM C635/C635M.
   2. Profile: Tee; 15/16 inch face width.
   3. Finish: Baked enamel.
   5. Products:
      a. USG Corporation; Donn Brand ZXLA 15/16 inch Acoustical Suspension System: www.usg.com/ceilings/#sle.

C. Exposed Suspension System: Hot-dipped galvanized steel grid and cap.
   1. Structural Classification: Intermediate-duty, when tested in accordance with ASTM C635/C635M.
   2. Profile: Tee; 9/16 inch face width.
   3. Finish: Baked enamel.
   5. Products:

2.04 ACCESSORIES

A. Support Channels and Hangers: Galvanized steel; size and type to suit application, seismic requirements, and ceiling system flatness requirement specified.

B. Hanger Wire: 12 gauge, 0.08 inch galvanized steel wire.

C. Perimeter Moldings: Same metal and finish as grid.
   1. Angle Molding: L-shaped, for mounting at same elevation as face of grid.
   2. Shadow Molding: Shaped to create a perimeter reveal.
   3. Gaskets For Perimeter Moldings: Closed-cell foam, factory-applied to molding.
   4. Acoustical Sealant For Perimeter Moldings: Non-hardening, non-skinning, for use in conjunction with suspended ceiling system.

D. Metal Edge Trim for “Cloud” Suspension Systems: Steel or extruded aluminum; provide attachment clips, splice plates, and preformed corner pieces for complete trim system.
   1. Trim Height: 6 inch.
   2. Finish: Baked enamel.

E. Touch-up Paint: Type and color to match acoustical and grid units.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify existing conditions before starting work.
B. Verify that layout of hangers will not interfere with other work.
3.02 PREPARATION
   A. Install after major above-ceiling work is complete.
   B. Coordinate the location of hangers with other work.
   C. Provide hanger clips during steel deck erection. Provide additional hangers and inserts as required.

3.03 INSTALLATION - SUSPENSION SYSTEM
   A. Install suspension system in accordance with ASTM C636/C636M, ASTM E580/E580M, and manufacturer's instructions and as supplemented in this section.
   B. Rigidly secure system, including integral mechanical and electrical components, for maximum deflection of 1:360.
   C. Lay out system to a balanced grid design with edge units no less than 50 percent of acoustical unit size.
   D. Perimeter Molding: Install at intersection of ceiling and vertical surfaces and at junctions with other interruptions.
      1. Use longest practical lengths.
   E. Suspension System, Non-Seismic: Hang suspension system independent of walls, columns, ducts, pipes and conduit. Where carrying members are spliced, avoid visible displacement of face plane of adjacent members.
   F. Where ducts or other equipment prevent the regular spacing of hangers, reinforce the nearest affected hangers and related carrying channels to span the extra distance.
   G. Do not support components on main runners or cross runners if weight causes total dead load to exceed deflection capability.
   H. Support fixture loads using supplementary hangers located within 6 inches of each corner, or support components independently.
   I. Do not eccentrically load system or induce rotation of runners.
   J. Form expansion joints as recommended by manufacturer. Form to accommodate plus or minus 1 inch movement. Maintain visual closure.

3.04 INSTALLATION - ACOUSTICAL UNITS
   A. Install acoustical units in accordance with manufacturer's instructions.
   B. Fit acoustical units in place, free from damaged edges or other defects detrimental to appearance and function.
   C. Fit border trim neatly against abutting surfaces.
   D. Install acoustical units level, in uniform plane, and free from twist, warp, and dents.
   E. Cutting Acoustical Units:
      1. Cut to fit irregular grid and perimeter edge trim.
      2. Make field cut edges of same profile as factory edges.
      3. Double cut and field paint exposed reveal edges.
   F. Where round obstructions occur, provide preformed closures to match perimeter molding.

3.05 TOLERANCES
   A. Maximum Variation from Flat and Level Surface: 1/8 inch in 10 feet.
   B. Maximum Variation from Plumb of Grid Members Caused by Eccentric Loads: 2 degrees.

END OF SECTION 09 51 00
SECTION 09 65 00
RESILIENT FLOORING

PART 1 GENERAL

1.01 SECTION INCLUDES
A. Resilient tile flooring.
B. Static control resilient tile flooring.
C. Resilient base.
D. Resilient stair accessories.
E. Installation accessories.

1.02 RELATED REQUIREMENTS
A. Section 01 61 16 - Volatile Organic Compound (VOC) Content Restrictions.
B. Section 09 05 61 - Common Work Results for Flooring Preparation: Removal of existing floor coverings, cleaning, and preparation.
C. Section 26 05 26 - Grounding and Bonding for Electrical Systems: Grounding and bonding of static control flooring to building grounding system.

1.03 REFERENCE STANDARDS

1.04 SUBMITTALS
A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.
B. Product Data: Provide data on specified products, describing physical and performance characteristics; including sizes, patterns and colors available; and installation instructions.
C. Verification Samples: Submit two samples, 12 by 12 inch in size illustrating color and pattern for each resilient flooring product specified.
D. Concrete Subfloor Test Report: Submit a copy of the moisture and alkalinity (pH) test reports.
E. Certification: Prior to installation of flooring, submit written certification by flooring manufacturer and adhesive manufacturer that condition of subfloor is acceptable.
F. Manufacturer's Qualification Statement.
G. Installer's Qualification Statement.
H. Maintenance Data: Include maintenance procedures, recommended maintenance materials, and suggested schedule for cleaning, stripping, and re-waxing.
I. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
1. See Section 01 60 00 - Product Requirements, for additional provisions.
2. Extra Flooring Material: 1 Box per 50 Boxes of each type and color.
3. Extra Wall Base: 10 LF per 500 LF of each type and color.

1.05 QUALITY ASSURANCE
A. Manufacturer Qualifications: Company specializing in manufacturing specified flooring with minimum three years documented experience.
B. Installer Qualifications: Company specializing in installing specified flooring with minimum three years documented experience.

1.06 DELIVERY, STORAGE, AND HANDLING
A. Upon receipt, immediately remove any shrink-wrap and check materials for damage and the correct style, color, quantity and run numbers.
B. Store all materials off of the floor in an acclimatized, weather-tight space.
C. Maintain temperature in storage area between 55 degrees F and 90 degrees F.
D. Do not double stack pallets.

1.07 FIELD CONDITIONS
A. Store materials for not less than 48 hours prior to installation in area of installation at a temperature of 70 degrees F to achieve temperature stability. Thereafter, maintain conditions above 55 degrees F.

PART 2 PRODUCTS
2.01 TILE FLOORING
A. Vinyl Tile - Type LVT-1: Solid vinyl with color and pattern throughout thickness.
   1. Minimum Requirements: Comply with ASTM F1700, of Class corresponding to type specified.
   2. Critical Radiant Flux (CRF): Minimum 0.45 watt per square centimeter, when tested in accordance with ASTM E648 or NFPA 253.
   3. Mold and Microbial Resistance: Highly resistant when tested in accordance with ASTM D6329; certified in accordance with UL 2824.
   4. VOC Content Limits: As specified in Section 01 61 16.
   5. Total Thickness: 0.125 inch.
   6. Color: As indicated on drawings.
B. Rubber Tile - Type RT-1: Heterogeneous, laminated construction.
   1. Minimum Requirements: Comply with ASTM F1344, of Class corresponding to type specified.
   2. Critical Radiant Flux (CRF): Minimum 0.45 watt per square centimeter, when tested in accordance with ASTM E648 or NFPA 253.
   3. VOC Content Limits: As specified in Section 01 61 16.
   5. Total Thickness: 0.125 inch.
   7. Color: As indicated on drawings.
C. Static Control Tile - Type ESD-1: Homogeneous; color and pattern throughout thickness.
   2. Electrical Resistance:
      a. Dissipative Tile: Resistance between 1.0 megohms and 1000 megohms as tested in accordance with ASTM F150.
   3. Critical Radiant Flux (CRF): Minimum 0.45 watt per square centimeter, when tested in accordance with ASTM E648 or NFPA 253.
   4. VOC Content Limits: As specified in Section 01 61 16.
   5. Tile Size: 12 by 12 inch.
   6. Total Thickness: 0.125 inch.
7. Color: As indicated on drawings.

2.02 STAIR COVERING
A. Stair Treads with Integral Risers: Rubber; full height of riser, full width and depth of tread in one piece; tapered thickness.
   1. Minimum Requirements: Comply with ASTM F2169, Type TP, rubber, thermoset.
   2. Critical Radiant Flux (CRF): Minimum 0.45 watt per square centimeter, when tested in accordance with ASTM E648 or NFPA 253.
   3. Nominal Thickness: 0.080 inch.
   5. Striping: 2 inch wide contrasting color abrasive strips.
   7. Color: As indicated on drawings.

2.03 RESILIENT BASE
A. Resilient Base - Type WB-2: ASTM F1861, Type TS rubber, vulcanized thermoset; style as scheduled.
   1. Height: 6 inch.
   2. Thickness: 0.125 inch.
   4. Length: Roll.
   5. Color: As indicated on drawings.
   6. Accessories: Premolded external corners and internal corners.

2.04 ACCESSORIES
A. Subfloor Filler: White premix latex; type recommended by adhesive material manufacturer.
B. Primers, Adhesives, and Seam Sealer: Waterproof; types recommended by flooring manufacturer.
   1. VOC Content Limits: As specified in Section 01 61 16.
C. Moldings, Transition and Edge Strips: Same material as flooring.
D. Copper Grounding Strips: Type and size as recommended by static control flooring manufacturer.
E. Floor Polish for Static Control Flooring: Fluid-applied polish, intended to protect electrical properties of flooring, as recommended by static control flooring manufacturer.

PART 3 EXECUTION
3.01 EXAMINATION
A. Verify that surfaces are flat to tolerances acceptable to flooring manufacturer, free of cracks that might telegraph through flooring, clean, dry, and free of curing compounds, surface hardeners, and other chemicals that might interfere with bonding of flooring to substrate.
B. Verify that wall surfaces are smooth and flat within the tolerances specified for that type of work, are dust-free, and are ready to receive resilient base.
C. Cementitious Subfloor Surfaces: Verify that substrates are ready for resilient flooring installation by testing for moisture and alkalinity (pH).
   1. Test in accordance with Section 09 05 61.
   2. Obtain instructions if test results are not within limits recommended by resilient flooring manufacturer and adhesive materials manufacturer.
   3. Follow moisture and alkalinity remediation procedures in Section 09 05 61.
D. Verify that required floor-mounted utilities are in correct location.

3.02 PREPARATION
A. Prepare floor substrates for installation of flooring in accordance with Section 09 05 61.

3.03 INSTALLATION - GENERAL
A. Starting installation constitutes acceptance of subfloor conditions.
B. Install in accordance with manufacturer's written instructions.

C. Adhesive-Applied Installation:
   1. Spread only enough adhesive to permit installation of materials before initial set.
   2. Place copper grounding strip in conductive adhesive and apply additional adhesive to top side of strip before installing static control flooring. Allow strip to extend beyond flooring in accordance with static control flooring manufacturer's instructions. Refer to Section 26.05 26 for grounding and bonding to building grounding system.
   3. Fit joints and butt seams tightly.
   4. Set flooring in place, press with heavy roller to attain full adhesion.

D. Where type of floor finish, pattern, or color are different on opposite sides of door, terminate flooring under centerline of door.

E. Install edge strips at unprotected or exposed edges, where flooring terminates, and where indicated.
   1. Metal Strips: Attach to substrate before installation of flooring using stainless steel screws.
   2. Resilient Strips: Attach to substrate using adhesive.

F. Scribe flooring to walls, columns, cabinets, floor outlets, and other appurtenances to produce tight joints.

G. At movable partitions, install flooring under partitions without interrupting floor pattern.

3.04 INSTALLATION - TILE FLOORING
A. Mix tile from container to ensure shade variations are consistent when tile is placed, unless otherwise indicated in manufacturer's installation instructions.

B. Lay flooring with joints and seams parallel to building lines to produce symmetrical pattern.

C. Install square tile to ashlar pattern. Allow minimum 1/2 full size tile width at room or area perimeter.

D. Install plank tile with a random offset of at least 6 inches from adjacent rows.

3.05 INSTALLATION - RESILIENT BASE
A. Fit joints tightly and make vertical. Maintain minimum dimension of 18 inches between joints.

B. Install base on solid backing. Bond tightly to wall and floor surfaces.

C. Scribe and fit to door frames and other interruptions.

3.06 INSTALLATION - STAIR COVERINGS
A. Install stair coverings in one piece for full width and depth of tread.

B. Adhere over entire surface. Fit accurately and securely.

3.07 CLEANING
A. Remove excess adhesive from floor, base, and wall surfaces without damage.

B. Clean in accordance with manufacturer's written instructions.

3.08 PROTECTION
A. Prohibit traffic on resilient flooring for 48 hours after installation.

END OF SECTION 09 65 00
SECTION 09 90 00
PAINTING AND COATING - COMMERCIAL FACILITY GUIDE SPECIFICATION - SHERWIN-WILLIAMS

PART 1 GENERAL
1.01 SECTION INCLUDES
A. Surface preparation.
B. Interior painting and coating systems.
C. Exterior painting and coating systems.
D. Scope:
   1. Finish surfaces exposed to view, unless fully factory-finished and unless otherwise indicated, including the following:
      a. Exterior:
         1) Concrete: Cementitious siding, Flexboard, Transite, non-roof shingles, common brick, stucco, tilt-up, precast, and poured-in-place cement.
         2) Drywall: Gypsum board and exterior drywall.
      b. Interior:
         1) Concrete, Walls and Ceilings: Poured concrete, precast concrete, unglazed brick, cement board, tilt-up, cast-in-place concrete, and plaster.

1.02 SUBMITTALS
A. See Section 01 30 00 - Administrative Requirements for submittal procedures.
B. Product Data: Provide complete list of products to be used, with the following information for each:
   1. Product characteristics.
   2. Surface preparation instructions and recommendations.
   3. Primer requirements and finish specification.
   4. Storage and handling requirements and recommendations.
   5. Application methods.
   6. Clean-up information.
C. Samples: Submit four paper draw down samples, 8-1/2 by 11 inches in size, illustrating range of colors available for each finishing product specified.
D. Certification: By manufacturer that paints and finishes comply with VOC limits specified.
E. Applicator's qualification statement.
F. Maintenance Data: Submit coating maintenance manual including finish schedule showing where each product/color/finish was used, product technical data sheets, safety data sheets (SDS), care and cleaning instructions, touch-up procedures, repair of painted and finished surfaces, and color samples of each color and finish used.
G. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
   1. See Section 01 60 00 - Product Requirements for additional provisions.
   2. Extra Paint and Finish Materials: 5% but not less than 1 gallon of each color; from the same product run, store where directed.
   3. Label each container with color in addition to manufacturer's label.

1.03 QUALITY ASSURANCE
A. Applicator Qualifications: Company specializing in performing the type of work specified with minimum 3 years experience and approved by manufacturer.

1.04 MOCK-UPS
A. See Section 01 40 00 - Quality Requirements for general requirements for mock-ups.
B. Provide one accent wall as directed by Architect to demonstrate color and finish.
C. Provide door and frame assembly indicating paint color, texture, and finish.
D. Locate where directed by Architect.
E. Mock-up may remain as part of the work.

1.05 DELIVERY, STORAGE, AND HANDLING
A. Deliver products to site in sealed and labeled containers; inspect to verify acceptability.
B. Container Label: Include manufacturer's name, type of paint, product name, product code, color designation, VOC content, batch date, environmental handling, surface preparation, application, and use instructions.
C. Paint Materials: Store at a minimum of 45 degrees F and a maximum of 90 degrees F, in ventilated area, and as required by manufacturer's instructions.
D. Handling: Maintain a clean, dry storage area to prevent contamination or damage to materials.

1.06 FIELD CONDITIONS
A. Do not apply materials when environmental conditions are outside the ranges required by manufacturer.
B. Follow manufacturer's recommended procedures for producing the best results, including testing of substrates, moisture in substrates, and humidity and temperature limitations.

PART 2 PRODUCTS
2.01 MANUFACTURERS
A. Basis of Design Products: Subject to compliance with requirements, provide Sherwin-Williams Company (The) products indicated; www.sherwin-williams.com/#sle.
B. Comparable Products: Products of approved manufacturers will be considered in accordance with 01 60 00 - Product Requirements, and the following:
   1. Products that meet or exceed performance and physical characteristics of basis of design products.

2.02 PAINTINGS AND COATINGS
A. General:
   1. Provide factory-mixed coatings unless otherwise indicated.
   2. When required, mix coatings to correct consistency in accordance with manufacturer's instructions before application.
   3. Do not reduce, thin, or dilute coatings or add materials to coatings unless specifically indicated in manufacturer's instructions.
B. Volatile Organic Compound (VOC) Content: Comply with Section 01 61 16.
C. Accessory Materials: Provide primers, sealers, cleaning agents, cleaning cloths, sanding materials, and clean-up materials as required for final completion of painted surfaces.

2.03 PAINT SYSTEMS - EXTERIOR
A. Concrete: Cementitious siding, Flexboard, Transite, non-roof shingles, common brick, stucco, tilt-up, precast, and poured-in-place cement.
   1. Latex Systems:
      a. Satin Finish:
         1) 1st Coat: Sherwin-Williams Loxon Concrete and Masonry Primer Sealer LX02W50: www.sherwin-williams.com/#sle.
            (a) 5.3 to 8 mils wet, 2.1 to 3.2 mils dry.
            (a) 4 mils wet, 1.5 mils dry per coat.
B. Drywall: Gypsum board and exterior drywall.
   1. Latex Systems:
      a. Semi-Gloss Finish:
   (a) 4 mils wet, 1.4 mils dry per coat.
   (a) 2 to 4 mils dry per coat.

2.04 PAINT SYSTEMS - INTERIOR

A. Concrete, Walls and Ceilings: Poured concrete, precast concrete, unglazed brick, cement board, tilt-up, cast-in-place concrete, and plaster.
   1. Latex Systems:
      a. Eg-Shel Finish:
         1) 1st Coat: Sherwin-Williams Loxon Concrete and Masonry Primer Sealer, LX02W50 Series: www.sherwin-williams.com/#sle.
            (a) 8 mils wet, 3.2 mils dry per coat.
            (a) 4 mils wet, 1.7 mils dry per coat.

   END OF SECTION 09 90 00
SECTION 09 91 13
EXTERIOR PAINTING

PART 2 PRODUCTS

1.01 PAINTS AND FINISHES - GENERAL
A. Paints and Finishes: Ready-mixed, unless required to be a field-catalyzed paint.
   1. Provide paints and finishes of a soft paste consistency, capable of being readily and uniformly dispersed to a homogeneous coating, with good flow and brushing properties, and capable of drying or curing free of streaks or sags.
   2. Supply each paint material in quantity required to complete entire project's work from a single production run.
   3. Do not reduce, thin, or dilute paint or finishes or add materials unless such procedure is described explicitly in manufacturer's product instructions.

PART 3 EXECUTION

2.01 PREPARATION
A. Clean surfaces thoroughly and correct defects prior to application.
B. Prepare surfaces using the methods recommended by the manufacturer for achieving the best result for the substrate under the project conditions.
C. Remove or mask surface appurtenances, including electrical plates, hardware, light fixture trim, escutcheons, and fittings, prior to preparing surfaces for finishing.
D. Seal surfaces that might cause bleed through or staining of topcoat.
E. Remove mildew from impervious surfaces by scrubbing with solution of tetra-sodium phosphate and bleach. Rinse with clean water and allow surface to dry.

2.02 APPLICATION
A. Apply products in accordance with manufacturer's written instructions and recommendations in "MPI Architectural Painting Specification Manual".
B. Do not apply finishes to surfaces that are not dry. Allow applied coats to dry before next coat is applied.
C. Apply each coat to uniform appearance.
D. Vacuum clean surfaces of loose particles. Use tack cloth to remove dust and particles just prior to applying next coat.
E. Reinstall electrical cover plates, hardware, light fixture trim, escutcheons, and fittings removed prior to finishing.

END OF SECTION 09 91 13
SECTION 09 91 23
INTERIOR PAINTING

PART 2 PRODUCTS
1.01 PAINTS AND FINISHES - GENERAL
A. Paints and Finishes: Ready-mixed, unless intended to be a field-catalyzed paint.
   1. Provide paints and finishes of a soft paste consistency, capable of being readily and uniformly dispersed to a homogeneous coating, with good flow and brushing properties, and capable of drying or curing free of streaks or sags.
   2. Supply each paint material in quantity required to complete entire project's work from a single production run.
   3. Do not reduce, thin, or dilute paint or finishes or add materials unless such procedure is specifically described in manufacturer's product instructions.

PART 3 EXECUTION
2.01 PREPARATION
A. Clean surfaces thoroughly and correct defects prior to application.
B. Prepare surfaces using the methods recommended by the manufacturer for achieving the best result for the substrate under the project conditions.
C. Remove or mask surface appurtenances, including electrical plates, hardware, light fixture trim, escutcheons, and fittings, prior to preparing surfaces or finishing.
D. Seal surfaces that might cause bleed through or staining of topcoat.

2.02 APPLICATION
A. Apply products in accordance with manufacturer's written instructions and recommendations in "MPI Architectural Painting Specification Manual".
B. Do not apply finishes to surfaces that are not dry. Allow applied coats to dry before next coat is applied.
C. Apply each coat to uniform appearance in thicknesses specified by manufacturer.
D. Vacuum clean surfaces of loose particles. Use tack cloth to remove dust and particles just prior to applying next coat.
E. Reinstall electrical cover plates, hardware, light fixture trim, escutcheons, and fittings removed prior to finishing.

END OF SECTION 09 91 23
SECTION 09 97 23
CONCRETE AND MASONRY COATINGS

PART 1 GENERAL

1.01 SECTION INCLUDES
   A. Moisture resistant textured concrete and masonry coatings.

1.02 RELATED REQUIREMENTS
   A. Section 01 61 16 - Volatile Organic Compound (VOC) Content Restrictions.

1.03 REFERENCE STANDARDS
   J. SSPC-SP 3 - Power Tool Cleaning 2018.
   K. SSPC-SP 6 - Commercial Blast Cleaning 2007.
   L. SSPC-SP 7 - Brush-Off Blast Cleaning 2007.

1.04 SUBMITTALS
   A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.
   B. Product Data: Provide data indicating coating materials.
   C. Samples: Submit two samples 6 by 6 inch in size illustrating colors available for selection.
   D. Manufacturer's Certificate: Certify that products meet or exceed specified requirements.
   E. Manufacturer's Installation Instructions: Indicate special procedures and perimeter conditions requiring special attention.
   F. Maintenance Data: Include cleaning procedures and repair and patching techniques.

1.05 QUALITY ASSURANCE
   A. Maintain one copy of each referenced document that applies to application on site.
   B. Manufacturer Qualifications: Company specializing in manufacturing the Products specified in this section with minimum three years documented experience.
   C. Applicator Qualifications: Company specializing in performing the work of this section with minimum three years documented experience.

1.06 MOCK-UP
   A. Provide mock-up, 10 feet long by 10 feet wide, illustrating coating, color, and surface sheen, for each specified coating.
   B. Locate where directed.
C. Mock-up may remain as part of the Work.

1.07 FIELD CONDITIONS
A. Do not install materials when temperature is below 55 degrees F or above 90 degrees F.
B. Maintain this temperature range, 24 hours before, during, and 72 hours after installation of coating.
C. Provide lighting level of 80 ft candles measured mid-height at substrate surface.
D. Restrict traffic from area where coating is being applied or is curing.

1.08 WARRANTY
A. See Section 01 78 00 - Closeout Submittals, for additional warranty requirements.
B. Correct defective Work within a five year period after Date of Substantial Completion.
C. Warranty: Include coverage for bond to substrate.

PART 2 PRODUCTS

2.01 MANUFACTURERS
A. Concrete and Masonry Coatings:
   3. Substitutions:  Section 01 60 00 - Product Requirements.

2.02 CONCRETE AND MASONRY COATINGS
A. Provide high-build, weather resistant coating systems that meet the following minimum performance criteria, unless more stringent criteria are specified:
   1. Salt Spray Resistance: Passes when tested according to ASTM B117 for 2000 hours.
   2. Surface Burning Characteristics: Flame spread/Smoke developed index of 0/0, maximum, when tested in accordance with ASTM E84.
   3. Accelerated Outdoor Exposure: Passes when tested according to ASTM G153 for 5,000 hours.

2.03 MATERIALS
A. Coatings - General: Provide complete systems formulated and recommended by manufacturer for the applications indicated, in the thicknesses indicated.
   1. Maximum volatile organic compound (VOC) content: As required by applicable regulations.
B. High Build, One Coat, Water Based Textured Coating for 'Green' Concrete: Water based, epoxy-acrylic resin with graded perlite aggregate.
   1. Stated by manufacturer as suitable for installation on visibly damp surfaces and concrete that has hardened but is not fully cured ("green" concrete) without requiring a primer.
   2. Dry Film Thickness: 15 mils, minimum.
   3. Flexibility Test: Passing, when tested according to ASTM D522/D522M with a 1 inch mandrel.
   4. Abrasion Resistance: Passing, when tested according to ASTM D968 with 792 gallons of falling sand.
   5. Freeze Thaw Resistance: Passing, when tested according to ASTM D2243 for 50 cycles.
   6. Wind Driven Rain Resistance: Passing, when tested according to ASTM D6904 at 98 miles per hour for 24 hours.
   7. Water Vapor Transmission: 20 perms, maximum, when tested in accordance with ASTM E96/E96M.
   8. Color: As indicated.

PART 3 EXECUTION

3.01 EXAMINATION
A. Verify existing conditions before starting work.
B. Verify that substrate surfaces are ready to receive work as instructed by the coating
manufacturer. Obtain and follow manufacturer's instructions for examination and testing of
substrates.
C. Cementitious Substrates: Do not begin application until substrate has cured 28 days minimum
and measured moisture content is not greater than 16 percent.
D. Masonry: Verify masonry joints are struck flush.

3.02 PREPARATION
A. Clean surfaces of loose foreign matter.
B. Remove substances that would bleed through finished coatings.
C. Remove finish hardware, fixture covers, and accessories and store.
D. Galvanized Surfaces: Remove surface contamination and oils and wash with solvent.
E. Ferrous Metal:
   1. Solvent clean.
   2. Remove loose rust, loose mill scale, and other foreign substances using hand tools
      according to SSPC-SP 2, power tools according to SSPC-SP 3, or blast cleaning
      according to SSPC-SP 6 or -SP 7.
F. Protect adjacent surfaces and materials not receiving coating from spatter and overspray; mask
   if necessary to provide adequate protection. Repair damage.

3.03 PRIMING
A. Apply primer to all surfaces, unless specifically not required by coating manufacturer. Apply in
   accordance with coating manufacturer's instructions.
B. Concrete and Masonry: Prior to priming, patch holes and indentations and fill cracks with
   manufacturer's recommended crack repair material.

3.04 COATING APPLICATION
A. Apply coatings in accordance with manufacturer's instructions, to thicknesses specified.
B. Apply in uniform thickness coats, without runs, drips, pinholes, brush marks, or variations in
   color, texture, or finish. Finish edges, crevices, corners, and other changes in dimension with
   full coating thickness.

3.05 CLEANING
A. Collect waste material that could constitute a fire hazard, place in closed metal containers, and
   remove daily from site.
B. Clean surfaces immediately of overspray, splatter, and excess material.
C. After coating has cured, clean and replace finish hardware, fixtures, and fittings previously
   removed.

3.06 PROTECTION
A. Protect finished work from damage.

END OF SECTION 09 97 23
SECTION 10 44 00
FIRE PROTECTION SPECIALTIES

PART 1 GENERAL

1.01 SECTION INCLUDES
A. Fire extinguishers.
B. Fire extinguisher cabinets.
C. Accessories.

1.02 RELATED REQUIREMENTS
A. Section 06 10 00 - Rough Carpentry: Wood blocking product and execution requirements.

1.03 REFERENCE STANDARDS

1.04 SUBMITTALS
A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.
B. Product Data: Provide extinguisher operational features.
C. Shop Drawings: Indicate locations of cabinets and cabinet physical dimensions.
D. Manufacturer's Installation Instructions: Indicate special criteria and wall opening coordination requirements.
E. Manufacturer's Certificate: Certify that products meet or exceed specified requirements.
F. Maintenance Data: Include test, refill or recharge schedules and re-certification requirements.

PART 2 PRODUCTS

2.01 MANUFACTURERS
A. Fire Extinguishers:
B. Fire Extinguisher Cabinets and Accessories:

2.02 FIRE EXTINGUISHERS
A. Fire Extinguishers - General: Comply with product requirements of NFPA 10 and applicable codes, whichever is more stringent.
   1. Provide extinguishers labeled by UL (DIR) or FM (AG) for purpose specified and as indicated.
B. Multipurpose Dry Chemical Type Fire Extinguishers: Carbon steel tank, with pressure gauge.
   2. Size: 5 pound.
   3. Finish: Baked polyester powder coat, red color.
4. Temperature range: Minus 40 degrees F to 120 degrees F.

C. Carbon Dioxide Type Fire Extinguishers: Aluminum tank, with pressure gauge.
   1. Class: B:C type.
   2. Size: 5 pound.
   3. Finish: Baked polyester powder coat, red color.
   4. Temperature range: Minus 40 degrees F to 120 degrees F.

2.03 FIRE EXTINGUISHER CABINETS
   A. Fire Rating: Listed and labeled in accordance with ASTM E814 requirements for fire resistance rating of walls where being installed.
   B. Cabinet Construction: Non-fire rated.
      1. Formed primed steel sheet; 0.036 inch thick base metal.
   C. Fire Rated Cabinet Construction: One-hour fire rated.
      1. Steel; double wall or outer and inner boxes with 5/8 inch thick fire barrier material.
   D. Cabinet Configuration: Semi-recessed type.
      1. Size to accommodate accessories.
      2. Projected Trim: Returned to wall surface, with 2 1/2” inch projection, and 13 inch wide face.
   E. Door: 0.036 inch metal thickness, reinforced for flatness and rigidity with nylon catch. Hinge doors for 180 degree opening with two butt hinges.
   F. Door Glazing: Acrylic plastic, clear, 1/8 inch thick, full view bubble shape and set in resilient channel glazing gasket.
   G. Cabinet Mounting Hardware: Appropriate to cabinet, with pre-drilled holes for placement of anchors.
   H. Fabrication: Weld, fill, and grind components smooth.
   I. Finish of Cabinet Interior: White colored enamel.

2.04 ACCESSORIES
   A. Lettering: FIRE EXTINGUISHER decal, or vinyl self-adhering, pre-spaced black lettering in accordance with authorities having jurisdiction (AHJ).

PART 3 EXECUTION
3.01 EXAMINATION
   A. Verify rough openings for cabinet are correctly sized and located.

3.02 INSTALLATION
   A. Install in accordance with manufacturer's instructions.
   B. Install cabinets plumb and level in wall openings, 30 inches from finished floor to inside bottom of cabinet.
   C. Secure rigidly in place.
   D. Place extinguishers in cabinets.

END OF SECTION 10 44 00
PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division-01 Specification sections, apply to work of this section.

1.2 SCOPE OF DIVISION

A. Work shall include all materials, equipment and labor necessary for a complete and properly functioning plumbing installation in accordance with all applicable codes, and contract drawings and specifications. Work shall include all work specified in Division-22, Plumbing.

B. Pay for all required licenses, fees, inspections and permits.

1.3 RELATION TO OTHER WORK

A. Work Not in Division 22: Related work not included in this division consists of requirements given in the following as may be included in the contract documents:

1. Other divisions which may include work (such as concrete, steel, painting, ceiling systems, structure and other work) related to the work of Division 22.

B. Work of Division 22: Any or all sections of Division 22 may include a paragraph or paragraphs under the heading, "Relation to other Work". Where such a paragraph is indicated and work directly related to the section is listed or described, such work shall be considered as relating directly to the indicated section. Any related work (directly related or otherwise) which may be omitted by reference from the "Relation to Other Work" paragraph of such section(s), shall be provided as necessary and required whether or not such work is included by reference. Such listing or description of related work within a section is given only as a convenience to the Contractor; omission of other related sections or described work does not in any way exclude the provision of such work.

C. The Plumbing contractor shall coordinate with the controls vendor for all control related equipment that is provided by the controls vendor and installed by the Plumbing contractor.

1.4 CODES

A. Install all work in accordance with the latest edition of all applicable regulations and governing codes, including the regulations of the utility companies serving the project.

B. Where a conflict in code requirements occurs the more stringent requirement shall govern.

1.5 STANDARDS

A. All equipment and devices shall bear U.L. label, the label of an industry recognized approved testing agency or A.G.A. certification for said item of equipment or device.

B. All electrical devices must be U.L. approved.
1.6 DRAWINGS

A. Architectural and structural drawings take precedence over plumbing drawings with reference to the building construction. Plumbing drawings are diagrammatic and indicate the general arrangement and extent of work. Architectural drawings indicate more exactly the desired relationship between diffusers, registers, lighting fixtures, equipment, electric panels and devices, plumbing fixtures, and other items which remain exposed in the completed building. Exact locations and arrangement of materials and equipment shall be determined, with the acceptance of the Architect/Engineer, as work progresses to conform in the best possible manner with the surroundings and with the adjoining work of other trades. Where locations of equipment, devices or fixtures are controlled by architectural features, establish such locations by referring to dimensions on Architectural drawings and not by scaling drawings.

1.7 DISCREPANCIES

A. In case of differences between drawings and specifications, or where drawings and specifications are not clear or definitive, the more stringent requirement shall apply. Any such discrepancies shall be referred to Architect/Engineer for clarification and instructions.

1.8 ELECTRICAL PROVISIONS

A. Work of Division 22 shall include the electrical requirements which are indicated to be integral with plumbing work and which can be summarized to include (but not necessarily be limited to) the following:

1. Motors
2. Unless shown otherwise, motor starters are to be furnished by plumbing contractor, installed by electrical contractor.
3. In lieu of the plumbing contractor furnishing motor starters, the plumbing contractor can coordinate with the electrical contractor where the electrical contractor furnishes and installs a combination motor starter / disconnect switch.
4. Control switch, pilot lights, interlocks and similar devices.
5. Electrical heating coils and similar elements in plumbing equipment.
6. Electrical work specified in Division-22 for the HVAC control system.
7. Drip pans to protect electrical work.

B. Motors, Starters, Switches:

1. All motors 1HP and above associated with plumbing equipment that are not being provided with a variable frequency drive shall be provided with a motor starter.
2. For motors under 1HP that are required to be controlled shall be coordinated with the building automation system to ensure start / stop control is achieved. Provide all relays, wiring and devices as required to achieve desired control.

C. Drip Pans: Where possible, do not run plumbing piping directly above electrical (or electronic) equipment which is sensitive to moisture; otherwise provide drip pans under plumbing piping. Locate pan below piping and extend 6" on each side of piping and lengthwise 18" beyond equipment. Fabricate pans 2" deep, of reinforced sheet metal with rolled edges and soldered or welded seams; 20 gage copper, or 16 gage steel with 2 oz. zinc finish hot dipped after fabrication. Provide 3/4" copper drainage piping, properly discharged to a waste receptor.
1.9 **ELECTRICAL/PLUMBING WORK**

A. Definitions: Definitions for the purpose of Plumbing/electrical control and power coordination are as follows: (Note: The use of the words, "Provide", "furnish" and "install" are intended only for use in describing the coordination indicated by this paragraph and do not necessarily have the same definitions when used outside of the context of this paragraph.) Any items which do not fall within the scope of this paragraph shall be coordinated as individually specified.

1. "Furnish" means to procure an item and to deliver it to the project for installation.
2. "Install" means to determine (in coordination with others as necessary) the appropriate intended location of an item and to set and connect it in place.
3. "Provide" means to both furnish and install.
4. Power Circuit: Circuit which carries main electric power to apparatus to which the power circuit is connected.
5. Control Circuit: Circuit which carries electrical signals directing the performance of a controller, but which does not carry the main electric power. (See NEC, Section 430-71.) Such circuits shall also include those which serve a dual control and power function (e.g., a line voltage thermostat circuit which both activates and powers a small fan motor).
6. Controller: A device, or group of devices, which serves to govern, in some predetermined manner, electric power delivered to apparatus to which the controller is connected and includes any switch or device normally used to start and stop a motor. (See NEC, Article 100, Definitions, "Controller", and Section 430-81(a).)
7. Control Device: A device which reacts to an operating condition (pressure, temperature, flow, humidity, etc.) and which initiates transmission of an electrical control signal which causes operation of a controller or which causes operation of pressure switches, etc.
8. Auxiliary Control Device: A device (such as a low voltage control transformer, electric relay, etc.) which is located in a control circuit and which carries or responds to (but does not initiate) an electrical control signal initiated by a control device.

B. Work of Division-22 includes (but is not necessarily limited to):

1. Provide:
   a. All controllers which are generally manufactured or shipped as integral with Division-22 equipment
   b. All electric motors and other electrical power consuming equipment (such as electric air heating coils, electric boilers, electric hot water heaters, etc.) which are specified in Division 22.
   c. All control circuits (including conduit and boxes) from the Division-26 panels to point of use including the necessary circuit breakers.
   d. All other control circuits, including conduit and boxes.
   e. All control connections to equipment.
   f. All control connections to controllers, switches, motors and other plumbing systems electrical power consuming equipment (such as, electric boilers, electric hot water heaters, etc.).
   g. Auxiliary control devices.
   h. All control devices (thermostats, pressure switches, flow switches, humidistats, etc.) and make control circuit connections thereto.
   i. Any and all pneumatic and electronic and electric control devices and electric or pneumatic connections thereto.
2. Furnish:
   a. All controllers which are generally manufactured and/or shipped as separate but companion items to Division-22 equipment.

1.10 AUXILIARIES AND ACCESSORIES
   A. Include all auxiliaries and accessories for complete and properly operating systems.

1.11 COORDINATION
   A. Provide all required coordination and supervision where work of this division connects to or is affected by work of others.

1.12 PROVISIONS FOR OPENINGS
   A. Provide all openings required for work performed under Division-22. Provide sleeves or other approved methods to allow passage of items installed under any Section of Division-22.

1.13 CLEANING AND PROTECTION
   A. Equipment: All plumbing equipment provided shall be thoroughly cleaned of all dirt, oil, concrete, etc. Any dents, scratches or other visible blemishes shall be corrected, and the appearance of the equipment made "like new" and to the satisfaction of the Architect/Engineer.
   
   B. Upon completion, and before final acceptance of the work, all debris, rubbish, leftover materials, tools and equipment shall be removed from the site.

   C. Protection of Work Until Final Acceptance: Protect all materials and equipment from damage, entrance of dirt and construction debris from the time of installation until final acceptance. Any materials and equipment which are damaged shall be repaired to "as new" condition or replaced at the direction of the Architect/Engineer. Where factory finishes occur and damage is minor, finishes may be touched up. If, in the opinion of the Architect/Engineer the damage is excessive, factory finish shall be replaced to "new" condition.

1.14 SHOP DRAWINGS
   A. Submit shop drawings for all items, services and systems included in the project.

   B. Shop drawings shall clearly show the following:

      1. Technical and descriptive data in detail equal to or greater than the data given in the item specification. Indicate all characteristics, special modifications and features. Where performance and characteristic data is shown on the drawings or specified, submitted data shall be provided in a degree which is both quantitatively and qualitatively equal to that specified and shown so that comparison can be made. Present data in detail equal to or greater than that given in item specification and include all weights, deflections, speeds, velocities, pressure drops, operating temperatures, operating curves, temperature ranges, sound ratings, dimensions, sizes, manufacturers’ names, model numbers, types of material used, operating pressures, full load amperages, starting amperages, fouling factors, capacities, set points, chemical compositions, certifications and endorsements, operating voltages, thicknesses, gauges and all other related information as applicable to particular item.
2. Exceptions to or deviations from the contract documents. Should Architect/Engineer accept any items having such deviations which are not clearly brought to Architect/Engineer's attention, in writing, on item submittal, then Contractor is responsible for correction of such deviations regardless of when such deviations are discovered.

C. Additional Requirements: See specific sections of the Specifications for any additional requirements.

1.15 SHOP DRAWINGS TECHNICAL INFORMATION SUBMITTALS

A. All submittals are to be submitted electronically in the form of PDF. Electronic submittal file names must be formatted with the specification section number followed by the title of the specification section. One PDF file shall be provided for each specification section that requires submittals to be provided.

B. A cover page shall have adequate space for Contractor, Subcontractor and Engineer review stamps and indicate the following minimum data:

1. Project Name
2. Project Address
3. Contractor Name
4. Subcontractor Name
5. Specification Section Number
6. Specification Section Name
7. Submittal Date

C. All shop drawings and equipment submittals shall be submitted complete based on specification division. Partial submittals of each specification section will not be accepted.

D. All submittals shall have been reviewed for compliance by the Contractor and associated subcontractor prior to submission to the Engineer. A stamp bearing the name of the reviewer and date review was completed shall be on the cover page of the submittal.

E. Submittal data shall be logically grouped based on equipment tags or like material. For submittals that contain data on multiple materials or equipment, it shall be clearly noted by equipment tag or applicable material.

F. Manufacturer's data indicating multiple options or choices shall be clearly noted as to what is applicable to the material and equipment being provided. Information not applicable should be struck through or extracted.

1.16 SHOP DRAWINGS FOR PIPING SYSTEMS

A. Shop drawings for piping systems shall be performed by the installing subcontractors. Shop drawings shall show all required maintenance and operational clearances required. Title drawings shall include identification of project and names of Architect, Engineer, Contractor, subcontractor and/or supplier, date, be numbered sequentially and shall indicate the following:

1. Architectural and structural backgrounds with room names and numbers, etc., including but not limited to plans, sections, elevations, details, etc.

   a. Fabrication and Erection dimensions.
   b. Arrangements and sectional views.
c. Necessary details, including complete information for making connections with other work.
d. Kinds of materials and finishes.
e. Descriptive names of equipment.
f. Modifications and options to standard equipment required by the contract.

B. Shop drawings shall be submitted in electronic PDF format and shall bear the review stamp from the plumbing subcontractor and general contractor / CM that it has been reviewed for compliance.

C. See specific sections of specifications for further requirements.

1.17 ELECTRONIC FILES

A. Any requests for electronic files shall be preceded by processing the required electronic file release form and submitting to the Engineer for authorization. Request for electronic files should be submitted through the Contractor for submission to the Architect / Engineer.

1.18 OPERATING INSTRUCTIONS

A. Submit for checking a specific set of written operating instructions on each item which requires instructions to operate. After acceptance, insert information in each Technical Information Brochure. Refer also to other sections which may describe operating instructions.

1.19 MAINTENANCE INFORMATION

A. Submit for acceptance Maintenance Information consisting of manufacturer's printed instruction and parts lists for each major item of equipment. After acceptance, insert information in each Technical Information Brochure. Refer also to other sections which may describe maintenance.

1.20 SYSTEM GUARANTEE

A. The work required under Division-22 shall include a one-year guarantee. This guarantee shall be by the Contractor to the Owner to replace for the Owner any defective workmanship, equipment, or material which has been furnished under this Contract at no cost to the Owner for a period of one year from the date of acceptance of the System. This guarantee shall also include reasonable adjustments of the system required for proper operation during the guarantee period.

1.21 MATERIALS AND EQUIPMENT

A. Each bidder represents that his bid is based upon the materials and equipment described in this division of the specifications.

1. Submittal shall include the name of the material or equipment for which it is to be substituted, substituted equipment model numbers, drawings, cuts, performance and test data and any other data or information necessary for the Architect/Engineer to determine that the equipment meets all specification and requirements. If the Architect/Engineer accepts any proposed substitutions, such acceptance will be set forth in writing.
2. Substituted equipment with all accessories installed or optional equipment where permitted and accepted, must conform to space requirements. Any substituted equipment that cannot meet space requirements, whether accepted or not, shall be replaced at the Contractor's expense. Any modifications of related systems of this or
other trades as a result of substitutions shall be made at the Contractor's expense, and Contractor shall so state in his written request for substitution.

B. Acceptable Manufacturers: Materials and Equipment specified in these contract documents are accepted only in regard to general performance and quality. It shall be the Contractor's responsibility to ensure that acceptable materials and equipment meet or exceed the efficiencies, capacities, electrical characteristics, performance and quality of the equipment herein specified. Acceptable equipment must also generally conform, without extensive modification of related systems to the accessories, weights, space and maintenance requirements, etc., of the specified equipment. Any modification to related systems of this or other trades shall be made at the Contractor's expense and the Contractor shall be responsible for coordination between trades. Any difference in capacity, efficiency, electrical characteristics, weights or quality of product, etc., between specified materials and equipment and acceptable alternates shall be submitted to the Architect/Engineer for acceptance within 30 days of Notice to Proceed.

PART 2 - PRODUCTS

2.1 Section part not applicable.

PART 3 - EXECUTION

3.1 Section part not applicable.

END OF SECTION 22 01 00
SECTION 22 05 19
METERS AND GAGES FOR PLUMBING PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:
   1. Bimetallic-actuated thermometers.
   2. Filled-system thermometers.
   4. Thermwells.
   5. Dial-type pressure gages.
   7. Test plugs.
   8. Test-plug kits.

B. Related Requirements:
   1. Section 22 11 13 "Facility Water Distribution Piping" for domestic water meters and combined domestic and fire-protection water-service meters outside the building.
   2. Section 22 11 19 "Domestic Water Piping Specialties" for water meters.

1.3 RELATION TO OTHER WORK

A. Refer to the section, "General Plumbing Provisions", for related requirements. Refer to other sections of Division 22 and to all other applicable portions of the Drawings and Specifications.

1.4 SUBMITTALS

A. Submit manufacturer's data for review before any work is commenced.

PART 2 - PRODUCTS

2.1 BIMETALLIC-ACTUATED THERMOMETERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   1. Ashcroft Inc.
   2. Ernst Flow Industries.
   5. REOTEMP Instrument Corporation.
   6. WATTS.
   7. Weiss Instruments, Inc.
   8. Weksler Glass Thermometer Corp.


2.2 FILLED-SYSTEM THERMOMETERS

A. Direct-Mounted, Metal-Case, Vapor-Actuated Thermometers:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. Ashcroft Inc.
   b. Marsh Bellofram.
   c. Miljoco Corporation.
   e. REOTEMP Instrument Corporation.
   f. Weiss Instruments, Inc.


B. Remote-Mounted, Metal-Case, Vapor-Actuated Thermometers:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. AMETEK, Inc.
   b. Ashcroft Inc.
   c. Miljoco Corporation.
   e. REOTEMP Instrument Corporation.
   f. Weiss Instruments, Inc.
   g. WIKA Instrument Corporation.


2.3 LIQUID-IN-GLASS THERMOMETERS

A. Metal-Case, Compact-Style, Liquid-in-Glass Thermometers:

1. Manufacturers: Subject to compliance with requirements, provide products by the following:
   a. Trerice, H. O. Co.


2.4 THERMOWELLS

A. Thermowells:

2. Description: Pressure-tight, socket-type fitting made for insertion into piping tee fitting.
3. Insertion Length: Length required to match thermometer bulb or stem.
4. Lagging Extension: Include on thermowells for insulated piping and tubing.
5. Bushings: For converting size of thermowell's internal screw thread to size of thermometer connection.

2.5 PRESSURE GAGES

A. Direct-Mounted, Metal-Case, Dial-Type Pressure Gages:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

   b. Ashcroft Inc.
   c. Ernst Flow Industries.
   d. Flo Fab Inc.
   e. Marsh Bellofram.
   f. Miljoco Corporation.
   g. Noshok.
   h. Palmer Wahl Instrumentation Group.
   i. REOTEMP Instrument Corporation.
   j. Tel-Tru Manufacturing Company.
   k. Trerice, H. O. Co.
   l. WATTS.
   m. Weiss Instruments, Inc.
   n. Weksler Glass Thermometer Corp.
   o. WIKA Instrument Corporation.
   p. Winters Instruments - U.S.


B. Remote-Mounted, Metal-Case, Dial-Type Pressure Gages:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

   b. Ashcroft Inc.
   c. Ernst Flow Industries.
   d. Flo Fab Inc.
   e. Marsh Bellofram.
   f. Miljoco Corporation.
   g. Noshok.
   h. Palmer Wahl Instrumentation Group.
   i. REOTEMP Instrument Corporation.
   j. Tel-Tru Manufacturing Company.
   k. Trerice, H. O. Co.
   l. WATTS.
   m. Weiss Instruments, Inc.
   n. WIKA Instrument Corporation.
   o. Winters Instruments - U.S.

2.6  GAGE ATTACHMENTS

A. Snubbers: ASME B40.100, brass; with ASME B1.20.1 pipe threads and surge-dampening device. Include extension for use on insulated piping.

B. Valves: ASME B1.20.1 pipe threads.

2.7  TEST PLUGS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Flow Design, Inc.
3. Nexus Valve, Inc.
4. Peterson Equipment Co., Inc.
5. Sisco Manufacturing Company, Inc.
6. Trerice, H. O. Co.
7. WATTS.
8. Weiss Instruments, Inc.
9. Weksler Glass Thermometer Corp.

B. Description: Test-station fitting made for insertion into piping tee fitting.

C. Body: Brass or stainless steel with core inserts and gasketed and threaded cap. Include extended stem on units to be installed in insulated piping.

D. Thread Size: ASME B1.20.1 pipe thread.

2.8  TEST-PLUG KITS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Flow Design, Inc.
3. Nexus Valve, Inc.
4. Peterson Equipment Co., Inc.
5. Sisco Manufacturing Company, Inc.
6. Trerice, H. O. Co.
7. WATTS.
8. Weiss Instruments, Inc.

B. Furnish test-plug kit(s) containing thermometer(s), one pressure gage and adapter, and carrying case. Thermometer sensing elements, pressure gage, and adapter probes shall be of diameter to fit test plugs and of length to project into piping.

C. Low-Range Thermometer: Small, bimetallic insertion type with diameter dial and tapered-end sensing element.

D. High-Range Thermometer: Small, bimetallic insertion type with dial and tapered-end sensing element.

E. Pressure Gage: Small, Bourdon-tube insertion type with dial and probe.
F. Carrying Case: Metal or plastic, with formed instrument padding.

2.9 SIGHT FLOW INDICATORS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. ARCHON Industries, Inc.
2. Dwyer Instruments, Inc.
3. Emerson Process Management; Rosemount Division.
4. Ernst Flow Industries.
5. John C. Ernst Co., Inc.
6. KOBOLD Instruments, Inc. - USA.
7. OPW Engineered Systems; OPW Fluid Transfer Group; a Dover company.
8. Pentair Valves & Controls; Penberthy Brand.

B. Description: Piping inline-installation device for visual verification of flow.

C. Construction: Bronze or stainless-steel body, with sight glass and indicator, and threaded or flanged ends.

D. End Connections for NPS 2 and Smaller: Threaded.

E. End Connections for NPS 2-1/2 and Larger: Flanged.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install thermowells with socket extending in vertical position in piping tees.

B. Install thermowells of sizes required to match thermometer connectors. Include bushings if required to match sizes.

C. Install thermowells with extension on insulated piping.

D. Fill thermowells with heat-transfer medium.

E. Install direct-mounted thermometers in thermowells and adjust vertical and tilted positions.

F. Install remote-mounted thermometer bulbs in thermowells and install cases on panels; connect cases with tubing and support tubing to prevent kinks. Use minimum tubing length.

G. Install direct-mounted pressure gages in piping tees with pressure gage located on pipe at the most readable position.

H. Install remote-mounted pressure gages on panel.

I. Install valve and snubber in piping for each pressure gage for fluids.

J. Install test plugs in piping tees.

K. Install thermometers in the following locations:
1. Inlet and outlet of each water heater.
2. Inlet and outlet of each domestic hot-water storage tank.
3. Inlet and outlet of each remote domestic water chiller.

L. Install pressure gages in the following locations:

1. Building water service entrance into building.
2. Inlet and outlet of each pressure-reducing valve.
3. Suction and discharge of each domestic water pump.

3.2 CONNECTIONS

A. Install meters and gages adjacent to machines and equipment to allow service and maintenance of meters, gages, machines, and equipment.

3.3 ADJUSTING

A. Adjust faces of meters and gages to proper angle for best visibility.

END OF SECTION 22 05 19
SECTION 22 05 23.12
BALL VALVES FOR PLUMBING PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

1. Brass ball valves.
2. Bronze ball valves.

1.3 DEFINITIONS

A. CWP: Cold working pressure.

1.4 RELATION TO OTHER WORK

A. Refer to the section, "General Plumbing Provisions", for related requirements. Refer to other sections of Division 22 and to all other applicable portions of the Drawings and Specifications.

1.5 SUBMITTALS

A. Submit manufacturer's data for review before any work is commenced.

1.  Certification that products comply with NSF 61 and NSF 372.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Prepare valves for shipping as follows:

1. Protect internal parts against rust and corrosion.
2. Protect threads, flange faces, and soldered ends.

B. Use the following precautions during storage:

1. Maintain valve end protection.
2. Store valves indoors and maintain at higher-than-ambient-dew-point temperature. If outdoor storage is necessary, store valves off the ground in watertight enclosures.

C. Use sling to handle large valves; rig sling to avoid damage to exposed parts. Do not use operating handles or stems as lifting or rigging points.
PART 2 - PRODUCTS

2.1 GENERAL REQUIREMENTS FOR VALVES

A. Source Limitations for Valves: Obtain each type of valve from single source from single manufacturer.

B. ASME Compliance:
   1. ASME B1.20.1 for threads for threaded end valves.
   2. ASME B16.10 and ASME B16.34 for ferrous valve dimensions and design criteria.
   4. ASME B31.9 for building services piping valves.

C. NSF Compliance: NSF 61 and NSF 372 for valve materials for potable-water service.

D. Bronze valves shall be made with dezincification-resistant materials. Bronze valves made with copper alloy (brass) containing more than 15 percent zinc are not permitted.

E. Valve Pressure-Temperature Ratings: Not less than indicated and as required for system pressures and temperatures.

F. Valve Sizes: Same as upstream piping unless otherwise indicated.

G. Valve Actuator Types:
   1. Gear Actuator: For quarter-turn valves NPS 4 and larger.
   2. Handlever: For quarter-turn valves smaller than NPS 4.

H. Valves in Insulated Piping:
   1. Include 2-inch stem extensions.
   2. Extended operating handles of nonthermal-conductive material and protective sleeves that allow operation of valves without breaking vapor seals or disturbing insulation.
   3. Memory stops that are fully adjustable after insulation is applied.

2.2 BRASS BALL VALVES

A. Brass Ball Valves, Two-Piece with Full Port and Brass Trim, Threaded or Soldered Ends:
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. Apollo Flow Controls; Conbraco Industries, Inc.
      b. Crane; Crane Energy Flow Solutions.
      c. Elkhart Products Corporation.
      d. Jomar Valve.
      e. Milwaukee Valve Company.
      f. NIBCO INC.
      g. WATTS.
   2. Description:
      a. Standard: MSS SP-110 or MSS SP-145.
b. CWP Rating: 600 psig.
c. Body Design: Two piece.
d. Body Material: Forged brass.
e. Ends: Threaded and soldered.
f. Seats: PTFE.
g. Stem: Brass.
h. Ball: Chrome-plated brass.
i. Port: Full.

B. Brass Ball Valves, Two-Piece with Full Port and Brass Trim, Press Ends:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Apollo Flow Controls; Conbraco Industries, Inc.
b. Crane; Crane Energy Flow Solutions.
c. Elkhart Products Corporation.
d. Hammond Valve.
e. Jomar Valve.
f. Legend Valve & Fitting, Inc.
g. Milwaukee Valve Company.
h. NIBCO INC.
i. Stockham; Crane Energy Flow Solutions.
j. WATTS.

2. Description:

a. Standard: MSS SP-110 or MSS SP-145.
b. CWP Rating: Minimum 200 psig.
c. Body Design: Two piece.
d. Body Material: Forged brass.
e. Ends: Press.
g. Seats: PTFE or RPTFE.
h. Stem: Brass.
i. Ball: Chrome-plated brass.
j. Port: Full.
k. O-Ring Seal: Buna-N or EPDM.

C. Brass Ball Valves, Two-Piece with Regular Port and Brass Trim:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Apollo Flow Controls; Conbraco Industries, Inc.
b. Hammond Valve.
c. Milwaukee Valve Company.
d. NIBCO INC.
e. WATTS.

2. Description:

b. CWP Rating: 600 psig.
c. Body Design: Two piece.
d. Body Material: Forged brass.
e. Ends: Threaded and soldered.
f. Seats: PTFE.
g. Stem: Brass.
h. Ball: Chrome-plated brass.
i. Port: Regular.

2.3 BRONZE BALL VALVES

A. Bronze Ball Valves, Two-Piece with Full Port, and Bronze or Brass Trim, Threaded or Soldered Ends:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Apollo Flow Controls; Conbraco Industries, Inc.
b. Crane; Crane Energy Flow Solutions.
c. FNW; Ferguson Enterprises, Inc.
d. Milwaukee Valve Company.
e. NIBCO INC.
f. WATTS.
g. Zum Industries, LLC.

2. Description:

a. Standard: MSS SP-110 or MSS-145.
b. CWP Rating: 600 psig.
c. Body Design: Two piece.
d. Body Material: Bronze.
e. Ends: Threaded and soldered.
f. Seats: PTFE.
g. Stem: Bronze or brass.
h. Ball: Chrome-plated brass.
i. Port: Full.

B. Bronze Ball Valves, Two-Piece with Full Port, and Bronze or Brass Trim, Press Ends:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Apollo Flow Controls; Conbraco Industries, Inc.
b. Crane; Crane Energy Flow Solutions.
c. Milwaukee Valve Company.
d. NIBCO INC.
e. WATTS.
f. Zum Industries, LLC.

2. Description:

a. Standard: MSS SP-110 or MSS-145.
b. CWP Rating: Minimum 200 psig.
c. Body Design: Two piece.
d. Body Material: Bronze.
e. Ends: Press.
g. Seats: PTFE or RTPFE.

h. Stem: Bronze or brass.

i. Ball: Chrome-plated brass.

j. Port: Full.

k. O-Ring Seal: EPDM or Buna-N.

C. Bronze Ball Valves, Two-Piece with Regular Port and Bronze or Brass Trim:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

   a. Apollo Flow Controls; Conbraco Industries, Inc.
   b. Milwaukee Valve Company.
   c. NIBCO INC.
   d. WATTS.

2. Description:

   b. CWP Rating: 600 psig.
   c. Body Design: Two piece.
   d. Body Material: Bronze.
   e. Ends: Threaded.
   f. Seats: PTFE.
   g. Stem: Bronze or brass.
   h. Ball: Chrome-plated brass.
   i. Port: Regular.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine valve interior for cleanliness, freedom from foreign matter, and corrosion. Remove special packing materials, such as blocks, used to prevent disc movement during shipping and handling.

B. Operate valves in positions from fully open to fully closed. Examine guides and seats made accessible by such operations.

C. Examine threads on valve and mating pipe for form and cleanliness.

D. Examine mating flange faces for conditions that might cause leakage. Check bolting for proper size, length, and material. Verify that gasket is of proper size, that its material composition is suitable for service, and that it is free from defects and damage.

E. Do not attempt to repair defective valves; replace with new valves.

F. Install valves and cocks in horizontal piping with the valve stem in the vertical upright position.

G. Install valves and cocks to provide adequate clearance to permit easy operation of the valve hand wheel and permit servicing of the valve packing.
3.2 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. Locate valves for easy access and provide separate support where necessary.

C. Install valves in horizontal piping with stem at or above center of pipe.

D. Install valves in position to allow full stem movement.

E. Install valve tags. Comply with requirements in Section 22 05 53 "Identification for Plumbing Piping and Equipment" for valve tags and schedules.

3.3 ACCESS PANELS

A. Furnish adequate number of properly sized access panels to adequately service and maintain systems installed under each section of specifications.

B. Access panels shall be installed and painted under other divisions of these specifications. Exact panel location shall be designated by the subcontractor performing the work of this Section.

C. Access panels are not required in exposed grid or other types of readily removable ceilings.

D. Access panels shall not compromise the fire rating of the wall.

3.4 GENERAL REQUIREMENTS FOR VALVE APPLICATIONS

A. If valves with specified CWP ratings are unavailable, the same types of valves with higher CWP ratings may be substituted.

B. Select valves with the following end connections:

1. For Copper Tubing, NPS 2 and Smaller: Threaded ends except where solder-joint valve-end option or press-end option is indicated in valve schedules below.
2. For Copper Tubing, NPS 2-1/2 to NPS 4: Flanged ends except where threaded valve-end option is indicated in valve schedules below.
3. For Copper Tubing, NPS 5 and Larger: Flanged ends.
4. For Steel Piping, NPS 2 and Smaller: Threaded ends.
5. For Steel Piping, NPS 2-1/2 to NPS 4: Flanged ends except where threaded valve-end option is indicated in valve schedules below.
6. For Steel Piping, NPS 5 and Larger: Flanged ends.

3.5 DOMESTIC HOT- AND COLD-WATER VALVE SCHEDULE

A. Pipe NPS 2 and Smaller:

1. Brass ball valve, one piece. Provide with threaded or solder-joint ends.
2. Bronze ball valve, one piece with bronze trim. Provide with threaded or solder-joint ends.
3. Brass ball valves, two-piece with full port and brass trim. Provide with threaded or solder joint ends.
4. Bronze ball valves, two-piece with full port and bronze or brass trim. Provide with threaded or solder-joint ends.
5. Brass ball valves, three-piece with full port and brass trim.
6. Bronze ball valves, three-piece with full port and bronze or brass trim.
7. Bronze ball valves, two-piece with regular port and bronze trim.

B. Pipe NPS 2-1/2 and Larger:

1. Steel and Iron Valves, NPS 2-1/2 to NPS 4: May be provided with threaded ends instead of flanged ends.
2. Steel ball valves, Class 150 with full port.
3. Iron ball valves, Class 150.

END OF SECTION 22 05 23.12
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. Bronze lift check valves.
2. Bronze swing check valves.
4. Iron swing check valves.
5. Iron swing check valves with closure control.
8. Iron, plate-type check valves.

1.3 DEFINITIONS

A. CWP: Cold working pressure.
B. EPDM: Ethylene propylene-diene terpolymer rubber.
C. NBR: Acrylonitrile-butadiene, Buna-N, or nitrile rubber.

1.4 RELATION TO OTHER WORK

A. Refer to the section, "General Plumbing Provisions", for related requirements. Refer to other sections of Division 22 and to all other applicable portions of the Drawings and Specifications.

1.5 ACTION SUBMITTALS

A. Submit manufacturer's data for review before any work is commenced.
B. Product Data: For each type of valve:

1. Certification that products comply with NSF 61 and NSF 372.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Prepare valves for shipping as follows:

1. Protect internal parts against rust and corrosion.
2. Protect threads, flange faces, grooves, and weld ends.
3. Set check valves in either closed or open position.
B. Use the following precautions during storage:

1. Maintain valve end protection.
2. Store valves indoors and maintain at higher-than-ambient-dew-point temperature. If outdoor storage is necessary, store valves off the ground in watertight enclosures.

C. Use sling to handle large valves; rig sling to avoid damage to exposed parts. Do not use handwheels or stems as lifting or rigging points.

PART 2 - PRODUCTS

2.1 GENERAL REQUIREMENTS FOR VALVES

A. Source Limitations for Valves: Obtain each type of valve from single source from single manufacturer.

B. ASME Compliance:

1. ASME B1.20.1 for threads for threaded end valves.
2. ASME B16.1 for flanges on iron valves.
3. ASME B16.10 and ASME B16.34 for ferrous valve dimensions and design criteria.
4. ASME B16.18 for solder joint.
5. ASME B31.9 for building services piping valves.

C. AWWA Compliance: Comply with AWWA C606 for grooved-end connections.


E. Bronze valves shall be made with dezincification-resistant materials. Bronze valves made with copper alloy (brass) containing more than 15 percent zinc are not permitted.

F. Valve Pressure-Temperature Ratings: Not less than indicated and as required for system pressures and temperatures.

G. Valve Sizes: Same as upstream piping unless otherwise indicated.

H. Valve Bypass and Drain Connections: MSS SP-45.

2.2 BRONZE LIFT CHECK VALVES

A. Bronze Lift Check Valves with Bronze Disc, Class 125:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. Crane; Crane Energy Flow Solutions.
   b. Jenkins Valves; Crane Energy Flow Solutions.
   c. Stockham; Crane Energy Flow Solutions.

2. Description:
   a. Standard: MSS SP-80, Type 1.
   b. CWP Rating: 200 psig.
e. Ends: Threaded or soldered. See valve schedule articles.
f. Disc: Bronze.

2.3 BRONZE SWING CHECK VALVES

A. Bronze Swing Check Valves with Bronze Disc, Class 125:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

   a. Apollo Flow Controls; Conbraco Industries, Inc.
   b. Crane; Crane Energy Flow Solutions.
   c. Jenkins Valves; Crane Energy Flow Solutions.
   d. NIBCO INC.
   e. Stockham; Crane Energy Flow Solutions.
   f. WATTS.

2. Description:

   a. Standard: MSS SP-80, Type 3.
   b. CWP Rating: 200 psig.
   c. Body Design: Horizontal flow.
   e. Ends: Threaded or soldered. See valve schedule articles.
   f. Disc: Bronze.

B. Bronze Swing Check Valves with Bronze Disc, Class 150:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

   a. Apollo Flow Controls; Conbraco Industries, Inc.
   b. Crane; Crane Energy Flow Solutions.
   c. Jenkins Valves; Crane Energy Flow Solutions.
   d. Jomar Valve.
   e. NIBCO INC.
   f. Stockham; Crane Energy Flow Solutions.

2. Description:

   a. Standard: MSS SP-80, Type 3.
   b. CWP Rating: 300 psig.
   c. Body Design: Horizontal flow.
   e. Ends: Threaded or soldered. See valve schedule articles.
   f. Disc: Bronze.

C. Bronze Swing Check Valves, Press Ends:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
2. Description:

a. Standard: MSS SP-80 and MSS SP-139.
b. CWP Rating: Minimum 200 psig.
c. Body Design: Horizontal flow.
e. Ends: Press.
f. Press Ends Connection Rating: Minimum 200 psig
g. Disc: Brass or bronze.

2.4 IRON SWING CHECK VALVES

A. Iron Swing Check Valves with Metal Seats, Class 125:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

   a. Apollo Flow Controls; Conbraco Industries, Inc.
   b. Elkhart Products Corporation.
   c. Milwaukee Valve Company.
   d. NIBCO INC.

2. Description:

   a. Standard: MSS SP-71, Type I.
   b. CWP Rating: 200 psig.
   c. Body Design: Clear or full waterway.
   d. Body Material: ASTM A 126, gray iron with bolted bonnet.
   e. Ends: Flanged or threaded. See valve schedule articles.
   f. Trim: Bronze.
   g. Gasket: Asbestos free.

B. Iron Swing Check Valves with Metal Seats, Class 250:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

   a. Apollo Flow Controls; Conbraco Industries, Inc.
   b. Crane; Crane Energy Flow Solutions.
   c. Jenkins Valves; Crane Energy Flow Solutions.
   d. NIBCO INC.
   e. Powell Valves.
   f. Red-White Valve Corp.
   g. Stockham; Crane Energy Flow Solutions.
   h. Sure Flow Equipment Inc.
   i. WATTS.
2. Description:
   a. Standard: MSS SP-71, Type I.
   b. CWP Rating: 500 psig.
   c. Body Design: Clear or full waterway.
   d. Body Material: ASTM A 126, gray iron with bolted bonnet.
   e. Ends: Flanged or threaded. See valve schedule articles.
   f. Trim: Bronze.
   g. Gasket: Asbestos free.

2.5 IRON SWING CHECK VALVES WITH CLOSURE CONTROL

A. Iron Swing Check Valves with Lever- and Spring-Closure Control, Class 125:
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. Crane; Crane Energy Flow Solutions.
      b. Jenkins Valves; Crane Energy Flow Solutions.
      c. NIBCO INC.
      d. Stockham; Crane Energy Flow Solutions.
      e. WATTS.

   2. Description:
      a. Standard: MSS SP-71, Type I.
      b. CWP Rating: 200 psig.
      c. Body Design: Clear or full waterway.
      d. Body Material: ASTM A 126, gray iron with bolted bonnet.
      e. Ends: Flanged or threaded. See valve schedule articles.
      f. Trim: Bronze.
      g. Gasket: Asbestos free.
      h. Closure Control: Factory-installed exterior lever and weight.

B. Iron Swing Check Valves with Lever and Weight-Closure Control, Class 125:
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. Apollo Flow Controls; Conbraco Industries, Inc.
      b. Crane; Crane Energy Flow Solutions.
      c. Jenkins Valves; Crane Energy Flow Solutions.
      d. NIBCO INC.
      e. Stockham; Crane Energy Flow Solutions.
      f. WATTS.

   2. Description:
      a. Standard: MSS SP-71, Type I.
      b. CWP Rating: 200 psig.
      c. Body Design: Clear or full waterway.
      d. Body Material: ASTM A 126, gray iron with bolted bonnet.
      e. Ends: Flanged or threaded. See valve schedule articles.
      f. Trim: Bronze.
2.6 IRON, GROOVED-END SWING CHECK VALVES

A. Iron, Grooved-End Swing Check Valves, 300 CWP:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

   a. Anvil International.
   b. Shurjoint Piping Products USA Inc.
   c. Tyco Fire Products LP.
   d. Victaulic Company.

2. Description:

   a. CWP Rating: 300 psig.
   c. Seal: EPDM.
   d. Disc: Spring operated, ductile iron or stainless steel.

2.7 IRON, CENTER-GUIDED, SPRING-LOADED CHECK VALVES

A. Iron, Compact-Wafer, Center-Guided Check Valves with Metal Seat, Class 125:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

   a. Anvil International.
   b. APCO Willamette Valve and Primer Corporation.
   c. Crispin Valve.
   d. DFT Inc.
   e. Flo Fab Inc.
   f. FNW; Ferguson Enterprises, Inc.
   g. Milwaukee Valve Company.
   h. Mueller Steam Specialty; A WATTS Brand.
   i. NIBCO INC.
   j. Val-Matic Valve & Manufacturing Corp.
   k. WATTS.

2. Description:

   b. CWP Rating: 200 psig.
   d. Style: Compact wafer, spring loaded.
   e. Seat: Bronze.

B. Iron Globe, Center-Guided Check Valves with Metal Seat, Class 125:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
a. APCO Willamette Valve and Primer Corporation.
b. Crispin Valve.
c. DFT Inc.
d. Flomatic Corporation.
e. Milwaukee Valve Company.
f. Mueller Steam Specialty; A WATTS Brand.
g. NIBCO INC.
h. Sure Flow Equipment Inc.
i. Val-Matic Valve & Manufacturing Corp.
j. WATTS.

2. Description:

b. CWP Rating: 200 psig.
d. Style: Globe, spring loaded.
e. Ends: Flanged.
f. Seat: Bronze.

C. Iron Globe, Center-Guided Check Valves with Metal Seat, Class 150:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

   a. APCO Willamette Valve and Primer Corporation.
   b. Crispin Valve.
   c. Val-Matic Valve & Manufacturing Corp.

2. Description:

   b. CWP Rating: 300 psig.
   d. Style: Globe, spring loaded.
   e. Ends: Flanged.
   f. Seat: Bronze.

D. Iron Globe, Center-Guided Check Valves with Metal Seat, Class 250:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

   a. APCO Willamette Valve and Primer Corporation.
   b. Flomatic Corporation.
   c. Metraflex Company (The).
   d. Mueller Steam Specialty; A WATTS Brand.
   e. NIBCO INC.

2. Description:

   b. CWP Rating: 400 psig.
E. Iron Globe, Center-Guided Check Valves with Metal Seat, Class 300:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   
a. APCO Willamette Valve and Primer Corporation.
b. Crispin Valve.
c. Val-Matic Valve & Manufacturing Corp.

2. Description:
   
b. CWP Rating: 500 psig.
d. Style: Globe, spring loaded.
e. Ends: Flanged.
f. Seat: Bronze.

F. Iron Globe, Center-Guided Check Valves with Resilient Seat, Class 125:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   
a. APCO Willamette Valve and Primer Corporation.
b. Apollo Flow Controls; Conbraco Industries, Inc.
c. NIBCO INC.
d. Sure Flow Equipment Inc.
e. Val-Matic Valve & Manufacturing Corp.
f. Zurn Industries, LLC.

2. Description:
   
b. CWP Rating: 200 psig.
d. Style: Globe, spring loaded.
e. Ends: Flanged.
f. Seat: NBR.

G. Iron Globe, Center-Guided Check Valves with Resilient Seat, Class 300:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   
a. APCO Willamette Valve and Primer Corporation.
b. Val-Matic Valve & Manufacturing Corp.

2. Description:
   
b. CWP Rating: 500 psig.
d. Style: Globe, spring loaded.
e. Ends: Flanged.
f. Seat: NBR.

2.8 IRON, PLATE-TYPE CHECK VALVES

A. Iron, Dual-Plate Check Valves with Metal Seat, Class 125:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. APCO Willamette Valve and Primer Corporation.
   b. Crane; Crane Energy Flow Solutions.
   c. Powell
   d. Mueller Steam Specialty; A WATTS Brand.


B. Iron, Dual-Plate Check Valves with Metal Seat, Class 150:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. APCO Willamette Valve and Primer Corporation.
   b. Crane; Crane Energy Flow Solutions.
   c. Mueller Steam Specialty; A WATTS Brand.
   d. Val-Matic Valve & Manufacturing Corp.

3. CWP Rating: 300 psig.

C. Iron, Dual-Plate Check Valves with Metal Seat, Class 250:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. APCO Willamette Valve and Primer Corporation.
   b. Crane; Crane Energy Flow Solutions.

3. CWP Rating: 400 psig.
D. Iron, Dual-Plate Check Valves with Metal Seat, Class 300:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. APCO Willamette Valve and Primer Corporation.
   b. Crane; Crane Energy Flow Solutions.
   c. Mueller Steam Specialty; A WATTS Brand.
   d. Val-Matic Valve & Manufacturing Corp.

3. CWP Rating: 500 psig.

E. Iron, Single-Plate Check Valves with Resilient Seat, Class 125:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. Flo Fab Inc.
   b. Keckley Company.
   c. Sure Flow Equipment Inc.


F. Iron, Dual-Plate Check Valves with Resilient Seat, Class 125:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. APCO Willamette Valve and Primer Corporation.
   b. Cooper Cameron Valves.
   c. Crane; Crane Energy Flow Solutions.
   d. NIBCO INC.
   e. Spence Strainers International.
   f. Sure Flow Equipment Inc.
   g. WATTS.

6. Seat: NBR.

G. Iron, Dual-Plate Check Valves with Resilient Seat, Class 150:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
a. APCO Willamette Valve and Primer Corporation.
b. Crane; Crane Energy Flow Solutions.
c. Val-Matic Valve & Manufacturing Corp.

3. CWP Rating: 300 psig.
6. Seat: NBR.

H. Iron, Wafer, Single-Plate Check Valves with Resilient Seat, Class 250:

1. Manufacturers: Subject to compliance with requirements, provide products by the following:
   a. Sure Flow Equipment Inc.

3. CWP Rating: 400 psig.
6. Seat: NBR.

I. Iron, Dual-Plate Check Valves with Resilient Seat, Class 250:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. APCO Willamette Valve and Primer Corporation.
   b. Crane; Crane Energy Flow Solutions.
   c. Sure Flow Equipment Inc.

3. CWP Rating: 400 psig.
6. Seat: NBR.

J. Iron, Dual-Plate Check Valves with Resilient Seat, Class 300:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. APCO Willamette Valve and Primer Corporation.
   b. Val-Matic Valve & Manufacturing Corp.

3. CWP Rating: 500 psig.
6. Seat: NBR.
PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine valve interior for cleanliness, freedom from foreign matter, and corrosion. Remove special packing materials, such as blocks, used to prevent disc movement during shipping and handling.

B. Operate valves in positions from fully open to fully closed. Examine guides and seats made accessible by such operations.

C. Examine threads on valve and mating pipe for form and cleanliness.

D. Examine mating flange faces for conditions that might cause leakage. Check bolting for proper size, length, and material. Verify that gasket is of proper size, that its material composition is suitable for service, and that it is free from defects and damage.

E. Do not attempt to repair defective valves; replace with new valves.

3.2 VALVE INSTALLATION

A. Install valves with unions or flanges at each piece of equipment arranged to allow service, maintenance, and equipment removal without system shutdown.

B. Locate valves for easy access and provide separate support where necessary.

C. Install valves in horizontal piping with stem at or above center of pipe.

D. Install valves in position to allow full stem movement.

E. Check Valves: Install check valves for proper direction of flow.

   1. Swing Check Valves: In horizontal position with hinge pin level.
   2. Check Valves: In horizontal or vertical position, between flanges.
   3. Lift Check Valves: With stem upright and plumb.

F. Install valve tags. Comply with requirements in Section 22 05 53 "Identification for Plumbing Piping and Equipment" for valve tags and schedules.

3.3 ADJUSTING

A. Adjust or replace valve packing after piping systems have been tested and put into service but before final adjusting and balancing. Replace valves if persistent leaking occurs.

3.4 ACCESS PANELS

A. Furnish adequate number of properly sized access panels to adequately service and maintain systems installed under each section of specifications.

B. Access panels shall be installed and painted under other divisions of these specifications. Exact panel location shall be designated by the subcontractor performing the work of this Section.

C. Access panels are not required in exposed grid or other types of readily removable ceilings.
D. Access panels shall not compromise the fire rating of the wall.

3.5 GENERAL REQUIREMENTS FOR VALVE APPLICATIONS

A. If valve applications are not indicated, use the following:

1. Pump-Discharge Check Valves:
   a. NPS 2 and Smaller: Bronze swing check valves with bronze disc.
   b. NPS 2-1/2 and Larger for Domestic Water: Iron swing check valves with lever and weight or spring; or iron, center-guided check valves.
   c. NPS 2-1/2 and Larger for Sanitary Waste and Storm Drainage: Iron swing check valves with lever and weight or spring.

B. If valves with specified CWP ratings are unavailable, the same types of valves with higher CWP ratings may be substituted.

C. End Connections:

   1. For Copper Tubing, NPS 2 and Smaller: Threaded or soldered or press-ends.
   2. For Copper Tubing, NPS 2-1/2 to NPS 4: Flanged or threaded.
   3. For Copper Tubing, NPS 5 and Larger: Flanged.
   4. For Steel Piping, NPS 2 and Smaller: Threaded.
   5. For Steel Piping, NPS 2-1/2 to NPS 4: Flanged or threaded.
   6. For Steel Piping, NPS 5 and Larger: Flanged.
   7. For Grooved-End Copper Tubing: Grooved.

3.6 DOMESTIC HOT- AND COLD-WATER VALVE SCHEDULE

A. Pipe NPS 2 and Smaller:

   1. Bronze swing check valves with bronze disc, with soldered end connections.
   2. Bronze swing check valves with press-end connections.

B. Pipe NPS 2-1/2 and Larger:

   1. Iron swing check valves with metal seats, with threaded or flanged end connections.
   2. Iron swing check valves with closure control lever, Class 125, with threaded or flanged end connections.
   3. Iron, grooved-end swing check valves, 300 CWP.
   4. Iron, center-guided check valves with compact wafer, Class 125.
   5. Iron, center-guided check valves with metal or resilient seat, with threaded or flanged end connections.
   6. Iron, dual-plate check valves with metal seat, with threaded or flanged end connections.
   7. Iron, single-plate check valves with resilient seat, with threaded or flanged end connections.

END OF SECTION 22 05 23.14
SECTION 22 05 29
HANGERS AND SUPPORTS FOR PLUMBING PIPING AND EQUIPMENT

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. Metal pipe hangers and supports.
2. Trapeze pipe hangers.
3. Metal framing systems.
4. Fastener systems.
5. Pipe stands.
6. Equipment supports.

1.3 RELATION TO OTHER WORK

A. Refer to the section, "General Plumbing Provisions", for related requirements. Refer to other sections of Division 22 and to all other applicable portions of the Drawings and Specifications.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Submit manufacturer's data for review before any work is commenced

B. fabrication and installation details and include calculations for the following:

1. Trapeze pipe hangers.
2. Metal framing systems.
3. Fiberglass strut systems.
4. Pipe stands.
5. Equipment supports.

C. Delegated-Design Submittal: For trapeze hangers indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

1. Detail fabrication and assembly of trapeze hangers.
2. Include design calculations for designing trapeze hangers.

1.5 INFORMATIONAL SUBMITTALS

A. Welding certificates.
1.6 QUALITY ASSURANCE

A. Structural-Steel Welding Qualifications: Qualify procedures and personnel according to AWS D1.1/D1.1M.

B. Pipe Welding Qualifications: Qualify procedures and operators according to 2015 ASME Boiler and Pressure Vessel Code, Section IX.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Delegated Design: Engage a qualified professional engineer, as defined in Section 01 40 00 "Quality Requirements," to design trapeze pipe hangers and equipment supports.

B. Structural Performance: Hangers and supports for plumbing piping and equipment shall withstand the effects of gravity loads and stresses within limits and under conditions indicated according to ASCE/SEI 7.

   1. Design supports for multiple pipes, including pipe stands, capable of supporting combined weight of supported systems, system contents, and test water.
   2. Design equipment supports capable of supporting combined operating weight of supported equipment and connected systems and components.
   3. Design seismic-restraint hangers and supports for piping and equipment and obtain approval from authorities having jurisdiction.

2.2 METAL PIPE HANGERS AND SUPPORTS

A. Carbon-Steel Pipe Hangers and Supports:

   1. Description: MSS SP-58, Types 1 through 58, factory-fabricated components.
   2. Galvanized Metallic Coatings: Pregalvanized, hot-dip galvanized, or electro-galvanized.
   3. Nonmetallic Coatings: Plastic coated or epoxy powder coated.
   4. Padded Hangers: Hanger with fiberglass or other pipe insulation pad or cushion to support bearing surface of piping.
   5. Hanger Rods: Continuous-thread rod, nuts, and washer

B. Stainless-Steel Pipe Hangers and Supports:

   1. Description: MSS SP-58, Types 1 through 58, factory-fabricated components.
   2. Padded Hangers: Hanger with fiberglass or other pipe insulation pad or cushion to support bearing surface of piping.

C. Copper Pipe and Tube Hangers:

   1. Description: MSS SP-58, Types 1 through 58, copper-coated-steel, factory-fabricated components.
2.3 TRAPEZE PIPE HANGERS

A. Description: MSS SP-58, Type 59, shop- or field-fabricated pipe-support assembly, made from structural-carbon-steel shapes, with MSS SP-58 carbon-steel hanger rods, nuts, saddles, and U-bolts.

2.4 METAL FRAMING SYSTEMS

A. MFMA Manufacturer Metal Framing Systems:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. B-line, an Eaton business.
   b. Flex-Strut Inc.
   c. G-Strut.
   d. Haydon Corporation.
   e. Thomas & Betts Corporation; A Member of the ABB Group.
   f. Unistrut; Part of Atkore International.
   g. Wesanco, Inc.

2. Description: Shop- or field-fabricated pipe-support assembly, made of steel channels, accessories, fittings, and other components for supporting multiple parallel pipes.


4. Channels: Continuous slotted channel with inturned lips.

5. Channel Width: Selected for applicable load criteria.

6. Channel Nuts: Formed or stamped nuts or other devices designed to fit into channel slot and, when tightened, prevent slipping along channel.

7. Hanger Rods: Continuous-thread rod, nuts, and washer

B. Non-MFMA Manufacturer Metal Framing Systems:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. Anvil International.
   b. Carpenter & Paterson, Inc.
   c. Empire Industries, Inc.
   d. FNW; Ferguson Enterprises, Inc.
   e. MIRO Industries.
   f. PHD Manufacturing, Inc.

2. Description: Shop- or field-fabricated pipe-support assembly, made of steel channels, accessories, fittings, and other components for supporting multiple parallel pipes.


4. Channels: Continuous slotted channel with inturned lips.

5. Channel Width: Select for applicable load criteria.

6. Channel Nuts: Formed or stamped nuts or other devices designed to fit into channel slot and, when tightened, prevent slipping along channel.

7. Hanger Rods: Continuous-thread rod, nuts, and washer
2.5 FASTENER SYSTEMS

A. Powder-Actuated Fasteners: Threaded-steel stud, for use in hardened portland cement concrete, with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. Hilti, Inc.
   b. ITW Ramset/Red Head; Illinois Tool Works, Inc.
   c. MKT Fastening, LLC.
   d. Simpson Strong-Tie Co., Inc.

B. Mechanical-Expansion Anchors: Insert-wedge-type anchors, for use in hardened portland cement concrete, with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. B-line, an Eaton business.
   b. Empire Tool and Manufacturing Co., Inc.
   c. Hilti, Inc.
   d. ITW Ramset/Red Head; Illinois Tool Works, Inc.
   e. MKT Fastening, LLC.

2. Indoor Applications: Zinc-coated or stainless steel.

2.6 PIPE STANDS

A. General Requirements for Pipe Stands: Shop- or field-fabricated assemblies made of manufactured corrosion-resistant components to support roof-mounted piping.

B. Curb-Mounted-Type Pipe Stands: Shop- or field-fabricated pipe supports made from structural-steel shapes, continuous-thread rods, and rollers, for mounting on permanent stationary roof curb.

2.7 EQUIPMENT SUPPORTS

A. Description: Welded, shop- or field-fabricated equipment support made from structural-carbon-steel shapes.

2.8 MATERIALS

A. Aluminum: ASTM B 221.

B. Carbon Steel: ASTM A 1011/A 1011M.

C. Structural Steel: ASTM A 36/A 36M carbon-steel plates, shapes, and bars; black and galvanized.

D. Stainless Steel: ASTM A 240/A 240M.
E. Grout: ASTM C 1107/C 1107M, factory-mixed and -packaged, dry, hydraulic-cement, nonshrink and nonmetallic grout; suitable for interior and exterior applications.
   2. Design Mix: 5000-psi, 28-day compressive strength.

PART 3 - EXECUTION

3.1 APPLICATION

A. Comply with requirements in Section 07 84 13 “Penetration Firestopping” for firestopping materials and installation, for penetrations through fire-rated walls, ceilings, and assemblies.

B. Strength of Support Assemblies: Where not indicated, select sizes of components, so strength will be adequate to carry present and future static loads within specified loading limits. Minimum static design load used for strength determination shall be weight of supported components plus 200 lb.

3.2 HANGER AND SUPPORT INSTALLATION

A. Metal Pipe-Hanger Installation: Comply with MSS SP-58. Install hangers, supports, clamps, and attachments as required to properly support piping from building structure.

B. Metal Trapeze Pipe-Hanger Installation: Comply with MSS SP-58. Arrange for grouping of parallel runs of horizontal piping, and support together on field-fabricated trapeze pipe hangers.
   1. Pipes of Various Sizes: Support together and space trapezes for smallest pipe size, or install intermediate supports for smaller-diameter pipes as specified for individual pipe hangers.
   2. Field fabricate from ASTM A 36/A 36M carbon-steel shapes selected for loads being supported. Weld steel according to AWS D1.1/D1.1M.

C. Fiberglass Pipe-Hanger Installation: Comply with applicable portions of MSS SP-58. Install hangers and attachments as required to properly support piping from building structure.

D. Metal Framing System Installation: Arrange for grouping of parallel runs of piping, and support together on field-assembled metal framing systems.

E. Thermal Hanger-Shield Installation: Install in pipe hanger or shield for insulated piping.

F. Fastener System Installation:
   1. Install powder-actuated fasteners for use in lightweight concrete or concrete slabs less than 4 inches thick in concrete, after concrete is placed and completely cured. Use operators that are licensed by powder-actuated tool manufacturer. Install fasteners according to powder-actuated tool manufacturer's operating manual.
   2. Install mechanical-expansion anchors in concrete, after concrete is placed and completely cured. Install fasteners according to manufacturer's written instructions.

G. Pipe Stand Installation:
   1. Pipe Stand Types, except Curb-Mounted Type: Assemble components and mount on smooth roof surface. Do not penetrate roof membrane.
2. Curb-Mounted-Type Pipe Stands: Assemble components or fabricate pipe stand and mount on permanent, stationary roof curb. See Section 07 72 00 "Roof Accessories" for curbs.

H. Pipe-Positioning-System Installation: Install support devices to make rigid supply and waste piping connections to each plumbing fixture.

I. Install hangers and supports complete with necessary attachments, inserts, bolts, rods, nuts, washers, and other accessories.


K. Install hangers and supports to allow controlled thermal and seismic movement of piping systems, to permit freedom of movement between pipe anchors, and to facilitate action of expansion joints, expansion loops, expansion bends, and similar units.

L. Install lateral bracing with pipe hangers and supports to prevent swaying.

M. Install building attachments within concrete slabs or attach to structural steel. Install additional attachments at concentrated loads, including valves, flanges, and strainers, NPS 2-1/2 and larger and at changes in direction of piping. Install concrete inserts before concrete is placed; fasten inserts to forms, and install reinforcing bars through openings at top of inserts.

N. Load Distribution: Install hangers and supports, so that piping live and dead loads and stresses from movement will not be transmitted to connected equipment.

O. Pipe Slopes: Install hangers and supports to provide indicated pipe slopes and to not exceed maximum pipe deflections allowed by ASME B31.9 for building services piping.

P. Insulated Piping:

1. Attach clamps and spacers to piping.
   a. Piping Operating Above Ambient Air Temperature: Clamp may project through insulation.
   b. Piping Operating Below Ambient Air Temperature: Use thermal hanger-shield insert with clamp sized to match OD of insert.
   c. Do not exceed pipe stress limits allowed by ASME B31.9 for building services piping.

2. Install MSS SP-58, Type 39 protection saddles if insulation without vapor barrier is indicated. Fill interior voids with insulation that matches adjoining insulation.
   a. Option: Thermal hanger-shield inserts may be used. Include steel weight-distribution plate for pipe NPS 4 and larger if pipe is installed on rollers.

3. Install MSS SP-58, Type 40 protective shields on cold piping with vapor barrier. Shields shall span an arc of 180 degrees.
   a. Option: Thermal hanger-shield inserts may be used. Include steel weight-distribution plate for pipe NPS 4 and larger if pipe is installed on rollers.
4. Shield Dimensions for Pipe: Not less than the following:
   a. NPS 1/4 to NPS 3-1/2: 12 inches long and 0.048 inch thick.
   b. NPS 4: 12 inches long and 0.06 inch thick.
   c. NPS 5 and NPS 6: 18 inches long and 0.06 inch thick.
   d. NPS 8 to NPS 14: 24 inches long and 0.075 inch thick.
   e. NPS 16 to NPS 24: 24 inches long and 0.105 inch thick.

5. Pipes NPS 8 and Larger: Include wood or reinforced calcium-silicate-insulation inserts of length at least as long as protective shield.
6. Thermal Hanger Shields: Install with insulation of same thickness as piping insulation.

3.3 EQUIPMENT SUPPORTS
   A. Fabricate structural-steel stands to suspend equipment from structure overhead or to support equipment above floor.
   B. Grouting: Place grout under supports for equipment, and make bearing surface smooth.
   C. Provide lateral bracing, to prevent swaying, for equipment supports.

3.4 METAL FABRICATIONS
   A. Cut, drill, and fit miscellaneous metal fabrications for trapeze pipe hangers and/or equipment supports.
   B. Fit exposed connections together to form hairline joints. Field weld connections that cannot be shop welded because of shipping size limitations.
   C. Field Welding: Comply with AWS D1.1/D1.1M procedures for shielded, metal arc welding; appearance and quality of welds; and methods used in correcting welding work; and with the following:
      1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
      2. Obtain fusion without undercut or overlap.
      3. Remove welding flux immediately.
      4. Finish welds at exposed connections, so no roughness shows after finishing and so contours of welded surfaces match adjacent contours.

3.5 ADJUSTING
   A. Hanger Adjustments: Adjust hangers to distribute loads equally on attachments and to achieve indicated slope of pipe.
   B. Trim excess length of continuous-thread hanger and support rods to 1-1/2 inches.

3.6 PAINTING
   A. Touchup: Clean field welds and abraded, shop-painted areas. Paint exposed areas immediately after erecting hangers and supports. Use same materials as those used for shop painting. Comply with SSPC-PA 1 requirements for touching up field-painted surfaces.
      1. Apply paint by brush or spray to provide a minimum dry film thickness of 2.0 mils.
B. Galvanized Surfaces: Clean welds, bolted connections, and abraded areas, and apply galvanizing-repair paint to comply with ASTM A 780/A 780M.

3.7 **HANGER AND SUPPORT SCHEDULE**

A. Specific hanger and support requirements are in Sections specifying piping systems and equipment.

B. Comply with MSS SP-58 for pipe-hanger selections and applications that are not specified in piping system Sections.

C. Use hangers and supports with galvanized metallic coatings for piping and equipment that will not have field-applied finishes.

D. Use nonmetallic coatings on attachments for electrolytic protection where attachments are in direct contact with copper tubing.

E. Use carbon-steel attachments for general service applications.

F. Use copper-plated pipe hangers and copper or stainless-steel attachments for copper piping and tubing.

G. Use padded hangers for piping that is subject to scratching.

H. Use thermal hanger-shield inserts for insulated piping and tubing.

I. Horizontal-Piping Hangers and Supports: Unless otherwise indicated and except as specified in piping system Sections, install the following types:

1. Adjustable, Steel Clevis Hangers (MSS Type 1): For suspension of noninsulated or insulated, stationary pipes NPS 1/2 to NPS 30.
2. Yoke-Type Pipe Clamps (MSS Type 2): For suspension of up to 1050 deg F pipes NPS 4 to NPS 24, requiring up to 4 inches of insulation.
3. Carbon- or Alloy-Steel, Double-Bolt Pipe Clamps (MSS Type 3): For suspension of pipes NPS 3/4 to NPS 36, requiring clamp flexibility and up to 4 inches of insulation.
4. Steel Pipe Clamps (MSS Type 4): For suspension of cold and hot pipes NPS 1/2 to NPS 24 if little or no insulation is required.
5. Pipe Hangers (MSS Type 5): For suspension of pipes NPS 1/2 to NPS 4, to allow off-center closure for hanger installation before pipe erection.
6. Adjustable, Swivel Split- or Solid-Ring Hangers (MSS Type 6): For suspension of noninsulated, stationary pipes NPS 3/4 to NPS 8.
7. Adjustable, Steel Band Hangers (MSS Type 7): For suspension of noninsulated, stationary pipes NPS 1/2 to NPS 8.
8. Adjustable Band Hangers (MSS Type 9): For suspension of noninsulated, stationary pipes NPS 1/2 to NPS 8.
9. Adjustable, Swivel-Ring Band Hangers (MSS Type 10): For suspension of noninsulated, stationary pipes NPS 1/2 to NPS 8.
10. Split Pipe Ring with or without Turnbuckle Hangers (MSS Type 11): For suspension of noninsulated, stationary pipes NPS 3/8 to NPS 8.
11. Extension Hinged or Two-Bolt Split Pipe Clamps (MSS Type 12): For suspension of noninsulated, stationary pipes NPS 3/8 to NPS 3.
12. U-Bolts (MSS Type 24): For support of heavy pipes NPS 1/2 to NPS 30.
13. Clips (MSS Type 26): For support of insulated pipes not subject to expansion or contraction.
14. Pipe Saddle Supports (MSS Type 36): For support of pipes NPS 4 to NPS 36, with steel-pipe base stanchion support and cast-iron floor flange or carbon-steel plate.
15. Pipe Stanchion Saddles (MSS Type 37): For support of pipes NPS 4 to NPS 36, with steel-pipe base stanchion support and cast-iron floor flange or carbon-steel plate, and with U-bolt to retain pipe.
16. Adjustable Pipe Saddle Supports (MSS Type 38): For stanchion-type support for pipes NPS 2-1/2 to NPS 36 if vertical adjustment is required, with steel-pipe base stanchion support and cast-iron floor flange.
17. Single-Pipe Rolls (MSS Type 41): For suspension of pipes NPS 1 to NPS 30, from two rods if longitudinal movement caused by expansion and contraction occurs.
18. Adjustable Roller Hangers (MSS Type 43): For suspension of pipes NPS 2-1/2 to NPS 24, from single rod if horizontal movement caused by expansion and contraction occurs.
19. Complete Pipe Rolls (MSS Type 44): For support of pipes NPS 2 to NPS 42 if longitudinal movement caused by expansion and contraction occurs but vertical adjustment is unnecessary.
20. Pipe Roll and Plate Units (MSS Type 45): For support of pipes NPS 2 to NPS 24 if small horizontal movement caused by expansion contraction occurs and vertical adjustment is unnecessary.
21. Adjustable Pipe Roll and Base Units (MSS Type 46): For support of pipes NPS 2 to NPS 30 if vertical and lateral adjustment during installation, in addition to expansion and contraction, is required.

J. Vertical-Piping Clamps: Unless otherwise indicated and except as specified in piping system Sections, install the following types:

1. Extension Pipe or Riser Clamps (MSS Type 8): For support of pipe risers NPS 3/4 to NPS 24.
2. Carbon- or Alloy-Steel Riser Clamps (MSS Type 42): For support of pipe risers NPS 3/4 to NPS 24 if longer ends are required for riser clamps.

K. Hanger-Rod Attachments: Unless otherwise indicated and except as specified in piping system Sections, install the following types:

1. Steel Turnbuckles (MSS Type 13): For adjustment of up to 6 inches for heavy loads.
2. Steel Clevises (MSS Type 14): For 120 to 450 deg F piping installations.
3. Swivel Turnbuckles (MSS Type 15): For use with MSS Type 11 split pipe rings.
4. Malleable-Iron Sockets (MSS Type 16): For attaching hanger rods to various types of building attachments.
5. Steel Weldless Eye Nuts (MSS Type 17): For 120 to 450 deg F piping installations.

L. Building Attachments: Unless otherwise indicated and except as specified in piping system Sections, install the following types:

1. Steel or Malleable-Concrete Inserts (MSS Type 18): For upper attachment to suspend pipe hangers from concrete ceiling.
2. Top-Beam C-Clamps (MSS Type 19): For use under roof installations with bar-joist construction, to attach to top flange of structural shape.
3. Side-Beam or Channel Clamps (MSS Type 20): For attaching to bottom flange of beams, channels, or angles.
4. Center-Beam Clamps (MSS Type 21): For attaching to center of bottom flange of beams.
5. Welded Beam Attachments (MSS Type 22): For attaching to bottom of beams if loads are considerable and rod sizes are large.
6. C-Clamps (MSS Type 23): For structural shapes.
7. **Top-Beam Clamps (MSS Type 25):** For top of beams if hanger rod is required tangent to flange edge.
8. **Side-Beam Clamps (MSS Type 27):** For bottom of steel I-beams.
9. **Steel-Beam Clamps with Eye Nuts (MSS Type 28):** For attaching to bottom of steel I-beams for heavy loads.
10. **Linked-Steel Clamps with Extension Pieces (MSS Type 29):** For attaching to bottom of steel I-beams for heavy loads, with link extensions.
11. **Malleable-Beam Clamps (MSS Type 30):** For attaching to structural steel.
12. **Welded-Steel Brackets:** For support of pipes from below or for suspending from above by using clip and rod. Use one of the following for indicated loads:
   
a. **Light (MSS Type 31):** 750 lb.
b. **Medium (MSS Type 32):** 1500 lb.
c. **Heavy (MSS Type 33):** 3000 lb.

13. **Side-Beam Brackets (MSS Type 34):** For sides of steel or wooden beams.
14. **Plate Lugs (MSS Type 57):** For attaching to steel beams if flexibility at beam is required.
15. **Horizontal Travelers (MSS Type 58):** For supporting piping systems subject to linear horizontal movement where headroom is limited.

M. **Saddles and Shields:** Unless otherwise indicated and except as specified in piping system Sections, install the following types:

1. **Steel-Pipe-Covering Protection Saddles (MSS Type 39):** To fill interior voids with insulation that matches adjoining insulation.
2. **Protection Shields (MSS Type 40):** Of length recommended in writing by manufacturer to prevent crushing insulation.
3. **Thermal Hanger-Shield Inserts:** For supporting insulated pipe.

N. **Spring Hangers and Supports:** Unless otherwise indicated and except as specified in piping system Sections, install the following types:

1. **Restraint-Control Devices (MSS Type 47):** Where indicated to control piping movement.
2. **Spring Cushions (MSS Type 48):** For light loads if vertical movement does not exceed 1-1/4 inches.
3. **Spring-Cushion Roll Hangers (MSS Type 49):** For equipping Type 41 roll hanger with springs.
4. **Spring Sway Braces (MSS Type 50):** To retard sway, shock, vibration, or thermal expansion in piping systems.
5. **Variable-Spring Hangers (MSS Type 51):** Preset to indicated load, and limit variability factor to 25 percent to allow expansion and contraction of piping system from hanger.
6. **Variable-Spring Base Supports (MSS Type 52):** Preset to indicated load, and limit variability factor to 25 percent to allow expansion and contraction of piping system from base support.
7. **Variable-Spring Trapeze Hangers (MSS Type 53):** Preset to indicated load, and limit variability factor to 25 percent to allow expansion and contraction of piping system from trapeze support.
8. **Constant Supports:** For critical piping stress and if necessary to avoid transfer of stress from one support to another support, critical terminal, or connected equipment. Include auxiliary stops for erection, hydrostatic test, and load-adjustment capability. These supports include the following types:
   
a. **Horizontal (MSS Type 54):** Mounted horizontally.
b. **Vertical (MSS Type 55):** Mounted vertically.
c. Trapeze (MSS Type 56): Two vertical-type supports and one trapeze member.

O. Comply with MSS SP-58 for trapeze pipe-hanger selections and applications that are not specified in piping system Sections.

P. Comply with MFMA-103 for metal framing system selections and applications that are not specified in piping system Sections.

Q. Use pipe-positioning systems in pipe spaces behind plumbing fixtures to support supply and waste piping for plumbing fixtures.

END OF SECTION 22 05 29
SECTION 22 05 53
IDENTIFICATION FOR PLUMBING PIPING AND EQUIPMENT

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Equipment labels.
2. Warning signs and labels.
3. Pipe labels.

1.2 ACTION SUBMITTALS

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

1.3 RELATION TO OTHER WORK

A. Refer to the section, "General Plumbing Provisions", for related requirements. Refer to other sections of Division 22 and to all other applicable portions of the Drawings and Specifications.

PART 2 - PRODUCTS

2.1 EQUIPMENT LABELS

A. Metal Labels for Equipment:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

   a. Brady Corporation.
   b. Brimar Industries, Inc.
   c. Carlton Industries, LP.
   d. Champion America.
   e. Craftmark Pipe Markers.
   f. emedco.
   g. Kolbi Pipe Marker Co.
   h. LEM Products Inc.
   i. Marking Services, Inc.
   j. Seton Identification Products.

2. Material and Thickness: Stainless steel, 0.025-inch minimum thickness, and having predrilled or stamped holes for attachment hardware.
4. Background Color: Yellow.
5. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch.
6. Minimum Letter Size: 1/4 inch for name of units if viewing distance is less than 24 inches, 1/2 inch for viewing distances up to 72 inches, and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-quarters the size of principal lettering.
8. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.
B. Plastic Labels for Equipment:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. Brady Corporation.
   b. Brimar Industries, Inc.
   c. Carlton Industries, LP.
   d. Champion America.
   e. Craftmark Pipe Markers.
   f. emedco.
   g. Kolbi Pipe Marker Co.
   h. LEM Products Inc.
   i. Marking Services, Inc.
   j. Seton Identification Products.

2. Material and Thickness: Multilayer, multicolor, plastic labels for mechanical engraving, 1/8 inch thick, and having predrilled holes for attachment hardware.


4. Background Color: Yellow.

5. Maximum Temperature: Able to withstand temperatures up to 160 deg F.

6. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch.

7. Minimum Letter Size: 1/4 inch for name of units if viewing distance is less than 24 inches, 1/2 inch for viewing distances up to 72 inches, and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-quarters the size of principal lettering.


9. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.

C. Label Content: Include equipment's Drawing designation or unique equipment number, Drawing numbers where equipment is indicated (plans, details, and schedules), and the Specification Section number and title where equipment is specified.

D. Equipment Label Schedule: For each item of equipment to be labeled, on 8-1/2-by-11-inch bond paper. Tabulate equipment identification number, and identify Drawing numbers where equipment is indicated (plans, details, and schedules) and the Specification Section number and title where equipment is specified. Equipment schedule shall be included in operation and maintenance data.

2.2 WARNING SIGNS AND LABELS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Brady Corporation.
2. Brimar Industries, Inc.
3. Carlton Industries, LP.
5. Craftmark Pipe Markers.
6. emedco.
7. LEM Products Inc.
8. Marking Services Inc.
10. Seton Identification Products.
11. Stranco, Inc.

B. Material and Thickness: Multilayer, multicolor, plastic labels for mechanical engraving, 1/8 inch thick, and having predrilled holes for attachment hardware.

C. Letter Color: Black.

D. Background Color: Yellow.

E. Maximum Temperature: Able to withstand temperatures up to 160 deg F.

F. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch.

G. Minimum Letter Size: 1/4 inch for name of units if viewing distance is less than 24 inches, 1/2 inch for viewing distances up to 72 inches, and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-quarters the size of principal lettering.

H. Fasteners: Stainless-steel rivets.

I. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.

J. Label Content: Include caution and warning information plus emergency notification instructions.

2.3 PIPE LABELS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Actioncraft Products, Inc.; a division of Industrial Test Equipment Co., Inc.
2. Brady Corporation.
4. Carlton Industries, LP.
5. Champion America.
7. emedco.
8. Kolbi Pipe Marker Co.
9. LEM Products Inc.
10. Marking Sevices Inc.
11. Seton Identification Products.

B. General Requirements for Manufactured Pipe Labels: Preprinted, color-coded, with lettering indicating service, and showing flow direction.

C. Pretensioned Pipe Labels: Precoiled, semirigid plastic formed to partially cover circumference of pipe and to attach to pipe without fasteners or adhesive.

D. Self-Adhesive Pipe Labels: Printed plastic with contact-type, permanent-adhesive backing.

E. Pipe Label Contents: Include identification of piping service using same designations or abbreviations as used on Drawings; also include pipe size and an arrow indicating flow direction.
1. Flow-Direction Arrows: Integral with piping-system service lettering to accommodate both directions or as separate unit on each pipe label to indicate flow direction.
2. Lettering Size: Size letters according to ASME A13.1 for piping.

PART 3 - EXECUTION

3.1 EQUIPMENT LABEL INSTALLATION

A. Install or permanently fasten labels on each major item of mechanical equipment.
B. Locate equipment labels where accessible and visible.

3.2 PIPE LABEL INSTALLATION

A. Piping Color Coding: Painting of piping is specified in Architectural drawings and/or specifications.
B. Pipe Label Locations: Locate pipe labels where piping is exposed or above accessible ceilings in finished spaces; machine rooms; accessible maintenance spaces such as shafts, tunnels, and plenums; and exterior exposed locations as follows:
   1. Near each valve and control device.
   2. Near each branch connection, excluding short takeoffs for fixtures and terminal units. Where flow pattern is not obvious, mark each pipe at branch.
   3. Near penetrations and on both sides of through walls, floors, ceilings, and inaccessible enclosures.
   4. At access doors, manholes, and similar access points that permit view of concealed piping.
   5. Near major equipment items and other points of origination and termination.
   6. Spaced at maximum intervals of 50 feet along each run. Reduce intervals to 25 feet in areas of congested piping and equipment.

C. Pipe Label Color Schedule:

1. Low-Pressure Compressed Air Piping:
   a. Background: Safety blue.

2. High-Pressure Compressed Air Piping:
   a. Background: Safety blue.

3. Domestic Water Piping
   a. Background: Safety green.

4. Sanitary Waste and Storm Drainage Piping:
   a. Background Color: Safety black.

END OF SECTION 220553
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 insulating the following plumbing piping services:

1. Domestic cold-water piping.
2. Domestic hot-water piping.
3. Domestic recirculating hot-water piping.
4. Domestic chilled-water piping for drinking fountains.
5. Sanitary waste piping exposed to freezing conditions.
6. Storm-water piping exposed to freezing conditions.
7. Roof drains and rainwater leaders.
8. Supplies and drains for handicap-accessible lavatories and sinks.

B. Related Sections:

1. Section 22 07 16 "Plumbing Equipment Insulation."

1.3 ACTION SUBMITTALS

A. Submit manufacturer's data for review before any work is commenced.

1.4 RELATION TO OTHER WORK

A. Refer to the section, "General Plumbing Provisions", for related requirements. Refer to other sections of Division 22 and to all other applicable portions of the Drawings and Specifications.

1.5 QUALITY ASSURANCE

A. Installer Qualifications: Skilled mechanics who have successfully completed an apprenticeship program or another craft training program certified by the Department of Labor, Bureau of Apprenticeship and Training.

B. Surface-Burning Characteristics: For insulation and related materials, as determined by testing identical products according to ASTM E 84 by a testing agency acceptable to authorities having jurisdiction. Factory label insulation and jacket materials and adhesive, mastic, tapes, and cement material containers, with appropriate markings of applicable testing agency.

1. Insulation Installed Indoors: Flame-spread index of 25 or less, and smoke-developed index of 50 or less.
2. Insulation Installed Outdoors: Flame-spread index of 75 or less, and smoke-developed index of 150 or less.

C. Mockups: Before installing insulation, build mockups for each type of insulation and finish listed below to demonstrate quality of insulation application and finishes. Build mockups in the
location indicated or, if not indicated, as directed by Architect. Use materials indicated for the completed Work.

1. Piping Mockups:
   a. One 10-foot section of NPS 2 straight pipe.
   b. One each of a 90-degree threaded, welded, and flanged elbow.
   c. One each of a threaded, welded, and flanged tee fitting.
   d. One NPS 2 or smaller valve, and one NPS 2-1/2 or larger valve.
   e. Four support hangers including hanger shield and insert.
   f. One threaded strainer and one flanged strainer with removable portion of insulation.
   g. One threaded reducer and one welded reducer.
   h. One pressure temperature tap.
   i. One mechanical coupling.

2. For each mockup, fabricate cutaway sections to allow observation of application details for insulation materials, adhesives, mastics, attachments, and jackets.
3. Notify Architect seven days in advance of dates and times when mockups will be constructed.
4. Obtain Architect's approval of mockups before starting insulation application.
5. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.
6. Maintain mockups during construction in an undisturbed condition as a standard for judging the completed Work.
7. Demolish and remove mockups when directed.

D. Comply with the following applicable standards and other requirements specified for miscellaneous components:


1.6 DELIVERY, STORAGE, AND HANDLING

A. Packaging: Insulation material containers shall be marked by manufacturer with appropriate ASTM standard designation, type and grade, and maximum use temperature.

1.7 COORDINATION

A. Coordinate sizes and locations of supports, hangers, and insulation shields specified in Section 22 05 29 "Hangers and Supports for Plumbing Piping and Equipment."

B. Coordinate clearance requirements with piping Installer for piping insulation application. Before preparing piping Shop Drawings, establish and maintain clearance requirements for installation of insulation and field-applied jackets and finishes and for space required for maintenance.

C. Coordinate installation and testing of heat tracing.

1.8 SCHEDULING

A. Schedule insulation application after pressure testing systems and, where required, after installing and testing heat tracing. Insulation application may begin on segments that have satisfactory test results.
B. Complete installation and concealment of plastic materials as rapidly as possible in each area of construction.

PART 2 - PRODUCTS

2.1 INSULATION MATERIALS


B. Products shall not contain asbestos, lead, mercury, or mercury compounds.

C. Products that come in contact with stainless steel shall have a leachable chloride content of less than 50 ppm when tested according to ASTM C 871.

D. Insulation materials for use on austenitic stainless steel shall be qualified as acceptable according to ASTM C 795.

E. Foam insulation materials shall not use CFC or HCFC blowing agents in the manufacturing process.

F. Cellular Glass: Inorganic, incombustible, foamed or cellulated glass with annealed, rigid, hermetically sealed cells. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.

1. Manufacturers: Subject to compliance with requirements, provide products by the following:
   a. Pittsburgh Corning Corporation.

2. Block Insulation: ASTM C 552, Type I.
3. Special-Shaped Insulation: ASTM C 552, Type III.
4. Preformed Pipe Insulation without Jacket: Comply with ASTM C 552, Type II, Class 1.
5. Preformed Pipe Insulation with Factory-Applied ASJ: Comply with ASTM C 552, Type II, Class 2.
6. Factory fabricate shapes according to ASTM C 450 and ASTM C 585.

G. Flexible Elastomeric Insulation: Closed-cell, sponge- or expanded-rubber materials. Comply with ASTM C 534, Type I for tubular materials.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. Aeroflex USA, Inc.
   b. Armacell LLC.
   c. K-Flex USA.

H. Mineral-Fiber Blanket Insulation: Mineral or glass fibers bonded with a thermosetting resin. Comply with ASTM C 553, Type II and ASTM C 1290, Type I. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
I. Mineral-Fiber, Preformed Pipe Insulation:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. Johns Manville; a Berkshire Hathaway company.
   b. Knauf Insulation.
   c. Manson Insulation Inc.
   d. Owens Corning.

J. Phenolic:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. Kingspan Tarec Industrial Insulation NV.
   b. Resolco International BV.

2. Preformed pipe insulation of rigid, expanded, closed-cell structure. Comply with ASTM C 1126, Type III, Grade 1.
3. Block insulation of rigid, expanded, closed-cell structure. Comply with ASTM C 1126, Type II, Grade 1.
4. Factory fabricate shapes according to ASTM C 450 and ASTM C 585.

K. Polyolefin: Unicellular, polyethylene thermal plastic insulation. Comply with ASTM C 534 or ASTM C 1427, Type I, Grade 1 for tubular materials.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. Armacell LLC.
   b. Nomaco Insulation.

2.2 INSULATING CEMENTS


1. Manufacturers: Subject to compliance with requirements, provide products by the following:
   a. Ramco Insulation, Inc.

B. Expanded or Exfoliated Vermiculite Insulating Cement: Comply with ASTM C 196.

1. Manufacturers: Subject to compliance with requirements, provide products by the following:
a. Ramco Insulation, Inc.


1. Manufacturers: Subject to compliance with requirements, provide products by the following:

   a. Ramco Insulation, Inc.

2.3 ADHESIVES

A. Materials shall be compatible with insulation materials, jackets, and substrates and for bonding insulation to itself and to surfaces to be insulated, unless otherwise indicated.

B. Cellular-Glass Adhesive: Two-component, thermosetting urethane adhesive containing no flammable solvents, with a service temperature range of minus 100 to plus 200 deg F.

1. Manufacturers: Subject to compliance with requirements, provide products by the following:

   a. Foster Brand; H. B. Fuller Construction Products.

C. Flexible Elastomeric and Polyolefin Adhesive: Comply with MIL-A-24179A, Type II, Class I.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

   a. Aeroflex USA, Inc.
   b. Armacell LLC.
   c. Foster Brand; H. B. Fuller Construction Products.
   d. K-Flex USA.

D. Mineral-Fiber Adhesive: Comply with MIL-A-3316C, Class 2, Grade A.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

   a. Childers Brand; H. B. Fuller Construction Products.
   b. Eagle Bridges - Marathon Industries.
   c. Foster Brand; H. B. Fuller Construction Products.
   d. Mon-Eco Industries, Inc.

E. Phenolic Adhesive: Solvent-based resin adhesive, with a service temperature range of minus 75 to plus 300 deg F.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

   a. Childers Brand; H. B. Fuller Construction Products.
   b. Foster Brand; H. B. Fuller Construction Products.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. Childers Brand; H. B. Fuller Construction Products.
   b. Eagle Bridges - Marathon Industries.
   c. Foster Brand; H. B. Fuller Construction Products.
   d. Mon-Eco Industries, Inc.

G. PVC Jacket Adhesive: Compatible with PVC jacket.
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. Dow Corning Corporation.
      b. Johns Manville; a Berkshire Hathaway company.
      c. P.I.C. Plastics, Inc.
      d. Speedline Corporation.

2.4 MASTICS

A. Materials shall be compatible with insulation materials, jackets, and substrates; comply with MIL-PRF-19565C, Type II.

B. Vapor-Barrier Mastic: Water based; suitable for indoor use on below-ambient services.
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. Foster Brand; H. B. Fuller Construction Products.
      b. Knauf Insulation.
      c. Vimasco Corporation.
   2. Water-Vapor Permeance: ASTM E 96/E 96M, Procedure B, 0.013 perm at 43-mil dry film thickness.
   3. Service Temperature Range: Minus 20 to plus 180 deg F.
   4. Solids Content: ASTM D 1644, 58 percent by volume and 70 percent by weight.

C. Vapor-Barrier Mastic: Solvent based; suitable for indoor use on below-ambient services.
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. Childers Brand; H. B. Fuller Construction Products.
      b. Eagle Bridges - Marathon Industries.
      c. Foster Brand; H. B. Fuller Construction Products.
      d. Mon-Eco Industries, Inc.
   2. Water-Vapor Permeance: ASTM F 1249, 0.05 perm at 35-mil dry film thickness.
   3. Service Temperature Range: 0 to 180 deg F.

D. Vapor-Barrier Mastic: Solvent based; suitable for outdoor use on below-ambient services.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. Childers Brand; H. B. Fuller Construction Products.
   b. Eagle Bridges - Marathon Industries.
   c. Foster Brand; H. B. Fuller Construction Products.

2. Water-Vapor Permeance: ASTM F 1249, 0.05 perm at 30-mil dry film thickness.
3. Service Temperature Range: Minus 50 to plus 220 deg F.
4. Solids Content: ASTM D 1644, 33 percent by volume and 46 percent by weight.

E. Breather Mastic: Water based; suitable for indoor and outdoor use on above-ambient services.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. Childers Brand; H. B. Fuller Construction Products.
   b. Eagle Bridges - Marathon Industries.
   c. Foster Brand; H. B. Fuller Construction Products.
   d. Knauf Insulation.
   e. Mon-Eco Industries, Inc.
   f. Vimasco Corporation.

2. Water-Vapor Permeance: ASTM F 1249, 1.8 perms at 0.0625-inch dry film thickness.
3. Service Temperature Range: Minus 20 to plus 180 deg F.
4. Solids Content: 60 percent by volume and 66 percent by weight.

2.5 LAGGING ADHESIVES

A. Description: Comply with MIL-A-3316C, Class I, Grade A, and shall be compatible with insulation materials, jackets, and substrates.

1. For indoor applications, use lagging adhesives that have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
2. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. Childers Brand; H. B. Fuller Construction Products.
   b. Foster Brand; H. B. Fuller Construction Products.
   c. Vimasco Corporation.

3. Fire-resistant, water-based lagging adhesive and coating for use indoors to adhere fire-resistant lagging cloths over pipe insulation.
4. Service Temperature Range: 0 to plus 180 deg F.

2.6 SEALANTS

A. Joint Sealants for Cellular-Glass and Phenolic Products:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
2. Materials shall be compatible with insulation materials, jackets, and substrates.
3. Permanently flexible, elastomeric sealant.
4. Service Temperature Range: Minus 100 to plus 300 deg F.
5. Color: White or gray.

B. FSK and Metal Jacket Flashing Sealants:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. Childers Brand; H. B. Fuller Construction Products.
   b. Eagle Bridges - Marathon Industries.
   c. Foster Brand; H. B. Fuller Construction Products.
   d. Mon-Eco Industries, Inc.

2. Materials shall be compatible with insulation materials, jackets, and substrates.
3. Fire- and water-resistant, flexible, elastomeric sealant.
4. Service Temperature Range: Minus 40 to plus 250 deg F.
5. Color: Aluminum.

C. ASJ Flashing Sealants, and Vinyl, PVDC, and PVC Jacket Flashing Sealants:

1. Manufacturers: Subject to compliance with requirements, provide products by the following:
   a. Childers Brand; H. B. Fuller Construction Products.

2. Materials shall be compatible with insulation materials, jackets, and substrates.
3. Fire- and water-resistant, flexible, elastomeric sealant.
4. Service Temperature Range: Minus 40 to plus 250 deg F.

2.7 FACTORY-APPLIED JACKETS

A. Insulation system schedules indicate factory-applied jackets on various applications. When factory-applied jackets are indicated, comply with the following:

1. ASJ: White, kraft-paper, fiberglass-reinforced scrim with aluminum-foil backing; complying with ASTM C 1136, Type I.
2. ASJ-SSL: ASJ with self-sealing, pressure-sensitive, acrylic-based adhesive covered by a removable protective strip; complying with ASTM C 1136, Type I.
3. FSK Jacket: Aluminum-foil, fiberglass-reinforced scrim with kraft-paper backing; complying with ASTM C 1136, Type II.

2.8 FIELD-APPLIED FABRIC-REINFORCING MESH

A. Woven Glass-Fiber Fabric: Approximately 2 oz./sq. yd. with a thread count of 10 strands by 10 strands/sq. in. for covering pipe and pipe fittings.
1. Manufacturers: Subject to compliance with requirements, provide products by the following:
   a. Childers Brand; H. B. Fuller Construction Products.

B. Woven Polyester Fabric: Approximately 1 oz./sq. yd. with a thread count of 10 strands by 10 strands/sq. in., in a Leno weave, for pipe.
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. Foster Brand; H. B. Fuller Construction Products.
      b. Vimasco Corporation.

2.9 FIELD-APPLIED CLOTHS

A. Woven Glass-Fiber Fabric: Comply with MIL-C-20079H, Type I, plain weave, and presized a minimum of 8 oz./sq. yd..
   1. Manufacturers: Subject to compliance with requirements, provide products by the following:

2.10 FIELD-APPLIED JACKETS

A. Field-applied jackets shall comply with ASTM C 921, Type I, unless otherwise indicated.

B. PVC Jacket: High-impact-resistant, UV-resistant PVC complying with ASTM D 1784, Class 16354-C; thickness as scheduled; roll stock ready for shop or field cutting and forming. Thickness is indicated in field-applied jacket schedules.
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. Johns Manville; a Berkshire Hathaway company.
      b. P.I.C. Plastics, Inc.
      c. Proto Corporation.
      d. Speedline Corporation.

   2. Adhesive: As recommended by jacket material manufacturer.
   3. Color: Color as selected by Architect.
   4. Factory-fabricated fitting covers to match jacket if available; otherwise, field fabricate.
      a. Shapes: 45- and 90-degree, short- and long-radius elbows, tees, valves, flanges, unions, reducers, end caps, soil-pipe hubs, traps, mechanical joints, and P-trap and supply covers for lavatories.

C. Metal Jacket:
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. Childers Brand; H. B. Fuller Construction Products.
   a. Finish and thickness are indicated in field-applied jacket schedules.
   c. Moisture Barrier for Outdoor Applications: 3-mil-thick, heat-bonded polyethylene and kraft paper.
   d. Factory-Fabricated Fitting Covers:
      1) Same material, finish, and thickness as jacket.
      2) Preformed 2-piece or gore, 45- and 90-degree, short- and long-radius elbows.
      3) Tee covers.
      4) Flange and union covers.
      5) End caps.
      6) Beveled collars.
      7) Valve covers.
      8) Field fabricate fitting covers only if factory-fabricated fitting covers are not available.

3. Stainless-Steel Jacket: ASTM A 167 or ASTM A 240/A 240M.
   a. Material, finish, and thickness are indicated in field-applied jacket schedules.
   c. Moisture Barrier for Outdoor Applications: 3-mil-thick, heat-bonded polyethylene and kraft paper.
   d. Factory-Fabricated Fitting Covers:
      1) Same material, finish, and thickness as jacket.
      2) Preformed 2-piece or gore, 45- and 90-degree, short- and long-radius elbows.
      3) Tee covers.
      4) Flange and union covers.
      5) End caps.
      6) Beveled collars.
      7) Valve covers.
      8) Field fabricate fitting covers only if factory-fabricated fitting covers are not available.

D. Underground Direct-Buried Jacket: 125-mil-thick vapor barrier and waterproofing membrane consisting of a rubberized bituminous resin reinforced with a woven-glass fiber or polyester scrim and laminated aluminum foil.
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. Pittsburgh Corning Corporation.
      b. Polyguard Products, Inc.
2.11 TAPES

A. ASJ Tape: White vapor-retarder tape matching factory-applied jacket with acrylic adhesive, complying with ASTM C 1136.
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. Avery Dennison Corporation, Specialty Tapes Division.
      b. Compac Corporation.
      c. Ideal Tape Co., Inc., an American Biltrite Company.
      d. Knauf Insulation.
      e. Venture Tape.
   2. Width: 3 inches.
   3. Thickness: 11.5 mils.
   5. Elongation: 2 percent.
   6. Tensile Strength: 40 lbf/inch in width.
   7. ASJ Tape Disks and Squares: Precut disks or squares of ASJ tape.

B. FSK Tape: Foil-face, vapor-retarder tape matching factory-applied jacket with acrylic adhesive; complying with ASTM C 1136.
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. Avery Dennison Corporation, Specialty Tapes Division.
      b. Compac Corporation.
      c. Ideal Tape Co., Inc., an American Biltrite Company.
      d. Knauf Insulation.
      e. Venture Tape.
   2. Width: 3 inches.
   3. Thickness: 6.5 mils.
   5. Elongation: 2 percent.
   6. Tensile Strength: 40 lbf/inch in width.
   7. FSK Tape Disks and Squares: Precut disks or squares of FSK tape.

C. PVC Tape: White vapor-retarder tape matching field-applied PVC jacket with acrylic adhesive; suitable for indoor and outdoor applications.
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. Compac Corporation.
      c. Venture Tape.
   2. Width: 2 inches.
   3. Thickness: 6 mils.
   5. Elongation: 500 percent.
6. Tensile Strength: 18 lbf/inch in width.

D. Aluminum-Foil Tape: Vapor-retarder tape with acrylic adhesive.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. Avery Dennison Corporation, Specialty Tapes Division.
   b. Compac Corporation.
   c. Ideal Tape Co., Inc., an American Biltrite Company.
   d. Knauf Insulation.
   e. Venture Tape.
2. Width: 2 inches.
3. Thickness: 3.7 mils.
5. Elongation: 5 percent.
6. Tensile Strength: 34 lbf/inch in width.

2.12 SECUREMENTS

A. Bands:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. ITW Insulation Systems; Illinois Tool Works, Inc.
   b. RPR Products, Inc.
2. Stainless Steel: ASTM A 167 or ASTM A 240/A 240M, Type 316; 0.015 inch thick, 1/2 inch wide with wing seal.
3. Aluminum: ASTM B 209, Alloy 3003, 3005, 3105, or 5005; Temper H-14, 0.020 inch thick, 1/2 inch wide with wing seal.

B. Staples: Outward-clinching insulation staples, nominal 3/4-inch-wide, stainless steel or Monel.

C. Wire: 0.062-inch soft-annealed, stainless steel.
1. Manufacturers: Subject to compliance with requirements, provide products by the following:

2.13 PROTECTIVE SHIELDING GUARDS

A. Protective Shielding Pipe Covers:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. Engineered Brass Company.
   b. Insul-Tect Products Co.
   c. McGuire Manufacturing.
   d. Plumberex Specialty Products, Inc.
e. Truebro.
f. Zurn Industries, LLC.

2. Description: Manufactured plastic wraps for covering plumbing fixture hot- and cold-water supplies and trap and drain piping. Comply with Americans with Disabilities Act (ADA) requirements.

B. Protective Shielding Piping Enclosures:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. Truebro.
   b. Zurn Industries, LLC.

2. Description: Manufactured plastic enclosure for covering plumbing fixture hot- and cold-water supplies and trap and drain piping. Comply with ADA requirements.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates and conditions for compliance with requirements for installation tolerances and other conditions affecting performance of insulation application.

1. Verify that systems to be insulated have been tested and are free of defects.
2. Verify that surfaces to be insulated are clean and dry.

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

3.2 PREPARATION

A. Surface Preparation: Clean and dry surfaces to receive insulation. Remove materials that will adversely affect insulation application.

B. Surface Preparation: Clean and prepare surfaces to be insulated. Before insulating, apply a corrosion coating to insulated surfaces as follows:

1. Stainless Steel: Coat 300 series stainless steel with an epoxy primer 5 mils thick and an epoxy finish 5 mils thick if operating in a temperature range between 140 and 300 deg F. Consult coating manufacturer for appropriate coating materials and application methods for operating temperature range.
2. Carbon Steel: Coat carbon steel operating at a service temperature between 32 and 300 deg F with an epoxy coating. Consult coating manufacturer for appropriate coating materials and application methods for operating temperature range.

C. Coordinate insulation installation with the trade installing heat tracing. Comply with requirements for heat tracing that apply to insulation.

D. Mix insulating cements with clean potable water; if insulating cements are to be in contact with stainless-steel surfaces, use demineralized water.
3.3 GENERAL INSTALLATION REQUIREMENTS

A. Install insulation materials, accessories, and finishes with smooth, straight, and even surfaces; free of voids throughout the length of piping including fittings, valves, and specialties.

B. Install insulation materials, forms, vapor barriers or retarders, jackets, and thicknesses required for each item of pipe system as specified in insulation system schedules.

C. Install accessories compatible with insulation materials and suitable for the service. Install accessories that do not corrode, soften, or otherwise attack insulation or jacket in either wet or dry state.

D. Install insulation with longitudinal seams at top and bottom of horizontal runs.

E. Install multiple layers of insulation with longitudinal and end seams staggered.

F. Do not weld brackets, clips, or other attachment devices to piping, fittings, and specialties.

G. Keep insulation materials dry during application and finishing.

H. Install insulation with tight longitudinal seams and end joints. Bond seams and joints with adhesive recommended by insulation material manufacturer.

I. Install insulation with least number of joints practical.

J. Where vapor barrier is indicated, seal joints, seams, and penetrations in insulation at hangers, supports, anchors, and other projections with vapor-barrier mastic.

   1. Install insulation continuously through hangers and around anchor attachments.
   2. For insulation application where vapor barriers are indicated, extend insulation on anchor legs from point of attachment to supported item to point of attachment to structure. Taper and seal ends at attachment to structure with vapor-barrier mastic.
   3. Install insert materials and install insulation to tightly join the insert. Seal insulation to insulation inserts with adhesive or sealing compound recommended by insulation material manufacturer.
   4. Cover inserts with jacket material matching adjacent pipe insulation. Install shields over jacket, arranged to protect jacket from tear or puncture by hanger, support, and shield.

K. Apply adhesives, mastics, and sealants at manufacturer's recommended coverage rate and wet and dry film thicknesses.

L. Install insulation with factory-applied jackets as follows:

   1. Draw jacket tight and smooth.
   2. Cover circumferential joints with 3-inch-wide strips, of same material as insulation jacket. Secure strips with adhesive and outward clinching staples along both edges of strip, spaced 4 inches o.c.
   3. Overlap jacket longitudinal seams at least 1-1/2 inches. Install insulation with longitudinal seams at bottom of pipe. Clean and dry surface to receive self-sealing lap. Staple laps with outward clinching staples along edge at 2 inches o.c.

      a. For below-ambient services, apply vapor-barrier mastic over staples.
4. Cover joints and seams with tape, according to insulation material manufacturer's written instructions, to maintain vapor seal.
5. Where vapor barriers are indicated, apply vapor-barrier mastic on seams and joints and at ends adjacent to pipe flanges and fittings.

M. Cut insulation in a manner to avoid compressing insulation more than 75 percent of its nominal thickness.

N. Finish installation with systems at operating conditions. Repair joint separations and cracking due to thermal movement.

O. Repair damaged insulation facings by applying same facing material over damaged areas. Extend patches at least 4 inches beyond damaged areas. Adhere, staple, and seal patches similar to butt joints.

P. For above-ambient services, do not install insulation to the following:
   1. Vibration-control devices.
   2. Testing agency labels and stamps.
   3. Nameplates and data plates.

3.4 **PENETRATIONS**

A. Insulation Installation at Roof Penetrations: Install insulation continuously through roof penetrations.
   1. Seal penetrations with flashing sealant.
   2. For applications requiring only indoor insulation, terminate insulation above roof surface and seal with joint sealant. For applications requiring indoor and outdoor insulation, install insulation for outdoor applications tightly joined to indoor insulation ends. Seal joint with joint sealant.
   3. Extend jacket of outdoor insulation outside roof flashing at least 2 inches below top of roof flashing.
   4. Seal jacket to roof flashing with flashing sealant.

B. Insulation Installation at Underground Exterior Wall Penetrations: Terminate insulation flush with sleeve seal. Seal terminations with flashing sealant.

C. Insulation Installation at Aboveground Exterior Wall Penetrations: Install insulation continuously through wall penetrations.
   1. Seal penetrations with flashing sealant.
   2. For applications requiring only indoor insulation, terminate insulation inside wall surface and seal with joint sealant. For applications requiring indoor and outdoor insulation, install insulation for outdoor applications tightly joined to indoor insulation ends. Seal joint with joint sealant.
   3. Extend jacket of outdoor insulation outside wall flashing and overlap wall flashing at least 2 inches.
   4. Seal jacket to wall flashing with flashing sealant.

D. Insulation Installation at Interior Wall and Partition Penetrations (That Are Not Fire Rated): Install insulation continuously through walls and partitions.
E. Insulation Installation at Fire-Rated Wall and Partition Penetrations: Install insulation continuously through penetrations of fire-rated walls and partitions.

1. Comply with requirements in Section 07 84 13 "Penetration Firestopping" for firestopping and fire-resistive joint sealers.

F. Insulation Installation at Floor Penetrations:

1. Pipe: Install insulation continuously through floor penetrations.
2. Seal penetrations through fire-rated assemblies. Comply with requirements in Section 07 84 13 "Penetration Firestopping."

3.5 GENERAL PIPE INSULATION INSTALLATION

A. Requirements in this article generally apply to all insulation materials except where more specific requirements are specified in various pipe insulation material installation articles.

B. Insulation Installation on Fittings, Valves, Strainers, Flanges, and Unions:

1. Install insulation over fittings, valves, strainers, flanges, unions, and other specialties with continuous thermal and vapor-retarder integrity unless otherwise indicated.
2. Insulate pipe elbows using preformed fitting insulation or mitered fittings made from same material and density as adjacent pipe insulation. Each piece shall be butted tightly against adjoining piece and bonded with adhesive. Fill joints, seams, voids, and irregular surfaces with insulating cement finished to a smooth, hard, and uniform contour that is uniform with adjoining pipe insulation.
3. Insulate tee fittings with preformed fitting insulation or sectional pipe insulation of same material and thickness as used for adjacent pipe. Cut sectional pipe insulation to fit. Butt each section closely to the next and hold in place with tie wire. Bond pieces with adhesive.
4. Insulate valves using preformed fitting insulation or sectional pipe insulation of same material, density, and thickness as used for adjacent pipe. Overlap adjoining pipe insulation by not less than two times the thickness of pipe insulation, or one pipe diameter, whichever is thicker. For valves, insulate up to and including the bonnets, valve stuffing-box studs, bolts, and nuts. Fill joints, seams, and irregular surfaces with insulating cement.
5. Insulate strainers using preformed fitting insulation or sectional pipe insulation of same material, density, and thickness as used for adjacent pipe. Overlap adjoining pipe insulation by not less than two times the thickness of pipe insulation, or one pipe diameter, whichever is thicker. Fill joints, seams, and irregular surfaces with insulating cement. Insulate strainers so strainer basket flange or plug can be easily removed and replaced without damaging the insulation and jacket. Provide a removable reusable insulation cover. For below-ambient services, provide a design that maintains vapor barrier.
6. Insulate flanges and unions using a section of oversized preformed pipe insulation. Overlap adjoining pipe insulation by not less than two times the thickness of pipe insulation, or one pipe diameter, whichever is thicker.
7. Cover segmented insulated surfaces with a layer of finishing cement and coat with a mastic. Install vapor-barrier mastic for below-ambient services and a breather mastic for above-ambient services. Reinforce the mastic with fabric-reinforcing mesh. Trowel the mastic to a smooth and well-shaped contour.
8. For services not specified to receive a field-applied jacket except for flexible elastomeric and polyolefin, install fitted PVC cover over elbows, tees, strainers, valves, flanges, and unions. Terminate ends with PVC end caps. Tape PVC covers to adjoining insulation facing using PVC tape.
9. Stencil or label the outside insulation jacket of each union with the word "union." Match size and color of pipe labels.

C. Insulate instrument connections for thermometers, pressure gages, pressure temperature taps, test connections, flow meters, sensors, switches, and transmitters on insulated pipes. Shape insulation at these connections by tapering it to and around the connection with insulating cement and finish with finishing cement, mastic, and flashing sealant.

D. Install removable insulation covers at locations indicated. Installation shall conform to the following:

1. Make removable flange and union insulation from sectional pipe insulation of same thickness as that on adjoining pipe. Install same insulation jacket as adjoining pipe insulation.
2. When flange and union covers are made from sectional pipe insulation, extend insulation from flanges or union long at least two times the insulation thickness over adjacent pipe insulation on each side of flange or union. Secure flange cover in place with stainless-steel or aluminum bands. Select band material compatible with insulation and jacket.
3. Construct removable valve insulation covers in same manner as for flanges, except divide the two-part section on the vertical center line of valve body.
4. When covers are made from block insulation, make two halves, each consisting of mitered blocks wired to stainless-steel fabric. Secure this wire frame, with its attached insulation, to flanges with tie wire. Extend insulation at least 2 inches over adjacent pipe insulation on each side of valve. Fill space between flange or union cover and pipe insulation with insulating cement. Finish cover assembly with insulating cement applied in two coats. After first coat is dry, apply and trowel second coat to a smooth finish.
5. Unless a PVC jacket is indicated in field-applied jacket schedules, finish exposed surfaces with a metal jacket.

3.6 INSTALLATION OF CELLULAR-GLASS INSULATION

A. Insulation Installation on Straight Pipes and Tubes:

1. Secure each layer of insulation to pipe with wire or bands and tighten bands without deforming insulation materials.
2. Where vapor barriers are indicated, seal longitudinal seams, end joints, and protrusions with vapor-barrier mastic and joint sealant.
3. For insulation with factory-applied jackets on above-ambient services, secure laps with outward clinched staples at 6 inches o.c.
4. For insulation with factory-applied jackets on below-ambient services, do not staple longitudinal tabs. Instead, secure tabs with additional adhesive as recommended by insulation material manufacturer and seal with vapor-barrier mastic and flashing sealant.

B. Insulation Installation on Pipe Flanges:

1. Install preformed pipe insulation to outer diameter of pipe flange.
2. Make width of insulation section same as overall width of flange and bolts, plus twice the thickness of pipe insulation.
3. Fill voids between inner circumference of flange insulation and outer circumference of adjacent straight pipe segments with cut sections of cellular-glass block insulation of same thickness as pipe insulation.
4. Install jacket material with manufacturer's recommended adhesive, overlap seams at least 1 inch, and seal joints with flashing sealant.
C. Insulation Installation on Pipe Fittings and Elbows:
   1. Install preformed sections of same material as straight segments of pipe insulation when available. Secure according to manufacturer's written instructions.
   2. When preformed sections of insulation are not available, install mitered sections of cellular-glass insulation. Secure insulation materials with wire or bands.

D. Insulation Installation on Valves and Pipe Specialties:
   1. Install preformed sections of cellular-glass insulation to valve body.
   2. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation.
   3. Install insulation to flanges as specified for flange insulation application.

3.7 INSTALLATION OF FLEXIBLE ELASTOMERIC INSULATION

A. Seal longitudinal seams and end joints with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

B. Insulation Installation on Pipe Flanges:
   1. Install pipe insulation to outer diameter of pipe flange.
   2. Make width of insulation section same as overall width of flange and bolts, plus twice the thickness of pipe insulation.
   3. Fill voids between inner circumference of flange insulation and outer circumference of adjacent straight pipe segments with cut sections of sheet insulation of same thickness as pipe insulation.
   4. Secure insulation to flanges and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

C. Insulation Installation on Pipe Fittings and Elbows:
   1. Install mitered sections of pipe insulation.
   2. Secure insulation materials and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

D. Insulation Installation on Valves and Pipe Specialties:
   1. Install preformed valve covers manufactured of same material as pipe insulation when available.
   2. When preformed valve covers are not available, install cut sections of pipe and sheet insulation to valve body. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation.
   3. Install insulation to flanges as specified for flange insulation application.
   4. Secure insulation to valves and specialties and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

3.8 INSTALLATION OF MINERAL-FIBER INSULATION

A. Insulation Installation on Straight Pipes and Tubes:
   1. Secure each layer of preformed pipe insulation to pipe with wire or bands and tighten bands without deforming insulation materials.
2. Where vapor barriers are indicated, seal longitudinal seams, end joints, and protrusions with vapor-barrier mastic and joint sealant.
3. For insulation with factory-applied jackets on above-ambient surfaces, secure laps with outward clinched staples at 6 inches o.c.
4. For insulation with factory-applied jackets on below-ambient surfaces, do not staple longitudinal tabs. Instead, secure tabs with additional adhesive as recommended by insulation material manufacturer and seal with vapor-barrier mastic and flashing sealant.

B. Insulation Installation on Pipe Flanges:

1. Install preformed pipe insulation to outer diameter of pipe flange.
2. Make width of insulation section same as overall width of flange and bolts, plus twice the thickness of pipe insulation.
3. Fill voids between inner circumference of flange insulation and outer circumference of adjacent straight pipe segments with mineral-fiber blanket insulation.
4. Install jacket material with manufacturer's recommended adhesive, overlap seams at least 1 inch, and seal joints with flashing sealant.

C. Insulation Installation on Pipe Fittings and Elbows:

1. Install preformed sections of same material as straight segments of pipe insulation when available.
2. When preformed insulation elbows and fittings are not available, install mitered sections of pipe insulation, to a thickness equal to adjoining pipe insulation. Secure insulation materials with wire or bands.

D. Insulation Installation on Valves and Pipe Specialties:

1. Install preformed sections of same material as straight segments of pipe insulation when available.
2. When preformed sections are not available, install mitered sections of pipe insulation to valve body.
3. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation.
4. Install insulation to flanges as specified for flange insulation application.

3.9 INSTALLATION OF PHENOLIC INSULATION

A. General Installation Requirements:

1. Secure single-layer insulation with stainless-steel bands at 12-inch intervals and tighten bands without deforming insulation materials.
2. Install 2-layer insulation with joints tightly butted and staggered at least 3 inches. Secure inner layer with 0.062-inch wire spaced at 12-inch intervals. Secure outer layer with stainless-steel bands at 12-inch intervals.

B. Insulation Installation on Straight Pipes and Tubes:

1. Secure each layer of insulation to pipe with wire or bands and tighten bands without deforming insulation materials.
2. Where vapor barriers are indicated, seal longitudinal seams, end joints, and protrusions with vapor-barrier mastic and joint sealant.
3. For insulation with factory-applied jackets on above-ambient services, secure laps with outward clinched staples at 6 inches o.c.
4. For insulation with factory-applied jackets with vapor retarders on below-ambient services, do not staple longitudinal tabs. Instead, secure tabs with additional adhesive as recommended by insulation material manufacturer and seal with vapor-barrier mastic and flashing sealant.

C. Insulation Installation on Pipe Flanges:
   1. Install preformed pipe insulation to outer diameter of pipe flange.
   2. Make width of insulation section same as overall width of flange and bolts, plus twice the thickness of pipe insulation.
   3. Fill voids between inner circumference of flange insulation and outer circumference of adjacent straight pipe segments with cut sections of block insulation of same material and thickness as pipe insulation.

D. Insulation Installation on Pipe Fittings and Elbows:
   1. Install preformed insulation sections of same material as straight segments of pipe insulation. Secure according to manufacturer's written instructions.

E. Insulation Installation on Valves and Pipe Specialties:
   1. Install preformed insulation sections of same material as straight segments of pipe insulation. Secure according to manufacturer's written instructions.
   2. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation.
   3. Install insulation to flanges as specified for flange insulation application.

3.10 INSTALLATION OF POLYOLEFIN INSULATION

A. Insulation Installation on Straight Pipes and Tubes:
   1. Seal split-tube longitudinal seams and end joints with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

B. Insulation Installation on Pipe Flanges:
   1. Install pipe insulation to outer diameter of pipe flange.
   2. Make width of insulation section same as overall width of flange and bolts, plus twice the thickness of pipe insulation.
   3. Fill voids between inner circumference of flange insulation and outer circumference of adjacent straight pipe segments with cut sections of polyolefin sheet insulation of same thickness as pipe insulation.
   4. Secure insulation to flanges and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

C. Insulation Installation on Pipe Fittings and Elbows:
   1. Install mitered sections of polyolefin pipe insulation.
   2. Secure insulation materials and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.
D. Insulation Installation on Valves and Pipe Specialties:

1. Install cut sections of polyolefin pipe and sheet insulation to valve body.
2. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation.
3. Install insulation to flanges as specified for flange insulation application.
4. Secure insulation to valves and specialties, and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

3.11 FIELD-APPLIED JACKET INSTALLATION

A. Where glass-cloth jackets are indicated, install directly over bare insulation or insulation with factory-applied jackets.

1. Draw jacket smooth and tight to surface with 2-inch overlap at seams and joints.
2. Embed glass cloth between two 0.062-inch-thick coats of lagging adhesive.
3. Completely encapsulate insulation with coating, leaving no exposed insulation.

B. Where FSK jackets are indicated, install as follows:

1. Draw jacket material smooth and tight.
2. Install lap or joint strips with same material as jacket.
3. Secure jacket to insulation with manufacturer's recommended adhesive.
4. Install jacket with 1-1/2-inch laps at longitudinal seams and 3-inch-wide joint strips at end joints.
5. Seal openings, punctures, and breaks in vapor-retarder jackets and exposed insulation with vapor-barrier mastic.

C. Where PVC jackets are indicated, install with 1-inch overlap at longitudinal seams and end joints. Seal with manufacturer's recommended adhesive.

1. Apply two continuous beads of adhesive to seams and joints, one bead under lap and the finish bead along seam and joint edge.

D. Where metal jackets are indicated, install with 2-inch overlap at longitudinal seams and end joints. Overlap longitudinal seams arranged to shed water. Seal end joints with weatherproof sealant recommended by insulation manufacturer. Secure jacket with stainless-steel bands 12 inches o.c. and at end joints.

3.12 FINISHES

A. Insulation with ASJ, Glass-Cloth, or Other Paintable Jacket Material: Paint jacket with paint system identified below and as specified in Section 09 91 13 "Exterior Painting" and Section 09 91 23 "Interior Painting."

1. Flat Acrylic Finish: Two finish coats over a primer that is compatible with jacket material and finish coat paint. Add fungicidal agent to render fabric mildew proof.

B. Flexible Elastomeric Thermal Insulation: After adhesive has fully cured, apply two coats of insulation manufacturer's recommended protective coating.
C. Color: Final color as selected by Architect. Vary first and second coats to allow visual inspection of the completed Work.

D. Do not field paint aluminum or stainless-steel jackets.

### 3.13 FIELD QUALITY CONTROL

A. Testing Agency: Owner will engage a qualified testing agency to perform tests and inspections.

B. Perform tests and inspections.

C. Tests and Inspections:

1. Inspect pipe, fittings, strainers, and valves, randomly selected by Architect, by removing field-applied jacket and insulation in layers in reverse order of their installation. Extent of inspection shall be limited to three locations of straight pipe, three locations of threaded fittings, three locations of welded fittings, two locations of threaded strainers, two locations of welded strainers, three locations of threaded valves, and three locations of flanged valves for each pipe service defined in the "Piping Insulation Schedule, General" Article.

D. All insulation applications will be considered defective Work if sample inspection reveals noncompliance with requirements.

### 3.14 PIPING INSULATION SCHEDULE, GENERAL

A. Acceptable preformed pipe and tubular insulation materials and thicknesses are identified for each piping system and pipe size range. If more than one material is listed for a piping system, selection from materials listed is Contractor's option.

B. Items Not Insulated: Unless otherwise indicated, do not install insulation on the following:

1. Drainage piping located in crawl spaces.
2. Underground piping.
3. Chrome-plated pipes and fittings unless there is a potential for personnel injury.

### 3.15 INDOOR PIPING INSULATION SCHEDULE

A. Domestic Cold Water:

1. NPS 1 and Smaller: Insulation shall be one of the following:
   a. Flexible Elastomeric: 1/2 inch thick.
   b. Mineral-Fiber, Preformed Pipe Insulation, Type I: 1/2 inch thick.
   c. Phenolic: 1 inch thick.
   d. Polyolefin: 1/2 inch thick.

2. NPS 1-1/4 and Larger: Insulation shall be one of the following:
   b. Flexible Elastomeric: 1 inch thick.
   c. Mineral-Fiber, Preformed Pipe Insulation, Type I: 1 inch thick.
   d. Phenolic: 1 inch thick.
   e. Polyolefin: 1 inch thick.
B. Domestic Hot and Recirculated Hot Water up to Delivery Temperature of 140 degrees:

1. NPS 1-1/4 and Smaller: Insulation shall be one of the following:
   a. Flexible Elastomeric: 1 inch thick.
   b. Cellular Glass: 1 inch thick.
   c. Mineral-Fiber, Preformed Pipe Insulation, Type I: 1 inch thick.
   d. Polyolefin: 1 inch thick.

2. NPS 1-1/2 and Larger: Insulation shall be one of the following:
   c. Mineral-Fiber, Preformed Pipe Insulation, Type I: 1-1/2 inches thick.
   d. Polyolefin: 1-1/2 inches thick.

C. Domestic Hot and Recirculated Hot Water Delivery Temperature over 140 degrees to max of 200 degrees:

1. NPS 1-1/4 and Smaller: Insulation shall be one of the following:
   c. Mineral-Fiber, Preformed Pipe Insulation, Type I: 1-1/2 inches thick.
   d. Polyolefin: 1-1/2 inches thick.

2. NPS 1-1/2 and Larger: Insulation shall be one of the following:
   a. Flexible Elastomeric: 2 inches thick.
   b. Cellular Glass: 2 inches thick.
   c. Mineral-Fiber, Preformed Pipe Insulation, Type I: 2 inches thick.
   d. Polyolefin: 2 inches thick.

D. Domestic Chilled Water (Potable):

1. All Pipe Sizes: Insulation shall be one of the following:
   b. Flexible Elastomeric: 1 inch thick.
   c. Mineral-Fiber, Preformed Pipe Insulation, Type I: 1 inch thick.
   d. Phenolic: 1 inch thick.
   e. Polyolefin: 1 inch thick.

E. Stormwater and Overflow:

1. All Pipe Sizes: Insulation shall be one of the following:
   b. Flexible Elastomeric: 1 inch thick.
   c. Mineral-Fiber, Preformed Pipe Insulation, Type I: 1 inch thick.
   d. Phenolic: 1 inch thick.
   e. Polyolefin: 1 inch thick.
F. Roof Drain and Overflow Drain Bodies:
   1. All Pipe Sizes: Insulation shall be one of the following:
      b. Flexible Elastomeric: 1 inch thick.
      c. Mineral-Fiber, Preformed Pipe Insulation, Type I: 1 inch thick.
      d. Phenolic: 1 inch thick.
      e. Polyolefin: 1 inch thick.

G. Exposed Sanitary Drains, Domestic Water, Domestic Hot Water, and Stops for Plumbing Fixtures for People with Disabilities:
   1. All Pipe Sizes: Insulation shall be one of the following:
      a. Flexible Elastomeric: 3/4 inch thick.
      b. Mineral-Fiber, Preformed Pipe Insulation, Type I: 1 inch thick.
      c. Polyolefin: 1 inch thick.

H. Sanitary Waste Piping Where Heat Tracing Is Installed:
   1. All Pipe Sizes: Insulation shall be one of the following:
      a. Cellular Glass: 2 inches thick.
      b. Mineral-Fiber, Preformed Pipe Insulation, Type I: 1-1/2 inches thick.
      c. Phenolic: 1-1/2 inches thick.

I. Floor Drains, Traps, and Sanitary Drain Piping within 10 Feet of Drain Receiving Condensate and Equipment Drain Water below 60 Deg F:
   1. All Pipe Sizes: Insulation shall be one of the following:
      b. Flexible Elastomeric: 1 inch thick.
      c. Mineral-Fiber, Preformed Pipe Insulation, Type I: 1 inch thick.
      d. Phenolic: 1 inch thick.
      e. Polyolefin: 1 inch thick.

J. Hot Service Drains:
   1. All Pipe Sizes: Insulation shall be one of the following:
      b. Mineral-Fiber, Preformed Pipe, Type I or II: 1 inch thick.

K. Hot Service Vents:
   1. All Pipe Sizes: Insulation shall be one of the following:
      b. Mineral-Fiber, Preformed Pipe, Type I or II: 1 inch thick.
3.16 OUTDOOR, ABOVEGROUND PIPING INSULATION SCHEDULE

A. Domestic Water Piping:

1. All Pipe Sizes: Insulation shall be one of the following:
   a. Cellular Glass: 2 inches thick.
   b. Flexible Elastomeric: 2 inches thick.
   c. Mineral-Fiber, Preformed Pipe Insulation, Type I: 2 inches thick.
   d. Phenolic: 2 inches thick.
   e. Polyolefin: 2 inches thick.

B. Domestic Hot and Recirculated Hot Water:

1. All Pipe Sizes: Insulation shall be one of the following:
   a. Cellular Glass: 2 inches thick.
   b. Flexible Elastomeric: 2 inches thick.
   c. Mineral-Fiber, Preformed Pipe Insulation, Type I: 2 inches thick.
   d. Phenolic: 2 inches thick.
   e. Polyolefin: 2 inches thick.

C. Sanitary Waste Piping Where Heat Tracing Is Installed:

1. All Pipe Sizes: Insulation shall be one of the following:
   a. Cellular Glass: 2 inches thick.
   b. Mineral-Fiber, Preformed Pipe Insulation, Type I: 2 inches thick.
   c. Phenolic: 2 inches thick.

D. Hot Service Drains:

1. All Pipe Sizes: Insulation shall be one of the following:
   b. Mineral-Fiber, Preformed Pipe Insulation, Type I: 1 inch thick.

E. Hot Service Vents:

1. All Pipe Sizes: Insulation shall be one of the following:
   b. Mineral-Fiber, Preformed Pipe Insulation, Type II: 1 inch thick.

3.17 OUTDOOR, UNDERGROUND PIPING INSULATION SCHEDULE


B. Chilled Water, All Sizes: Cellular glass, 2 inches thick.

3.18 INDOOR, FIELD-APPLIED JACKET SCHEDULE

A. Install jacket over insulation material. For insulation with factory-applied jacket, install the field-applied jacket over the factory-applied jacket.
B. If more than one material is listed, selection from materials listed is Contractor's option.

C. Piping, Concealed:
   1. None.
   2. PVC, Color-Coded by System: 30 mils thick.
   3. Aluminum, Smooth: 0.016 inch thick.
   4. Painted Aluminum, Smooth: 0.016 inch thick.
   5. Stainless Steel, Type 316, Smooth 2B Finish: 0.020 inch thick.

D. Piping, Exposed:
   1. None.
   2. PVC, Color-Coded by System: 30 mils thick.
   3. Aluminum: 0.016 inch thick.
   4. Painted Aluminum, Smooth: 0.016 inch thick.
   5. Stainless Steel, Type 316: 0.020 inch thick.

3.19 OUTDOOR, FIELD-APPLIED JACKET SCHEDULE

A. Install jacket over insulation material. For insulation with factory-applied jacket, install the field-applied jacket over the factory-applied jacket.

B. If more than one material is listed, selection from materials listed is Contractor's option.

C. Piping, Concealed:
   1. None.
   2. PVC, Color-Coded by System: 20 mils thick.
   3. Aluminum, Smooth: 0.016 inch thick.
   4. Painted Aluminum, Smooth: 0.016 inch thick.
   5. Stainless Steel, Type 316: 0.020 inch thick.

D. Piping, Exposed:
   1. PVC: 20 mils thick.
   2. Painted Aluminum, Smooth: 0.016 inch thick.
   3. Stainless Steel, Type 316: 0.020 inch thick.

3.20 UNDERGROUND, FIELD-INSTALLED INSULATION JACKET

A. For underground direct-buried piping applications, install underground direct-buried jacket over insulation material.

END OF SECTION 22 07 19
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 specifies the water distribution piping system, including potable cold, hot, and recirculated hot water piping, fittings, and specialties within the building to a point 5 feet outside the building.

1.3 DEFINITIONS

A. EPDM: Ethylene propylene diene terpolymer rubber.
B. LLDPE: Linear, low-density polyethylene plastic.
C. PA: Polyamide (nylon) plastic.
D. PE: Polyethylene plastic.
E. PP: Polypropylene plastic.
F. PVC: Polyvinyl chloride plastic.
G. RTRF: Reinforced thermosetting resin (fiberglass) fittings.
H. RTRP: Reinforced thermosetting resin (fiberglass) pipe.

1.4 ACTION SUBMITTALS

A. Shop Drawing Data: For each type of product indicated.

1.5 RELATION TO OTHER WORK

A. Refer to the section, "General Plumbing Provisions", for related requirements. Refer to other sections of Division 22 and to all other applicable portions of the Drawings and Specifications.

1.6 QUALITY ASSURANCE

A. Regulatory Requirements:

1. Comply with requirements of utility company supplying water. Include tapping of water mains and backflow prevention.
2. Comply with standards of authorities having jurisdiction for potable-water-service piping, including materials, installation, testing, and disinfection.

B. Piping materials shall bear label, stamp, or other markings of specified testing agency.
C. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

D. Comply with ASTM F 645 for selection, design, and installation of thermoplastic water piping.

E. Codes and Standards:

1. ASTM A 120-84 Specifications for pipe.
2. ASTM B 88-83A Specifications for seamless copper water tube.
3. ANSI B16.4 Fittings, Flanges, and Valves.
4. ANSI B16.22 Fittings, Flanges, and Valves.
5. ASSE 1003 and 1003-1 - Performance Requirements for Water Pressure Reducing Valves.
7. AWWA C600 - Standard for Installation of Gray and Ductile Cast-Iron Water Mains and Appurtenances.
10. PDI WH-201 - Water Hammer Arresters.

F. ASME Compliance: Fabricate and stamp pressure - Standards of these Organizations, the more stringent regulations shall govern

1.7 DELIVERY, STORAGE, AND HANDLING

A. Preparation for Transport: Prepare valves, according to the following:

1. Ensure that valves are dry and internally protected against rust and corrosion.
2. Protect valves against damage to threaded ends and flange faces.
3. Set valves in best position for handling. Set valves closed to prevent rattling.

B. During Storage: Use precautions for valves, and piping according to the following:

1. Do not remove end protectors unless necessary for inspection; then reinstall for storage.
2. Protect from weather. Store indoors and maintain temperature higher than ambient dew-point temperature. Support off the ground or pavement in watertight enclosures when outdoor storage is necessary.
3. Store pipe in a manner to prevent sagging and bending.

C. Deliver piping with factory-applied end caps. Maintain end caps through shipping, storage, and handling to prevent pipe-end damage and to prevent entrance of dirt, debris, and moisture.

D. Protect stored piping from moisture and dirt. Elevate above grade. Do not exceed structural capacity of floor when storing inside.

E. Protect flanges, fittings, and specialties from moisture and dirt.

F. Store plastic piping protected from direct sunlight. Support to prevent sagging and bending.
1.8 SPARE PARTS
   A. Furnish to Owner, with receipt, one valve key for each key operated hydrant, bibb, or faucet installed.

1.9 COORDINATION
   A. Coordinate connection to water main with utility company.

PART 2 - PRODUCTS

2.1 PIPING MATERIALS
   A. Comply with requirements in "Piping Schedule" Article for applications of pipe, tube, fitting materials, and joining methods for specific services, service locations, and pipe sizes.

   B. Potable-water piping and components shall comply with NSF 14, NSF 61, and NSF 372.

2.2 COPPER TUBE AND FITTINGS
   A. Soft Copper Tube: ASTM B 88, Type K, water tube, annealed temper.

   B. Hard Copper Tube: ASTM B 88, Type K, water tube, drawn temper.

   C. Bronze Flanges: ASME B16.24, Class 150, with solder-joint end. Furnish Class 300 flanges if required to match piping.

   D. Copper Unions:
      1. MSS SP-123.
      4. Solder-joint or threaded ends.

   E. Copper, Brass or Bronze, Pressure-Seal-Joint Fittings:
      1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
         a. Apollo Flow Controls; Conbraco Industries, Inc.
         b. Elkhart Products Corporation.
         c. Mueller Industries, Inc.
         d. NIBCO INC.
         e. Viega LLC.
2. Fittings: Cast-brass, cast-bronze, or wrought-copper with EPDM O-ring seal in each end. Sizes NPS 2-1/2 and larger with stainless steel grip ring and EPDM O-ring seal.
3. Minimum 200-psig working-pressure rating at 250 deg F.

2.3 DUCTILE-IRON PIPE AND FITTINGS

A. Mechanical-Joint, Ductile-Iron Pipe: AWWA C151, with mechanical-joint bell and plain spigot end unless grooved or flanged ends are indicated.
   1. Mechanical-Joint, Ductile-Iron Fittings: AWWA C110, ductile- or gray-iron standard pattern or AWWA C153, ductile-iron compact pattern.
   2. Glands, Gaskets, and Bolts: AWWA C111, ductile- or gray-iron glands, rubber gaskets, and steel bolts.

B. Push-on-Joint, Ductile-Iron Pipe: AWWA C151, with push-on-joint bell and plain spigot end unless grooved or flanged ends are indicated.
   1. Push-on-Joint, Ductile-Iron Fittings: AWWA C110, ductile- or gray-iron standard pattern or AWWA C153, ductile-iron compact pattern.
   2. Gaskets: AWWA C111, rubber.

C. Grooved-Joint, Ductile-Iron Pipe: AWWA C151, with cut, rounded-grooved ends.
   1. Grooved-End, Ductile-Iron Pipe Appurtenances:
      a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
         1) Anvil International.
         2) Smith-Cooper International.
         3) Victaulic Company.
      c. Grooved-End, Ductile-Iron-Piping Couplings: AWWA C606, for ductile-iron-pipe dimensions. Include ferrous housing sections, gasket suitable for water, and bolts and nuts.

D. Flanges: ASME 16.1, Class 125, cast iron.

2.4 PVC PIPE AND FITTINGS

A. PVC, Schedule 40 Pipe: ASTM D 1785.
   1. PVC, Schedule 40 Socket Fittings: ASTM D 2466.

B. PVC, Schedule 80 Pipe: ASTM D 1785.
   1. PVC, Schedule 80 Socket Fittings: ASTM D 2467.
   2. PVC, Schedule 80 Threaded Fittings: ASTM D 2464.

C. PVC, AWWA Pipe: AWWA C900, with bell end with gasket, and with spigot end.
   1. Comply with UL 1285 for fire-service mains if indicated.
2. PVC Fabricated Fittings: AWWA C900, with bell-and-spigot or double-bell ends. Include elastomeric gasket in each bell.
3. PVC Molded Fittings: AWWA C907, Class 150, with bell-and-spigot or double-bell ends. Include elastomeric gasket in each bell.
4. Push-on-Joint, Ductile-Iron Fittings: AWWA C110, ductile- or gray-iron standard pattern or AWWA C153, ductile-iron compact pattern.
5. Mechanical-Joint, Ductile-Iron Fittings: AWWA C110, ductile- or gray-iron standard pattern or AWWA C153, ductile-iron compact pattern.
   a. Glands, Gaskets, and Bolts: AWWA C111, ductile- or gray-iron glands, rubber gaskets, and steel bolts.

2.5 JOINING MATERIALS

A. Copper Tubing: Solder joints in accordance with the procedures specified in ANSI B9.1
B. Brazing Filler Metals: AWS A5.8, BCuP Series.
C. Plastic Pipe-Flange Gasket, Bolts, and Nuts: Type and material recommended by piping system manufacturer, unless otherwise indicated.

2.6 PIPING SPECIALTIES

A. Transition Fittings: Manufactured fitting or coupling same size as, with pressure rating at least equal to and ends compatible with, piping to be joined.
B. Install backflow preventers at each connection to mechanical equipment and systems, and in compliance with the plumbing code and authority having jurisdiction. Locate in same room as equipment being connected. Pipe relief outlet without valves, to nearest floor drain.
C. Install pressure regulating valves with inlet and outlet shutoff valves, and balance cock bypass for domestic booster pump. Install pressure gage on valve outlet.

2.7 CORROSION-PROTECTION PIPING ENCASEMENT

A. Encasement for Underground Metal Piping:
   1. Standards: ASTM A 674 or AWWA C105.
   2. Material: LLDPE film of 0.008-inch minimum thickness.
   3. Material: LLDPE film of 0.008-inch minimum thickness, or high-density, crosslaminated PE film of 0.004-inch minimum thickness.
   4. Material: High-density, crosslaminated PE film of 0.004-inch minimum thickness.

2.8 GATE VALVES

A. AWWA, Cast-Iron Gate Valves:
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. American AVK Co.
c. Clow Valve Company; a subsidiary of McWane, Inc.
d. Crane; Crane Energy Flow Solutions.
e. Flomatic Corporation.
f. Kennedy Valve Company; a division of McWane, Inc.
g. M & H Valve Company; a division of McWane, Inc.
h. Mueller Co.
i. NIBCO INC.
j. Tyler Pipe; a subsidiary of McWane Inc.
k. U.S. Pipe and Foundry Company.
l. Zurn Industries, LLC.

2.9 CHECK VALVES

A. AWWA Check Valves:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

   a. American AVK Co.
   c. APCO Willamette Valve and Primer Corporation.
   d. Crane; Crane Energy Flow Solutions.
   e. Flomatic Corporation.
   f. Kennedy Valve Company; a division of McWane, Inc.
   g. M & H Valve Company; a division of McWane, Inc.
   h. Mueller Co.
   i. NIBCO INC.
   j. Stockham; Crane Energy Flow Solutions.
   k. WATTS.

2.10 BUTTERFLY VALVES

A. AWWA Butterfly Valves:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

   a. DeZURIK/Copes-Vulcan.
   b. Flomatic Corporation.
   c. Milliken Valve Company.
   d. Milwaukee Valve Company.
   e. Mosser Valve.
   f. Mueller Co.
   g. Pratt, Henry Company.
   h. Val-Matic Valve & Manufacturing Corp.

2.11 PLUG VALVES

A. Plug Valves:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
a. DeZURIK/Copes-Vulcan.
b. Homestead Valve.
c. M & H Valve Company; a division of McWane, Inc.
d. Milliken Valve Company.
e. Pratt, Henry Company.
f. Val-Matic Valve & Manufacturing Corp.

2. Description: Resilient-seated eccentric.

b. Body: Cast iron.
c. Pressure Rating: 175-psig minimum CWP.
d. Seat Material: Suitable for potable-water service.

B. Water meters will be furnished by utility company.

2.12 RELIEF VALVES

A. Air-Release Valves:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

   b. Flomatic Corporation.
   c. GA Industries, Inc.
   d. Val-Matic Valve & Manufacturing Corp.

B. Air/Vacuum Valves:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

   b. Flomatic Corporation.
   c. GA Industries, Inc.
   d. Val-Matic Valve & Manufacturing Corp.

2.13 VACUUM BREAKERS

A. Pressure Vacuum Breaker Assembly:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

   a. Ames Fire & Waterworks; A WATTS Brand.
   b. Apollo Flow Controls; Conbraco Industries, Inc.
   c. FEBCO; A WATTS Brand.
   d. Flowmatic Corporation.
   e. Toro Company (The).
   f. WATTS.
   g. Wilkins.
   h. Zurn Industries, LLC.
3. Accessories: Ball valves on inlet and outlet.

2.14 CONCRETE VAULTS

A. Description: Precast, reinforced-concrete vault, designed for A-16 load designation according to ASTM C 857 and made according to ASTM C 858.

1. Ladder: ASTM A 36/A 36M, steel or polyethylene-encased steel steps.
2. Manhole: ASTM A 48/A 48M Class No. 35A minimum tensile strength, gray-iron traffic frame and cover.
   a. Dimension: 24-inch minimum diameter, unless otherwise indicated.
3. Manhole: ASTM A 536, Grade 60-40-18, ductile-iron traffic frame and cover.
   a. Dimension: 24-inch minimum diameter, unless otherwise indicated.
4. Drain: ASME A112.6.3, cast-iron floor drain with outlet of size indicated. Include body anchor flange, light-duty cast-iron grate, bottom outlet, and integral or field-installed bronze ball or clapper-type backwater valve.

2.15 PROTECTIVE ENCLOSURES

A. Freeze-Protection Enclosures:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. AquaSHIELD.
   b. BF Products Inc.
   c. Dunco Manufacturing, Inc.
   d. Hot Box: Hubbell Power Systems, Inc.
   e. HydroCowl, Inc.
   f. WATTS.
2. Description: Insulated enclosure designed to protect aboveground water piping, equipment, or specialties from freezing and damage, with heat source to maintain minimum internal temperature of 40 deg F when external temperatures reach as low as minus 34 deg F.
   b. Class I: For equipment or devices other than pressure or atmospheric vacuum breakers.
   c. Class I-V: For pressure or atmospheric vacuum breaker equipment or devices. Include drain opening in housing.
      1) Housing: Reinforced-aluminum construction.
         a) Size: Of dimensions indicated, but not less than those required for access and service of protected unit.
         b) Drain opening for units with drain connection.
         c) Access doors with locking devices.
         d) Insulation inside housing.
e) Anchoring devices for attaching housing to concrete base.

2) Electric heating cable or heater with self-limiting temperature control.

B. Weather-Resistant Enclosures:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. AquaSHIELD.
   b. BF Products Inc.
   c. Dunco Manufacturing, Inc.
   d. Hot Box: Hubbell Power Systems, Inc.
   e. HydroCowl, Inc.
   f. WATTS.

2. Description: Uninsulated enclosure designed to protect aboveground water piping, equipment, or specialties from weather and damage.
   b. Class III: For equipment or devices other than pressure or atmospheric vacuum breakers.
   c. Class III-V: For pressure or atmospheric vacuum breaker equipment or devices. Include drain opening in housing.

1) Housing: Reinforced-aluminum construction.
   a) Size: Of dimensions indicated, but not less than those required for access and service of protected unit.
   b) Drain opening for units with drain connection.
   c) Access doors with locking devices.
   d) Anchoring devices for attaching housing to concrete base.

C. Expanded-Metal Enclosures:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. Backflow Prevention Device InnClosures, Inc.
   b. BF Products Inc.
   c. Cross Brothers Inc.
   d. Le Meur Welding & Manufacturing Co.

2. Description: Enclosure designed to protect aboveground water piping, equipment, or specialties from damage.
   a. Material: ASTM F 1267, expanded metal side and top panels, of weight and with reinforcement of same metal at edges as required for rigidity.
   b. Finish: Manufacturer's enamel paint.
   c. Size: Of dimensions indicated, but not less than those required for access and service of protected unit.
   d. Locking device.
   e. Lugs or devices for securing enclosure to base.
PART 3 - EXECUTION

3.1 PIPING SCHEDULE

A. General: Use pipe, fittings, and joining methods for piping systems according to the following applications.

B. Transition couplings and special fittings with pressure ratings at least equal to piping pressure rating may be used, unless otherwise indicated.

C. Do not use flanges or unions for underground piping.

D. Flanges, unions, grooved-end-pipe couplings, and special fittings may be used, instead of joints indicated, on aboveground piping and piping in vaults.

E. Underground water-service piping NPS 3/4 to NPS 3 shall be any of the following:
   1. Soft copper tube, ASTM B 88, Type K.
   2. PVC, Schedule 80 pipe; PVC, Schedule 80 socket fittings; and solvent-cemented joints.

F. Underground water-service piping NPS 4 to NPS 8 shall be any of the following:
   1. Soft copper tube, ASTM B 88, Type K; wrought-copper, solder-joint fittings; and brazed joints.
   2. Ductile-iron, piping and joints.
   3. PVC, Schedule 80 pipe; PVC, Schedule 80 socket fittings; and solvent-cemented joints.

G. Aboveground Water-Service Piping NPS 3/4 to NPS 3 shall be any of the following:
   1. Hard copper tube, ASTM B 88, Type K.
   2. PVC, Schedule 80 pipe.

H. Aboveground water-service piping NPS 4 to NPS 8 shall be any of the following:
   1. Hard copper tube, ASTM B 88, Type K; wrought-copper, solder-joint fittings; and brazed joints.
   2. Ductile-iron, grooved-end pipe; ductile-iron, grooved-end appurtenances; and grooved joints.
   3. PVC, Schedule 80 pipe.

3.2 VALVE APPLICATIONS

A. General Application: Use mechanical-joint-end valves for NPS 3 and larger underground installation. Use threaded- or flanged-end valves for installation in vaults. Use UL/FMG, nonrising-stem gate valves for installation with indicator posts. Use corporation valves and curb valves with ends compatible with piping, for NPS 2 and smaller installation.

B. Drawings indicate valve types to be used. Where specific valve types are not indicated, the following requirements apply:
   1. Underground Valves, NPS 3 and Larger: AWWA, cast-iron, nonrising-stem, gate valves with valve box.
   2. Underground Valves, NPS 4 and Larger, for Indicator Posts: UL/FMG, cast-iron, nonrising-stem gate valves with indicator post.
4. Detector Check Valves: Use for water-service piping in vaults and aboveground to detect unauthorized use of water.

3.3 PIPING INSTALLATION

A. Install ductile-iron, water-service piping according to AWWA C600 and AWWA M41.

B. Install PVC, AWWA pipe according to ASTM F 645 and AWWA M23.

C. Bury piping with depth of cover over top at least 30 inches with top at least 12 inches level of maximum frost penetration, and according to the following:
   1. Under Driveways: With at least 36 inches cover over top.
   2. Under Railroad Tracks: With at least 48 inches cover over top.
   3. In Loose Gravelly Soil and Rock: With at least 12 inches additional cover.

D. Install piping by tunneling or jacking, or combination of both, under streets and other obstructions that cannot be disturbed.

E. Install underground piping with restrained joints at horizontal and vertical changes in direction. Use restrained-joint piping, thrust blocks, anchors, tie-rods and clamps, and other supports.

F. See Section 22 11 16 "Domestic Water Piping" for potable-water piping inside the building.

3.4 JOINT CONSTRUCTION

A. Make pipe joints according to the following:
   1. Copper-Tubing, Pressure-Sealed Joints: Join copper tube and pressure-seal fittings with tools and procedures recommended by pressure-seal-fitting manufacturer. Leave insertion marks on pipe after assembly.
   5. PVC Piping Gasketed Joints: Use joining materials according to AWWA C900. Construct joints with elastomeric seals and lubricant according to ASTM D 2774 or ASTM D 3139 and pipe manufacturer's written instructions.
   6. Install dielectric fittings in piping at connections of dissimilar metal piping and tubing.

3.5 ANCHORAGE INSTALLATION

A. Anchorage, General: Install water-distribution piping with restrained joints. Anchorages and restrained-joint types that may be used include the following:
   1. Concrete thrust blocks.
   2. Locking mechanical joints.
   4. Bolted flanged joints.
   5. Heat-fused joints.
6. Pipe clamps and tie rods.

B. Install anchorages for tees, plugs and caps, bends, crosses, valves, and hydrant branches. Include anchorages for the following piping systems:

2. Gasketed-Joint, PVC Water-Service Piping: According to AWWA M23.

C. Apply full coat of asphalt or other acceptable corrosion-resistant material to surfaces of installed ferrous anchorage devices.

3.6 VALVE INSTALLATION

A. AWWA Gate Valves: Comply with AWWA C600 and AWWA M44. Install each underground valve with stem pointing up and with valve box.

B. AWWA Valves Other Than Gate Valves: Comply with AWWA C600 and AWWA M44.

C. UL/FMG, Gate Valves: Comply with NFPA 24. Install each underground valve and valves in vaults with stem pointing up and with vertical cast-iron indicator post.

D. UL/FMG, Valves Other Than Gate Valves: Comply with NFPA 24.

E. MSS Valves: Install as component of connected piping system.

F. Corporation Valves and Curb Valves: Install each underground curb valve with head pointed up and with service box.

G. Pressure-Reducing Valves: Install in vault or aboveground between shutoff valves.

H. Relief Valves: Comply with AWWA C512. Install aboveground with shutoff valve on inlet.

3.7 VACUUM BREAKER ASSEMBLY INSTALLATION

A. Install pressure vacuum breaker assemblies of type, size, and capacity indicated. Include valves and test cocks. Install according to requirements of plumbing and health department and authorities having jurisdiction.

B. Do not install pressure vacuum breaker assemblies in vault or other space subject to flooding.

3.8 EQUIPMENT CONNECTIONS

A. Piping Runouts to Fixtures: Provide hot and cold water piping runouts to fixtures of sizes indicated, but in no case smaller than required by Plumbing Code.

B. Mechanical Equipment Connections: Connect hot and cold water piping system to mechanical equipment as indicated. Provide connection. For connections 2-1/2" and larger, use flanges instead of unions.

3.9 FIELD QUALITY CONTROL

A. Inspections:
1. Do not enclose, cover, or put into operation water distribution piping system until it has been inspected and approved by the authority having jurisdiction.

2. During the progress of the installation, notify the plumbing official having jurisdiction, at least 24 hours prior to the time such inspection must be made. Perform test specified below in the presence of the plumbing official.
   
a. Rough-in Inspection: Arrange for inspection of the piping system before concealed or closed-in after system is roughed-in, and prior to setting fixtures.
   
b. Final Inspection: Arrange for a final inspection by the plumbing official to observe the tests specified below and to insure compliance with the requirements of the plumbing official.
   
c. Reinspection’s: Whenever the plumbing official finds that the piping system will not pass the test or inspection, make the required corrections and arrange System Test:

3. Test for leaks and defects all new water distribution piping systems and parts of existing systems, which have been altered, extended or repaired. If testing is performed in segments, submit a separate report for each test, complete with a diagram of the portion of the system tested.

4. Leave uncovered and unconcealed all new, altered, extended, or replaced water distribution piping until it has been tested and approved. Expose all such work for testing that has been covered or concealed before it has been tested and approved.

5. Cap and subject the piping system to a static water pressure of 50 psig above the operating pressure without exceeding the pressure rating of the piping system materials. Isolate the test source and allow to stand for a period of 4 hours. Leaks and loss in test pressure constitute defects which must be repaired.

6. Repair all leaks and defects using new materials and retest system or portion thereof until satisfactory results are obtained.

3.10 ADJUSTING AND CLEANING

A. Cleaning and Disinfecting:

1. Purge all new water distribution piping systems and parts of existing systems, which have been altered, extended, or repaired prior to use.

2. Use the purging and disinfecting procedure prescribed by the authority having jurisdiction, or in case a method is not prescribed by that authority, the procedure described in either AWWA C601, or AWWA D105, or as described below:

   a. Flush the piping system with clean, potable water until dirty water does not appear at the points of outlet.
   
   b. Fill the system or part thereof, with a water/chlorine solution containing at least 50 parts per million of chlorine. Isolate (valve off) the system, or part thereof, and allow to stand for 24 hours.
   
   c. Drain the system, or part thereof, of the previous solution, and refill with a water/chlorine solution containing at least 200 parts per million of chlorine and isolate and allow to stand for 3 hours.
   
   d. Following the allowed standing time, flush the system with clean potable water until chlorine does not remain in the water coming for the system.
   
   e. Submit water samples in sterile bottles to the authority having jurisdiction. Repeat the procedure if the biological examination made by the authority shows evidence of contamination.

END OF SECTION 22 11 13
SECTION 22 11 16
DOMESTIC WATER PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

1. Copper tube and fittings.
2. Ductile-iron pipe and fittings.
3. Galvanized steel pipe and fittings.
4. Stainless-steel piping
5. CPVC piping.
6. PVC pipe and fittings.
7. Piping joining materials.
8. Encasement for piping.
10. Dielectric fittings.

B. Related Requirements:

1. Section 22 11 13 "Facility Water Distribution Piping" for water-service piping outside the building from source to the point where water-service piping enters the building.
2. Alternates may or may not substantially change scope and general character of the work; and must not be confused with "change orders", "substitutions", and other similar provisions.
3. Refer to the section, "General Plumbing Provisions", for related requirements. Refer to other sections of Division 22 and to all other applicable portions of the Drawings and Specifications.

1.3 ACTION SUBMITTALS

A. Submit manufacturer's data for review before any work is commenced.

PART 2 - PRODUCTS

2.1 PIPING MATERIALS

A. Comply with requirements in "Piping Schedule" Article for applications of pipe, tube, fitting materials, and joining methods for specific services, service locations, and pipe sizes.

B. Potable-water piping and components shall comply with NSF 14, NSF 61, and NSF 372.

2.2 COPPER TUBE AND FITTINGS

A. Hard Copper Tube: ASTM B 88, Type L water tube, drawn temper.

B. Soft Copper Tube: ASTM B 88, Type K water tube, annealed temper.
C. Cast-Copper, Solder-Joint Fittings: ASME B16.18, pressure fittings.


E. Bronze Flanges: ASME B16.24, Class 150, with solder-joint ends.

F. Copper Unions:
   1. MSS SP-123.
   4. Solder-joint or threaded ends.

G. Copper, Brass, or Bronze Pressure-Seal-Joint Fittings:
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. Apollo Flow Controls; Conbraco Industries, Inc.
      b. Elkhart Products Corporation.
      c. Mueller Industries, Inc.
      d. NIBCO INC.
      e. Viega LLC.
   2. Fittings: Cast-brass, cast-bronze or wrought-copper with EPDM O-ring seal in each end. Sizes NPS 2-1/2 and larger with stainless steel grip ring and EPDM O-ring seal.
   3. Minimum 200-psig working-pressure rating at 250 deg F.

H. Copper Push-on-Joint Fittings:
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. Apollo Flow Controls; Conbraco Industries, Inc.
      b. Elkhart Products Corporation.
      c. NIBCO INC.
      d. Victaulic Company.
   2. Description:
      a. Cast-copper fitting complying with ASME B16.18 or wrought-copper fitting complying with ASME B 16.22.
      b. Stainless-steel teeth and EPDM-rubber, O-ring seal in each end instead of solder-joint ends.

I. Copper-Tube, Extruded-Tee Connections:
   1. Manufacturers: Subject to compliance with requirements, provide products by the following:
      a. T-DRILL Industries Inc.
   2. Description: Tee formed in copper tube according to ASTM F 2014.
J. Appurtenances for Grooved-End Copper Tubing:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. Anvil International.
   b. Grinnell Mechanical Products.
   c. Shurjoint Piping Products USA Inc.
   d. Victaulic Company.

2. Bronze Fittings for Grooved-End, Copper Tubing: ASTM B 75/B 75M copper tube or ASTM B 584 bronze castings.
3. Mechanical Couplings for Grooved-End Copper Tubing:
   a. Copper-tube dimensions and design similar to AWWA C606.
   b. Ferrous housing sections.
   c. EPDM-rubber gaskets suitable for hot and cold water.
   d. Bolts and nuts.
   e. Minimum Pressure Rating: 300 psig.

2.3 DUCTILE-IRON PIPE AND FITTINGS

A. Mechanical-Joint, Ductile-Iron Pipe:

1. AWWA C151/A21.51, with mechanical-joint bell and plain spigot end unless grooved or flanged ends are indicated.
2. Glands, Gaskets, and Bolts: AWWA C111/A21.11, ductile- or gray-iron glands, rubber gaskets, and steel bolts.

B. Standard-Pattern, Mechanical-Joint Fittings:

1. AWWA C110/A21.10, ductile or gray iron.
2. Glands, Gaskets, and Bolts: AWWA C111/A21.11, ductile- or gray-iron glands, rubber gaskets, and steel bolts.

C. Compact-Pattern, Mechanical-Joint Fittings:

1. AWWA C153/A21.53, ductile iron.
2. Glands, Gaskets, and Bolts: AWWA C111/A21.11, ductile- or gray-iron glands, rubber gaskets, and steel bolts.

D. Push-on-Joint, Ductile-Iron Pipe:

1. AWWA C151/A21.51.
2. Push-on-joint bell and plain spigot end unless grooved or flanged ends are indicated.

E. Standard-Pattern, Push-on-Joint Fittings:

1. AWWA C110/A21.10, ductile or gray iron.

F. Compact-Pattern, Push-on-Joint Fittings:

1. AWWA C153/A21.53, ductile iron.


H. Appurtenances for Grooved-End, Ductile-Iron Pipe:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. Shurjoint Piping Products USA Inc.
   b. Smith-Cooper International.
   c. Star Pipe Products.
   d. Victaulic Company.

2. Fittings for Grooved-End, Ductile-Iron Pipe: ASTM A 47/A 47M, malleable-iron castings or ASTM A 536, ductile-iron castings with dimensions that match pipe.

3. Mechanical Couplings for Grooved-End, Ductile-Iron-Piping:
   a. AWWA C606 for ductile-iron-pipe dimensions.
   b. Ferrous housing sections.
   c. EPDM-rubber gaskets suitable for hot and cold water.
   d. Bolts and nuts.

2.4 GALVANIZED-STEEL PIPE AND FITTINGS

A. Galvanized-Steel Pipe:

1. ASTM A 53/A 53M, Standard Weight.
2. Include ends matching joining method.


C. Galvanized, Gray-Iron Threaded Fittings: ASME B16.4, Class 125, standard pattern.

D. Malleable-Iron Unions:

1. ASME B16.39, Class 150.
2. Hexagonal-stock body.
4. Threaded ends.

E. Flanges: ASME B16.1, Class 125, cast iron.

F. Appurtenances for Grooved-End, Galvanized-Steel Pipe:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. Anvil International.
   b. Grinnell Mechanical Products.
   c. Shurjoint Piping Products USA Inc.
   d. Victaulic Company.
2. Fittings for Grooved-End, Galvanized-Steel Pipe: Galvanized, ASTM A 47/A 47M, malleable-iron casting; ASTM A 106/A 106M, steel pipe; or ASTM A 536, ductile-iron casting; with dimensions matching steel pipe.

3. Fittings for Grooved-End, Galvanized-Steel Pipe:
   a. AWWA C606 for steel-pipe dimensions.
   b. Ferrous housing sections.
   c. EPDM-rubber gaskets suitable for hot and cold water.
   d. Bolts and nuts.

2.5 CPVC PIPING

A. CPVC Pipe: ASTM F 441/F 441M, Schedule 80.
   2. CPVC Threaded Fittings: ASTM F 437, Schedule 80.


2.6 PVC PIPE AND FITTINGS

A. PVC Pipe: ASTM D 1785, Schedule 80.


C. PVC Schedule 80 Threaded Fittings: ASTM D 2464.

2.7 PIPING JOINING MATERIALS

A. Pipe-Flange Gasket Materials:
   1. AWWA C110/A21.10, rubber, flat face, 1/8 inch thick or ASME B16.21, nonmetallic and asbestos free unless otherwise indicated.
   2. Full-face or ring type unless otherwise indicated.

B. Metal, Pipe-Flange Bolts and Nuts: ASME B18.2.1, carbon steel unless otherwise indicated.

C. Solder Filler Metals: ASTM B 32, lead-free alloys.

D. Flux: ASTM B 813, water flushable.

E. Brazing Filler Metals: AWS A5.8M/A5.8, BCuP Series, copper-phosphorus alloys for general-duty brazing unless otherwise indicated.

F. Solvent Cements for Joining CPVC Piping and Tubing: ASTM F 493.

G. Solvent Cements for Joining PVC Piping: ASTM D 2564. Include primer according to ASTM F 656.

2.8 ENCASEMENT FOR PIPING

A. Standard: ASTM A 674 or AWWA C105/A21.5.
2.9 TRANSITION FITTINGS

A. General Requirements:

1. Same size as pipes to be joined.
2. Pressure rating at least equal to pipes to be joined.
3. End connections compatible with pipes to be joined.

B. Fitting-Type Transition Couplings: Manufactured piping coupling or specified piping system fitting.

C. Sleeve-Type Transition Coupling: AWWA C219.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   b. Dresser, Inc.
   c. Ford Meter Box Company, Inc. (The).
   e. JCM Industries, Inc.
   f. Romac Industries, Inc.
   g. Smith-Blair, Inc.
   h. Viking Johnson.

D. Plastic-to-Metal Transition Fittings:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   b. Harvel Plastics, Inc.
   c. Spears Manufacturing Company.
   d. Uponor.

2. Description:
   a. CPVC or PVC one-piece fitting with manufacturer's Schedule 80 equivalent dimensions.
   b. One end with threaded brass insert and one solvent-cement-socket or threaded end.

E. Plastic-to-Metal Transition Unions:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. Colonial Engineering, Inc.
   b. NIBCO INC.
   c. Spears Manufacturing Company.

2. Description:
   a. CPVC or PVC four-part union.
2.10 DIELECTRIC FITTINGS

A. General Requirements: Assembly of copper alloy and ferrous materials with separating nonconductive insulating material. Include end connections compatible with pipes to be joined.

B. Dielectric Unions:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

   a. A.Y. McDonald Mfg. Co.
   b. Capitol Manufacturing Company.
   c. Central Plastics Company.
   d. HART Industrial Unions, LLC.
   e. Jomar Valve.
   f. Matco-Norca.
   g. WATTS.
   h. Wilkins.
   i. Zurn Industries, LLC.


C. Dielectric Flanges:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

   b. Central Plastics Company.
   c. Matco-Norca.
   d. WATTS.
   e. Wilkins.
   f. Zurn Industries, LLC.


3. Factory-fabricated, bolted, companion-flange assembly.

4. End Connections: Solder-joint copper alloy and threaded ferrous; threaded solder-joint copper alloy and threaded ferrous.

D. Dielectric-Flange Insulating Kits:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

   a. Advance Products & Systems, Inc.
   b. Calpico, Inc.
   c. Central Plastics Company.
   d. Pipeline Seal and Insulator, Inc.
2. Nonconducting materials for field assembly of companion flanges.
3. Gasket: Neoprene or phenolic.
4. Bolt Sleeves: Phenolic or polyethylene.
5. Washers: Phenolic with steel backing washers.

E. Dielectric Nipples:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. Elster Perfection Corporation.
   b. Grinnell Mechanical Products.
   c. Matco-Norca.
   d. Precision Plumbing Products.
   e. Victaulic Company.
3. Electroplated steel nipple complying with ASTM F 1545.
4. End Connections: Male threaded or grooved.
5. Lining: Inert and noncorrosive, propylene.

PART 3 - EXECUTION

3.1 PIPING INSTALLATION

A. Drawing plans, schematics, and diagrams indicate general location and arrangement of domestic water piping. Indicated locations and arrangements are used to size pipe and calculate friction loss, expansion, and other design considerations. Install piping as indicated unless deviations to layout are approved on coordination drawings.

B. Install copper tubing under building slab according to CDA's "Copper Tube Handbook."

C. Install ductile-iron piping under building slab with restrained joints according to AWWA C600 and AWWA M41.

D. Install underground copper tube and ductile-iron pipe in PE encasement according to ASTM A 674 or AWWA C105/A21.5.

E. Install shutoff valve, hose-end drain valve, strainer, pressure gage, and test tee with valve inside the building at each domestic water-service entrance. Comply with requirements for pressure gages in Section 22 05 19 "Meters and Gages for Plumbing Piping" and with requirements for drain valves and strainers in Section 22 11 19 "Domestic Water Piping Specialties."

F. Install shutoff valve immediately upstream of each dielectric fitting.

G. Install water-pressure-reducing valves downstream from shutoff valves. Comply with requirements for pressure-reducing valves in Section 22 11 19 "Domestic Water Piping Specialties."

H. Install piping concealed from view and protected from physical contact by building occupants unless otherwise indicated and except in equipment rooms and service areas.
I. 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.

J. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal, and coordinate with other services occupying that space.

K. Install piping to permit valve servicing.

L. Install nipples, unions, special fittings, and valves with pressure ratings the same as or higher than the system pressure rating used in applications below unless otherwise indicated.

M. Install piping free of sags and bends.

N. Install fittings for changes in direction and branch connections.

O. Install PEX tubing with loop at each change of direction of more than 90 degrees.

P. Install unions in copper tubing at final connection to each piece of equipment, machine, and specialty.

Q. Install pressure gages on suction and discharge piping for each plumbing pump and packaged booster pump and provide booster pump by-pass.

R. Install thermostats in hot-water circulation piping. Comply with requirements for thermostats in Section 22 11 23 "Domestic Water Pumps."

S. Install thermometers on inlet and outlet piping from each water heater. Comply with requirements for thermometers in Section 22 05 19 "Meters and Gages for Plumbing Piping."

T. Install sleeves for piping penetrations of walls, ceilings, and floors.

U. Install sleeve seals for piping penetrations of concrete walls and slabs.

V. Install escutcheons for piping penetrations of walls, ceilings, and floors.

3.2 JOINT CONSTRUCTION

A. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.

B. Remove scale, slag, dirt, and debris from inside and outside of pipes, tubes, and fittings before assembly.

C. Threaded Joints: Thread pipe with tapered pipe threads according to ASME B1.20.1. Cut threads full and clean using sharp dies. Ream threaded pipe ends to remove burrs and restore full ID. Join pipe fittings and valves as follows:

1. Apply appropriate tape or thread compound to external pipe threads.

2. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged.

D. Brazed Joints for Copper Tubing: Comply with CDA's "Copper Tube Handbook," "Brazed Joints" chapter.
E. Soldered Joints for Copper Tubing: Apply ASTM B 813, water-flushable flux to end of tube. Join copper tube and fittings according to ASTM B 828 or CDA's "Copper Tube Handbook."

F. Pressure-Sealed Joints for Copper Tubing: Join copper tube and pressure-seal fittings with tools and procedure recommended by pressure-seal-fitting manufacturer. Leave insertion marks on pipe after assembly.

G. Push-on Joints for Copper Tubing: Clean end of tube. Measure insertion depth with manufacturer's depth gage. Join copper tube and push-on-joint fittings by inserting tube to measured depth.

H. Extruded-Tee Connections: Form tee in copper tube according to ASTM F 2014. Use tool designed for copper tube; drill pilot hole, form collar for outlet, dimple tube to form seating stop, and braze branch tube into collar.

I. Joint Construction for Grooved-End Copper Tubing: Make joints according to AWWA C606. Roll groove ends of tubes. Lubricate and install gasket over ends of tubes or tube and fitting. Install coupling housing sections over gasket with keys seated in tubing grooves. Install and tighten housing bolts.

J. Joint Construction for Grooved-End, Ductile-Iron Piping: Make joints according to AWWA C606. Cut round-bottom grooves in ends of pipe at gasket-seat dimension required for specified (flexible or rigid) joint. Lubricate and install gasket over ends of pipes or pipe and fitting. Install coupling housing sections over gasket with keys seated in piping grooves. Install and tighten housing bolts.

K. Joint Construction for Grooved-End Steel Piping: Make joints according to AWWA C606. Groove ends of pipe as specified. Lubricate and install gasket over ends of pipes or pipe and fitting. Install coupling housing sections over gasket with keys seated in piping grooves. Install and tighten housing bolts.

L. Flanged Joints: Select appropriate asbestos-free, nonmetallic gasket material in size, type, and thickness suitable for domestic water service. Join flanges with gasket and bolts according to ASME B31.9.

M. Joint Construction for Solvent-Cemented Plastic Piping: Clean and dry joining surfaces. Join pipe and fittings according to the following:

2. CPVC Piping: Join according to ASTM D 2846/D 2846M Appendix.
3. PVC Piping: Join according to ASTM D 2855.

N. Joints for Dissimilar-Material Piping: Make joints using adapters compatible with materials of both piping systems.

3.3 TRANSITION FITTING INSTALLATION

A. Install transition couplings at joints of dissimilar piping.

B. Transition Fittings in Underground Domestic Water Piping:

1. Fittings for NPS 1-1/2 and Smaller: Fitting-type coupling.
2. Fittings for NPS 2 and Larger: Sleeve-type coupling.
C. Transition Fittings in Aboveground Domestic Water Piping NPS 2 and Smaller: Plastic-to-metal transition.

3.4 DIELECTRIC FITTING INSTALLATION

A. Install dielectric fittings in piping at connections of dissimilar metal piping and tubing.
B. Dielectric Fittings for NPS 2 and Smaller: Use dielectric couplings or nipples and unions.
C. Dielectric Fittings for NPS 2-1/2 to NPS 4: Use dielectric flanges.
D. Dielectric Fittings for NPS 5 and Larger: Use dielectric flange kits.

3.5 CONNECTIONS

A. Drawings indicate general arrangement of piping, fittings, and specialties.
B. When installing piping adjacent to equipment and machines, allow space for service and maintenance.
C. Connect domestic water piping to exterior water-service piping. Use transition fitting to join dissimilar piping materials.
D. Connect domestic water piping to water-service piping with shutoff valve; extend and connect to the following:
   1. Domestic Water Booster Pumps: Cold-water suction and discharge piping.
   2. Water Heaters: Cold-water inlet and hot-water outlet piping in sizes indicated, but not smaller than sizes of water heater connections.
   3. Plumbing Fixtures: Cold- and hot-water-supply piping in sizes indicated, but not smaller than that required by plumbing code.
   4. Equipment: Cold- and hot-water-supply piping as indicated, but not smaller than equipment connections. Provide shutoff valve and union for each connection. Use flanges instead of unions for NPS 2-1/2 and larger.

3.6 IDENTIFICATION

A. Identify system components. Comply with requirements for identification materials and installation in Section 22 05 53 "Identification for Plumbing Piping and Equipment."
B. Label pressure piping with system operating pressure.

3.7 FIELD QUALITY CONTROL

A. Perform the following tests and inspections:
   1. Piping Inspections:
      a. Do not enclose, cover, or put piping into operation until it has been inspected and approved by authorities having jurisdiction.
      b. During installation, notify authorities having jurisdiction at least one day before inspection must be made. Perform tests specified below in presence of authorities having jurisdiction:
1) Roughing-in Inspection: Arrange for inspection of piping before concealing or closing in after roughing in and before setting fixtures.

2) Final Inspection: Arrange for authorities having jurisdiction to observe tests specified in "Piping Tests" Subparagraph below and to ensure compliance with requirements.

c. Reinspection: If authorities having jurisdiction find that piping will not pass tests or inspections, make required corrections and arrange for reinspection.

d. Reports: Prepare inspection reports and have them signed by authorities having jurisdiction.

2. Piping Tests:

a. Fill domestic water piping. Check components to determine that they are not air bound and that piping is full of water.

b. Test for leaks and defects in new piping and parts of existing piping that have been altered, extended, or repaired. If testing is performed in segments, submit a separate report for each test, complete with diagram of portion of piping tested.

c. Leave new, altered, extended, or replaced domestic water piping uncovered and unconcealed until it has been tested and approved. Expose work that was covered or concealed before it was tested.

d. Cap and subject piping to static water pressure of 50 psig above operating pressure, without exceeding pressure rating of piping system materials. Isolate test source and allow it to stand for four hours. Leaks and loss in test pressure constitute defects that must be repaired.

e. Repair leaks and defects with new materials, and retest piping or portion thereof until satisfactory results are obtained.

f. Prepare reports for tests and for corrective action required.

B. Domestic water piping will be considered defective if it does not pass tests and inspections.

C. Prepare test and inspection reports.

3.8 ADJUSTING

A. Perform the following adjustments before operation:

1. Close drain valves, hydrants, and hose bibbs.
2. Open shutoff valves to fully open position.
3. Open throttling valves to proper setting.
4. Adjust balancing valves in hot-water-circulation return piping to provide adequate flow.

a. Manually adjust ball-type balancing valves in hot-water-circulation return piping to provide hot-water flow in each branch.

b. Adjust calibrated balancing valves to flows indicated.

5. Remove plugs used during testing of piping and for temporary sealing of piping during installation.
7. Remove filter cartridges from housings and verify that cartridges are as specified for application where used and are clean and ready for use.
8. Check plumbing specialties and verify proper settings, adjustments, and operation.
3.9 CLEANING

A. Clean and disinfect potable domestic water piping as follows:

1. Purge new piping and parts of existing piping that have been altered, extended, or repaired before using.
2. Use purging and disinfecting procedures prescribed by authorities having jurisdiction; if methods are not prescribed, use procedures described in either AWWA C651 or AWWA C652 or follow procedures described below:

   a. Flush piping system with clean, potable water until dirty water does not appear at outlets.

   b. Fill and isolate system according to either of the following:

      1) Fill system or part thereof with water/chlorine solution with at least 50 ppm of chlorine. Isolate with valves and allow to stand for 24 hours.

      2) Fill system or part thereof with water/chlorine solution with at least 200 ppm of chlorine. Isolate and allow to stand for three hours.

   c. Flush system with clean, potable water until no chlorine is in water coming from system after the standing time.

   d. Repeat procedures if biological examination shows contamination.

   e. Submit water samples in sterile bottles to authorities having jurisdiction.

B. Clean interior of domestic water piping system. Remove dirt and debris as work progresses.

3.10 PIPING SCHEDULE

A. Transition and special fittings with pressure ratings at least equal to piping rating may be used in applications below unless otherwise indicated.

B. Flanges and unions may be used for aboveground piping joints unless otherwise indicated.

C. Fitting Option: Extruded-tee connections and brazed joints may be used on aboveground copper tubing.

D. Under-building-slab, domestic water, building-service piping, NPS 3 and smaller, shall be one of the following:

   1. Soft copper tube, ASTM B 88, Type K.
   2. PVC, Schedule 80; socket fittings; and solvent-cemented joints.

E. Under-building-slab, domestic water, building-service piping, NPS 4 to NPS 8 and larger, shall be one of the following:

   1. Soft copper tube, ASTM B 88, Type K; wrought-copper, solder-joint fittings; and brazed joints.
   2. Mechanical-joint, ductile-iron pipe; standard- or compact-pattern, mechanical-joint fittings; and mechanical joints.
   3. Push-on-joint, ductile-iron pipe; standard- or compact-pattern, push-on-joint fittings; and gasketed joints.
   4. Plain-end, ductile-iron pipe; groove-joint, ductile-iron-pipe appurtenances; and grooved joints.
   5. PVC, Schedule 80; socket fittings; and solvent-cemented joints.
F. Under-building-slab, combined domestic water, building-service, NPS 6 to NPS 12, shall be one of the following:

1. Mechanical-joint, ductile-iron pipe; standard- or compact-pattern, mechanical-joint fittings; and mechanical joints.
2. Push-on-joint, ductile-iron pipe; standard- or compact-pattern, push-on-joint fittings; and gasketed joints.
3. Plain-end, ductile-iron pipe; grooved-joint, ductile-iron-pipe appurtenances; and grooved joints.

G. Under-building-slab, domestic water piping, NPS 2 and smaller, shall be one of the following:

1. Copper tube, ASTM B 88, Type L.
2. PVC, Schedule 80; socket fittings; and solvent-cemented joints.

H. Aboveground domestic water piping, NPS 2 and smaller, shall be one of the following:

1. Galvanized-steel pipe and nipples; galvanized, gray-iron threaded fittings; and threaded joints.
2. Hard copper tube, ASTM B 88, Type L; solder-joint fittings; and soldered joints.
3. Hard copper tube, ASTM B 88, Type L; copper pressure-seal-joint fittings; and pressure-sealed joints.
4. Hard copper tube, ASTM B 88, Type L; copper push-on-joint fittings; and push-on joints.
5. CPVC, Schedule 80; socket fittings; and solvent-cemented joints.
6. CPVC, Schedule 80 pipe; CPVC, Schedule 80 threaded fittings; and threaded joints.
7. CPVC Tubing System: CPVC tube; CPVC socket fittings; and solvent-cemented joints. NPS 1-1/2 and NPS 2 CPVC pipe with CPVC socket fittings may be used instead of tubing.
8. PVC, Schedule 80; socket fittings; and solvent-cemented joints.

I. Aboveground domestic water piping, NPS 2-1/2 to NPS 4, shall be one of the following:

1. Hard copper tube, ASTM B 88, Type L; solder-joint fittings; and soldered joints.
2. Hard copper tube, ASTM B 88, Type L; copper pressure-seal-joint fittings; and pressure-sealed joints.
3. Hard copper tube, ASTM B 88, Type L; grooved-joint, copper-tube appurtenances; and grooved joints.
4. Galvanized-steel pipe and nipples; galvanized, gray-iron threaded fittings; and threaded joints.
5. Galvanized-steel pipe; grooved-joint, galvanized-steel-pipe appurtenances; and grooved joints.
6. CPVC, Schedule 80 pipe; CPVC, Schedule 80 threaded fittings; and threaded joints.
7. PVC, Schedule 80; socket fittings; and solvent-cemented joints.

3.11 VALVE SCHEDULE

A. Drawings indicate valve types to be used. Where specific valve types are not indicated, the following requirements apply:

1. Shutoff Duty: Use ball or gate valves for piping NPS 2 and smaller. Use butterfly, ball, or gate valves with flanged ends for piping NPS 2-1/2 and larger.
2. Throttling Duty: Use ball or globe valves for piping NPS 2 and smaller. Use butterfly or ball valves with flanged ends for piping NPS 2-1/2 and larger.
B. Use check valves to maintain correct direction of domestic water flow to and from equipment.

C. Iron grooved-end valves may be used with grooved-end piping.

END OF SECTION 22 11 16
SECTION 22 11 19
DOMESTIC WATER PIPING SPECIALTIES

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. Vacuum breakers.
2. Automatic water shutoff valves.
4. Temperature-actuated, water mixing valves.
5. Strainers.
6. Hose bibbs.
7. Wall hydrants.
8. Drain valves.
10. Air vents.
11. Trap-seal primer valves.
12. Trap-seal primer systems.
13. Flexible connectors.

1.3 SUBMITTALS

A. Submit manufacturer's data for review before any work is commenced

1.4 RELATION TO OTHER WORK

A. Refer to the section, "General Plumbing Provisions", for related requirements. Refer to other sections of Division 22 and to all other applicable portions of the Drawings and Specifications.

PART 2 - PRODUCTS

2.1 GENERAL REQUIREMENTS FOR PIPING SPECIALTIES

A. Potable-water piping and components shall comply with NSF 61.

B. Comply with NSF 372 for low lead.

2.2 PERFORMANCE REQUIREMENTS

A. Minimum Working Pressure for Domestic Water Piping Specialties: 125 psig unless otherwise indicated.

2.3 VACUUM BREAKERS

A. Pipe-Applied, Atmospheric-Type Vacuum Breakers:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. Ames Fire & Waterworks; A WATTS Brand.
   b. Apollo Flow Controls; Conbraco Industries, Inc.
   c. FEBCO; A WATTS Brand.
   d. WATTS.
   e. Zurn Industries, LLC.

3. Size: NPS 1/4 to NPS 3, as required to match connected piping.
5. Inlet and Outlet Connections: Threaded.

B. Hose-Connection Vacuum Breakers:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. Apollo Flow Controls; Conbraco Industries, Inc.
   b. MIFAB, Inc.
   c. WATTS.
   d. Woodford Manufacturing Company.
   e. Zurn Industries, LLC.


C. Pressure Vacuum Breakers:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. Ames Fire & Waterworks; A WATTS Brand.
   b. Apollo Flow Controls; Conbraco Industries, Inc.
   c. FEBCO; A WATTS Brand.
   d. WATTS.
   e. Zurn Industries, LLC.


D. Water-Control Valves:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   b. Apollo Flow Controls; Conbraco Industries, Inc.
   c. CLA-VAL Automatic Control Valves.
   d. Flomatic Corporation.
   e. OCV Control Valves.
   f. WATTS.
   g. Zurn Industries, LLC.
2. Description: Pilot-operated, diaphragm-type, single-seated, main water-control valve.
3. Pressure Rating: Initial working pressure of 150 psig minimum with AWWA C550 or FDA-approved, interior epoxy coating. Include small pilot-control valve, restrictor device, specialty fittings, and sensor piping.
4. Main Valve Body: Cast- or ductile-iron body with AWWA C550 or FDA-approved, interior epoxy coating; or stainless-steel body.

2.4 AUTOMATIC WATER SHUTOFF VALVES

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   1. DynaQuip Controls.
   2. FloLogic, Inc.
   3. OnSite PRO Inc.
   4. QMI Manufacturing Inc.
   5. Reliance Detection Technologies.

B. Standards: NSF 61 and NSF 372.

C. Shutoff Control Ball Valve:
   1. Control Valve: Two-piece, full-port brass ball valve, MSS SP-110.
      b. Seats: PTFE.
      c. O-Rings: FKM.
      d. Stem: Low lead brass. Blowout proof.

D. Shutoff Control Butterfly Valve:
   2. Full-port, epoxy-coated, ductile-iron lug body.
   3. Seat: EPDM, minus 30 deg F to plus 250 deg F.
   4. Face-to-Face Flange: ASME B16.5 flanges.
   7. Bushings: PTFE.
   8. O-Rings: EPDM.

2.5 BALANCING VALVES

A. Copper-Alloy Calibrated Balancing Valves
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. Circuit Solver, Therm omega tech.
      b. NIBCO INC.
      c. TACO Comfort Solutions, Inc.
2. Type: Ball valve with two readout ports and memory-setting indicator.
3. Size: Same as connected piping, but not larger than NPS 2.
4. Accessories: Meter hoses, fittings, valves, differential pressure meter, and carrying case.

2.6 TEMPERATURE-ACTUATED, WATER MIXING VALVES

A. Water-Temperature Limiting Devices:
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      b. Leonard Valve Company.
      c. POWERS; A WATTS Brand.
      d. Symmons Industries, Inc.
      e. TACO Comfort Solutions, Inc.
      f. WATTS.
      g. Zurn Industries, LLC.
   
   4. Type: Thermostatically controlled, water mixing valve.
   5. Material: Bronze body with corrosion-resistant interior components.
   7. Accessories: Check stops on hot- and cold-water supplies, and adjustable, temperature-control handle.

B. Primary, Thermostatic, Water Mixing Valves:
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      b. Armstrong International, Inc.
      c. Lawler Manufacturing Company, Inc.
      d. Leonard Valve Company.
      e. POWERS; A WATTS Brand.
      f. Zurn Industries, LLC.
   
   3. Pressure Rating: 125 psig minimum unless otherwise indicated.
   4. Type: Thermostatically controlled, water mixing valve.
   5. Material: Bronze body with corrosion-resistant interior components.
   7. Accessories: Manual temperature control, check stops on hot- and cold-water supplies, and adjustable, temperature-control handle.

C. Manifold, Thermostatic, Water Mixing-Valve Assemblies:
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
2. Description: Factory-fabricated, thermostatically controlled.
3. Large-Flow Parallel: Thermostatic, water mixing valve and downstream-pressure regulator with pressure gages on inlet and outlet.
6. Thermostatic Mixing Valves: Comply with ASSE 1017. Include check stops on hot- and cold-water inlets and shutoff valve on outlet.
7. Water Regulator(s): Comply with ASSE 1003. Include pressure gage on inlet and outlet.
8. Pressure Rating: 125 psig minimum unless otherwise indicated.
9. Cabinet: Factory fabricated, stainless steel, for mounting and with hinged, stainless-steel door.

D. Individual-Fixture, Water Tempering Valves:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. Lawler Manufacturing Company, Inc.
   b. Leonard Valve Company.
   c. POWERS; A WATTS Brand.
   d. WATTS.
   e. Zurn Industries, LLC.
2. Standard: ASSE 1016, thermostatically controlled, water tempering valve.
3. Pressure Rating: 125 psig minimum unless otherwise indicated.
5. Temperature Control: Adjustable.
6. Inlets and Outlet: Threaded.
7. Finish: Rough or chrome-plated bronze.

2.7 STRAINERS FOR DOMESTIC WATER PIPING

A. Y-Pattern Strainers:
1. Pressure Rating: 125 psig minimum unless otherwise indicated.
2. Body: Bronze for NPS 2 and smaller; cast iron with interior lining that complies with AWWA C550 or that is FDA approved, epoxy coated and for NPS 2-1/2 and larger.
3. End Connections: Threaded for NPS 2 and smaller; flanged for NPS 2-1/2 and larger.
4. Screen: Stainless steel with round perforations unless otherwise indicated.

2.8 HOSE BIBBS
A. Hose Bibbs:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   b. MIFAB, Inc.
2. Standard: ASME A112.18.1 for sediment faucets.
5. Supply Connections: NPS 1/2 or NPS 3/4 threaded or solder-joint inlet.
8. Vacuum Breaker: Integral or field-installation, nonremovable, drainable, hose-connection vacuum breaker complying with ASSE 1011.
9. Finish for Equipment Rooms: Rough bronze, or chrome or nickel plated.
10. Operation for Equipment Rooms: Wheel handle or operating key.
11. Include operating key with each operating-key hose bibb.

2.9 WALL HYDRANTS

A. Nonfreeze Wall Hydrants:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   b. Josam Company.
   c. MIFAB, Inc.
   d. WATTS.
   e. Woodford Manufacturing Company.
   f. Zurn Industries, LLC.

4. Operation: Loose key.
5. Casing and Operating Rod: Of length required to match wall thickness. Include wall clamp.
6. Inlet: NPS 3/4 or NPS 1.
7. Outlet: Concealed, with integral vacuum breaker and garden-hose thread complying with ASME B1.20.7.
8. Box: Deep, flush mounted with cover.
10. Operating Keys(s): Two with each wall hydrant.

B. Nonfreeze, Hot- and Cold-Water Wall Hydrants:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   b. Josam Company.
   c. WATTS.
   d. Woodford Manufacturing Company.
   e. Zurn Industries, LLC.

4. Operation: Loose key.
5. Casing and Operating Rods: Of length required to match wall thickness. Include wall clamps.
6. Inlet: NPS 3/4 or NPS 1.
7. Outlet: Concealed.
8. Box: Deep, flush mounted with cover.
9. Vacuum Breaker:
   a. Nonremovable, manual-drain-type, hose-connection vacuum breaker complying with ASSE 1011 or backflow preventer complying with ASSE 1052.
   b. Garden-hose thread complying with ASME B1.20.7 on outlet.
10. Operating Key(s): Two with each wall hydrant.

C. Vacuum Breaker Wall Hydrants:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   b. WATTS.
   c. Woodford Manufacturing Company.
   d. Zurn Industries, LLC.
2. Standard: ASSE 1019, Type A or Type B.
3. Type: Freeze-resistant, automatic draining with integral air-inlet valve.
4. Classification: Type A, for automatic draining with hose removed or Type B, for automatic draining with hose removed or with hose attached and nozzle closed.
7. Casing and Operating Rod: Of length required to match wall thickness. Include wall clamp.
8. Inlet: NPS 1/2 or NPS 3/4.

2.10 WATER-HAMMER ARRESTERS

A. Water-Hammer Arresters:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. AMTROL, Inc.
   b. Josam Company.
   c. MIFAB, Inc.
   d. Precision Plumbing Products.
   e. Sioux Chief Manufacturing Company, Inc.
   f. WATTS.
   g. Zurn Industries, LLC.
3. Size: ASSE 1010, Sizes AA and A through F, or PDI-WH 201, Sizes A through F.
2.11 AIR VENTS

A. Bolted-Construction Automatic Air Vents:
   1. Body: Bronze.
   2. Pressure Rating and Temperature: 125-psig minimum pressure rating at 140 deg F.
   3. Float: Replaceable, corrosion-resistant metal.
   5. Inlet and Vent Outlet End Connections: Threaded.

B. Welded-Construction Automatic Air Vents:
   2. Pressure Rating: 150-psig minimum pressure rating.
   3. Float: Replaceable, corrosion-resistant metal.

2.12 TRAP-SEAL PRIMER DEVICE

A. Drainage-Type, Trap-Seal Primer Device:
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. MIFAB
      b. WATTS
      c. PROSET

PART 3 - EXECUTION

3.1 INSTALLATION

A. Water Control Valves: Install with inlet and outlet shutoff valves. Install pressure gages on inlet and outlet.

B. Balancing Valves: Install in locations where they can easily be adjusted.

C. Temperature-Actuated, Water Mixing Valves: Install with check stops or shutoff valves on inlets and with shutoff valve on outlet.
   1. Install cabinet-type units recessed in or surface mounted on wall as specified.

D. Y-Pattern Strainers: For water, install on supply side of each control valve, solenoid valve, and pump.

E. Water-Hammer Arresters: Install in water piping according to PDI-WH 201.

F. Air Vents: Install vents at high points of water piping
G. Drainage-Type, Trap-Seal Primer Device: Install as lavatory trap with outlet piping pitched down toward drain trap a minimum of 1 percent, and connect to floor-drain body, trap, or inlet fitting.

H. Trap-Seal Primer Systems: Install with outlet piping pitched down toward drain trap a minimum of 1 percent, and connect to floor-drain body, trap, or inlet fitting. Adjust system for proper flow.

3.2 CONNECTIONS

A. Drawings indicate general arrangement of piping, fittings, and specialties.

B. When installing piping specialties adjacent to equipment and machines, allow space for service and maintenance.

C. Comply with requirements for grounding equipment in Section 26 05 26 "Grounding and Bonding for Electrical Systems."

3.3 IDENTIFICATION

A. Plastic Labels for Equipment: Install engraved plastic-laminate equipment nameplate or sign on or near each of the following:

1. Pressure vacuum breakers.
2. Automatic water shutoff valves.
3. Primary, thermostatic, water mixing valves.
5. Primary water tempering valves.

B. Distinguish among multiple units, inform operator of operational requirements, indicate safety and emergency precautions, and warn of hazards and improper operations, in addition to identifying unit. Nameplates and signs are specified in Section 22 05 53 "Identification for Plumbing Piping and Equipment."

3.4 FIELD QUALITY CONTROL

A. Perform the following tests and inspections:

1. Test each valve according to authorities having jurisdiction and the device's reference standard.

B. Domestic water piping specialties will be considered defective if they do not pass tests and inspections.

C. Prepare test and inspection reports.

3.5 ADJUSTING

A. Set field-adjustable pressure set points of water pressure-reducing valves.

B. Set field-adjustable flow set points of balancing valves.

C. Set field-adjustable temperature set points of temperature-actuated, water mixing valves.
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:

2. Hubless, cast-iron soil pipe and fittings.
3. Ductile-iron pipe and fittings.
4. PVC pipe and fittings.
5. Specialty pipe fittings.

B. Related Requirements:

1. Section 22 13 13 "Facility Sanitary Sewers" for sanitary sewerage piping and structures outside the building.

1.3 RELATION TO OTHER WORK

A. Refer to the section, "General Plumbing Provisions", for related requirements. Refer to other sections of Division 22 and to all other applicable portions of the Drawings and Specifications.

1.4 SUBMITTALS

A. Submit manufacturer's data for review before any work is commenced.

1.5 FIELD CONDITIONS

A. Interruption of Existing Sanitary Waste Service: Do not interrupt service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary service according to requirements indicated:

1. Notify Construction Manager no fewer than two days in advance of proposed interruption of sanitary waste service.
2. Do not proceed with interruption of sanitary waste service without Construction Manager's written permission.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Components and installation shall be capable of withstanding the following minimum working pressure unless otherwise indicated:

B. Seismic Performance: Soil, waste, and vent piping and support and installation shall withstand the effects of earthquake motions determined according to ASCE/SEI 7.

2.2 PIPING MATERIALS

A. Piping materials shall bear label, stamp, or other markings of specified testing agency.

B. Comply with requirements in "Piping Schedule" Article for applications of pipe, tube, fitting materials, and joining methods for specific services, service locations, and pipe sizes.

2.3 HUB-AND-SPIGOT, CAST-IRON SOIL PIPE AND FITTINGS

A. Pipe and Fittings: ASTM A 74.

B. Gaskets: ASTM C 564, rubber.

C. Calking Materials: ASTM B 29, pure lead and oakum or hemp fiber.

2.4 HUBLESS, CAST-IRON SOIL PIPE AND FITTINGS

A. Pipe and Fittings: ASTM A 888 or CISPI 301.

   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. Conine Manufacturing Co., Inc.
      b. SE Sovent.

C. CISPI, Hubless-Piping Couplings:
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. ANACO-Husky.
      b. Charlotte Pipe and Foundry Company.
      d. Fernco Inc.
      e. Josam Company.
      f. Matco-Norca.
      g. MIFAB, Inc.
      h. Mission Rubber Company, LLC; a division of MCP Industries.
      i. NewAge Casting.
      j. Stant.
      k. Tyler Pipe; a subsidiary of McWane Inc.

   3. Description: Stainless-steel corrugated shield with stainless-steel bands and tightening devices; and ASTM C 564, rubber sleeve with integral, center pipe stop.
D. Heavy-Duty, Hubless-Piping Couplings:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. ANACO-Husky.
   b. Charlotte Pipe and Foundry Company.
   c. Clamp-All Corp.
   e. MIFAB, Inc.
   f. Mission Rubber Company, LLC; a division of MCP Industries.
   g. NewAge Casting.
   h. Stant.
   i. Tyler Pipe; a subsidiary of McWane Inc.

3. Description: Stainless-steel shield with stainless-steel bands and tightening devices; and ASTM C 564, rubber sleeve with integral, center pipe stop.

E. Cast-Iron, Hubless-Piping Couplings:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   b. MG Piping Products Company.

3. Description: Two-piece ASTM A 48/A 48M, cast-iron housing; stainless-steel bolts and nuts; and ASTM C 564, rubber sleeve with integral, center pipe stop.

2.5 DUCTILE-IRON PIPE AND FITTINGS

A. Ductile-Iron, Mechanical-Joint Piping:

1. Ductile-Iron Pipe: AWWA C151/A21.51, with mechanical-joint bell and plain spigot ends unless grooved or flanged ends are indicated.
3. Glands, Gaskets, and Bolts: AWWA C111/A21.11, ductile- or gray-iron glands, rubber gaskets, and steel bolts.

B. Ductile-Iron, Push-on-Joint Piping:

1. Ductile-Iron Pipe: AWWA C151/A21.51, with push-on-joint bell and plain spigot ends unless grooved or flanged ends are indicated.

C. Ductile-Iron, Grooved-Joint Piping: AWWA C151/A21.51, with round-cut-grooved ends according to AWWA C606.
D. Ductile-Iron, Grooved-End Pipe Appurtenances:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. Anvil International.
   b. Shurjoint Piping Products USA Inc.
   c. Smith-Cooper International.
   d. Star Pipe Products.
   e. Victaulic Company.


3. Grooved Mechanical Couplings for Ductile-Iron Pipe: ASTM F 1476, Type I. Include ferrous housing sections with continuous curved keys; EPDM-rubber center-leg gasket suitable for hot and cold water; and bolts and nuts.

2.6 PVC PIPE AND FITTINGS


B. Solid-Wall PVC Pipe: ASTM D 2665, drain, waste, and vent.

C. PVC Socket Fittings: ASTM D 2665, made to ASTM D 3311, drain, waste, and vent patterns and to fit Schedule 40 pipe.

D. Adhesive Primer: ASTM F 656.

E. Solvent Cement: ASTM D 2564.

2.7 SPECIALTY PIPE FITTINGS

A. Transition Couplings:

1. Fitting-Type Transition Couplings: Manufactured piping coupling or specified piping system fitting.

2. Unshielded, Nonpressure Transition Couplings:

   a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

      2) Fernco Inc.
      3) Froet Industries LLC.
      4) Mission Rubber Company, LLC; a division of MCP Industries.
      5) Plastic Oddities.


   c. Description: Elastomeric, sleeve-type, reducing or transition pattern. Include shear ring and corrosion-resistant-metal tension band and tightening mechanism on each end.
d. End Connections: Same size as and compatible with pipes to be joined.
e. Sleeve Materials:
   2) For Plastic Pipes: ASTM F 477, elastomeric seal or ASTM D 5926, PVC.
   3) For Dissimilar Pipes: ASTM D 5926, PVC or other material compatible with pipe materials being joined.

3. Shielded, Nonpressure Transition Couplings:
   a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      2) Mission Rubber Company, LLC; a division of MCP Industries.
c. Description: Elastomeric or rubber sleeve with full-length, corrosion-resistant outer shield and corrosion-resistant-metal tension band and tightening mechanism on each end.
d. End Connections: Same size as and compatible with pipes to be joined.

4. Pressure Transition Couplings:
   a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      1) Apollo Flow Controls; Conbraco Industries, Inc.
      3) Dresser, Inc.
      4) EBAA Iron, Inc.
      5) Ford Meter Box Company, Inc. (The).
      7) JCM Industries, Inc.
      8) Romac Industries, Inc.
      9) Viking Johnson.
c. Description: Metal, sleeve-type same size as, with pressure rating at least equal to, and ends compatible with, pipes to be joined.
d. Center-Sleeve Material: Manufacturer's standard.
e. Gasket Material: Natural or synthetic rubber.
f. Metal Component Finish: Corrosion-resistant coating or material.

B. Dielectric Fittings:

1. Dielectric Unions:
   a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      1) A.Y. McDonald Mfg. Co.
      2) Capitol Manufacturing Company.
      3) Central Plastics Company.
4) HART Industrial Unions, LLC.
5) Jomar Valve.
6) Matco-Norca.
7) WATTTS.
8) Wilkins.
9) Zurn Industries, LLC.

b. Description:

1) Standard: ASSE 1079.
2) Pressure Rating: 250 psig.
3) End Connections: Solder-joint copper alloy and threaded ferrous.

2. Dielectric Flanges:

a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1) Capitol Manufacturing Company.
2) Central Plastics Company.
3) Matco-Norca.
4) WATTTS.
5) Wilkins.
6) Zurn Industries, LLC.

b. Description:

1) Standard: ASSE 1079.
2) Factory-fabricated, bolted, companion-flange assembly.
3) Pressure Rating: 300 psig.
4) End Connections: Solder-joint copper alloy and threaded ferrous; threaded solder-joint copper alloy and threaded ferrous.

3. Dielectric-Flange Insulating Kits:

a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1) Advance Products & Systems, Inc.
2) Calpico, Inc.
3) Central Plastics Company.
4) Pipeline Seal and Insulator, Inc.

b. Description:

1) Nonconducting materials for field assembly of companion flanges.
2) Pressure Rating: 150 psig.
3) Gasket: Neoprene or phenolic.
4) Bolt Sleeves: Phenolic or polyethylene.
5) Washers: Phenolic with steel backing washers.
4. **Dielectric Nipples:**

   a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

       1) Elster Perfection Corporation.
       2) Grinnell Mechanical Products.
       3) Josam Company.
       4) Matco-Norca.
       5) Precision Plumbing Products.
       6) Victaulic Company.

   b. Description:

       1) Standard: IAPMO PS 66.
       2) Electroplated steel nipple.
       3) Pressure Rating: 300 psig at 225 deg F.
       4) End Connections: Male threaded or grooved.
       5) Lining: Inert and noncorrosive, propylene.

**PART 3 - EXECUTION**

3.1 **PIPING INSTALLATION**

A. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems.

   1. The design drawings are generally diagrammatic. They do not show every bend, off-set, elbow or other fitting which may be required in the piping for installation in the space allotted. Careful coordination of the work is necessary to avoid conflicts.
   2. Indicated locations and arrangements were used to size pipe and calculate friction loss, expansion, pump sizing, and other design considerations.
   3. Install piping as indicated unless deviations to layout are approved on coordination drawings.
   4. PVC piping, fittings and other PVC materials shall not be installed in air conditioning plenums or equipment rooms used as air conditioning plenums.

B. Install piping in concealed locations unless otherwise indicated and except in equipment rooms and service areas.

C. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.

D. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal.

E. Install piping to permit valve servicing.

F. Install piping at indicated slopes.

G. Install piping free of sags and bends.

H. Install fittings for changes in direction and branch connections.
I. Install piping to allow application of insulation.

J. Make changes in direction for soil and waste drainage and vent piping using appropriate branches, bends, and long-sweep bends.
   1. Sanitary tees and short-sweep 1/4 bends may be used on vertical stacks if change in direction of flow is from horizontal to vertical.
   2. Use long-turn, double Y-branch and 1/8-bend fittings if two fixtures are installed back to back or side by side with common drain pipe.
      a. Straight tees, elbows, and crosses may be used on vent lines.
   3. Do not change direction of flow more than 90 degrees.
   4. Use proper size of standard increasers and reducers if pipes of different sizes are connected.
      a. Reducing size of waste piping in direction of flow is prohibited.

K. Lay buried building waste piping beginning at low point of each system.
   1. Install true to grades and alignment indicated, with unbroken continuity of invert. Place hub ends of piping upstream.
   2. Install required gaskets according to manufacturer's written instructions for use of lubricants, cements, and other installation requirements.
   3. Maintain swab in piping and pull past each joint as completed.

L. Install soil and waste and vent piping at the following minimum slopes unless otherwise indicated:
   1. Building Sanitary Waste: 2 percent downward in direction of flow for piping NPS 3 and smaller; 1 percent downward in direction of flow for piping NPS 4 and larger.
   3. Vent Piping: 1 percent down toward vertical fixture vent or toward vent stack.

M. Install cast-iron soil piping according to CISPI's "Cast Iron Soil Pipe and Fittings Handbook," Chapter IV, "Installation of Cast Iron Soil Pipe and Fittings."
   1. Install encasement on underground piping according to ASTM A 674 or AWWA C105/A 21.5.

N. Install aboveground copper tubing according to CDA's "Copper Tube Handbook."

O. Install aboveground PVC piping according to ASTM D 2665.

P. Install underground PVC piping according to ASTM D 2321.

Q. Install engineered soil and waste and vent piping systems as follows:
   3. Reduced-Size Venting: Comply with standards of authorities having jurisdiction.

R. Install underground, ductile-iron, force-main piping according to AWWA C600.
1. Install buried piping inside building between wall and floor penetrations and connection to sanitary sewer piping outside building with restrained joints.
2. Anchor pipe to wall or floor. Install thrust-block supports at vertical and horizontal offsets.
3. Install encasement on piping according to ASTM A 674 or AWWA C105/A 21.5.

S. Install underground, copper, force-main tubing according to CDA's "Copper Tube Handbook."

1. Install encasement on piping according to ASTM A 674 or AWWA C105/A 21.5.

T. Install force mains at elevations indicated.

U. Do not enclose, cover, or put piping into operation until it is inspected and approved by authorities having jurisdiction.

3.2 JOINT CONSTRUCTION


C. Join hubless, cast-iron soil piping according to CISPI 310 and CISPI's "Cast Iron Soil Pipe and Fittings Handbook" for hubless-piping coupling joints.

D. Threaded Joints: Thread pipe with tapered pipe threads according to ASME B1.20.1.
   1. Cut threads full and clean using sharp dies.
   2. Ream threaded pipe ends to remove burrs and restore full ID. Join pipe fittings and valves as follows:
      a. Apply appropriate tape or thread compound to external pipe threads unless dry seal threading is specified.
      b. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged.
      c. Do not use pipe sections that have cracked or open welds.

E. Join stainless-steel pipe and fittings with gaskets according to ASME A112.3.1.

F. Join copper tube and fittings with soldered joints according to ASTM B 828. Use ASTM B 813, water-flushable, lead-free flux and ASTM B 32, lead-free-alloy solder.

G. Grooved Joints: Cut groove ends of pipe according to AWWA C606. Lubricate and install gasket over ends of pipes or pipe and fitting. Install coupling housing sections, over gasket, with keys seated in piping grooves. Install and tighten housing bolts.

H. Flanged Joints: Align bolt holes. Select appropriate gasket material, size, type, and thickness. Install gasket concentrically positioned. Use suitable lubricants on bolt threads. Torque bolts in cross pattern.

I. Plastic, Nonpressure-Piping, Solvent-Cement Joints: Clean and dry joining surfaces. Join pipe and fittings according to the following:
1. Comply with ASTM F 402 for safe-handling practice of cleaners, primers, and solvent cements.
2. ABS Piping: Join according to ASTM D 2235 and ASTM D 2661 appendixes.
3. PVC Piping: Join according to ASTM D 2855 and ASTM D 2665 appendixes.

3.3 VALVE INSTALLATION

A. Comply with requirements in Section 22 05 23.12 "Ball Valves for Plumbing Piping," Section 22 05 23.13 "Butterfly Valves for Plumbing Piping," Section 22 05 23.14 "Check Valves for Plumbing Piping," and Section 22 05 23.15 "Gate Valves for Plumbing Piping" for general-duty valve installation requirements.

B. Shutoff Valves:
   1. Install shutoff valve on each sewage pump discharge.
   2. Install gate or full-port ball valve for piping NPS 2 and smaller.
   3. Install gate valve for piping NPS 2-1/2 and larger.

C. Check Valves: Install swing check valve, between pump and shutoff valve, on each sewage pump discharge.

D. Backwater Valves: Install backwater valves in piping subject to backflow.
   1. Horizontal Piping: Horizontal backwater valves
   2. Floor Drains: Drain outlet backwater valves unless drain has integral backwater valve.
   3. Install backwater valves in accessible locations.

3.4 HANGER AND SUPPORT INSTALLATION

A. Vertical Piping shall be supported at its base and no greater than every story height, not to exceed 20 foot intervals.

B. Horizontal Piping (Suspended) shall be supported at each bend; at not more than five (5) foot intervals; except that pipe exceeding five (5) feet in length may be supported at not more than ten (10) foot intervals. Supports shall be adequate to maintain alignment and prevent sagging and shall be made directly behind the bell or coupling, where possible, not near the center of the pipe.

C. Supports shall be connected to the building structure not from other equipment, ducts or conduits.

D. Horizontal pipe and fittings six inches and larger shall be suitably braced to prevent horizontal movement. This should be done at every branch opening or change of direction by the use of braces, blocks, rodding or other suitable method, to prevent movement.

E. Where components are suspended in excess of eighteen inches by means of non-rigid hangers, they should be suitably braced against movement horizontally, often called sway bracing.

3.5 CONNECTIONS

A. Drawings indicate general arrangement of piping, fittings, and specialties.
B. Connect soil and waste piping to exterior sanitary sewerage piping. Use transition fitting to join dissimilar piping materials.

C. Connect waste and vent piping to the following:

1. Plumbing Fixtures: Connect waste piping in sizes indicated, but not smaller than required by plumbing code.
2. Plumbing Fixtures and Equipment: Connect atmospheric vent piping in sizes indicated, but not smaller than required by authorities having jurisdiction.
3. Plumbing Specialties: Connect waste and vent piping in sizes indicated, but not smaller than required by plumbing code.
4. Install test tees (wall cleanouts) in conductors near floor and floor cleanouts with cover flush with floor.
5. Install horizontal backwater valves with cleanout cover flush with floor.
6. Comply with requirements for backwater valves, cleanouts, and drains specified in Section 22 13 19 "Sanitary Waste Piping Specialties."
7. Equipment: Connect waste piping as indicated.
   a. Provide shutoff valve if indicated and union for each connection.
   b. Use flanges instead of unions for connections NPS 2-1/2 and larger.

D. Connect force-main piping to the following:

1. Sanitary Sewer: To exterior force main.
2. Sewage Pump: To sewage pump discharge.

E. Where installing piping adjacent to equipment, allow space for service and maintenance of equipment.

F. Make connections according to the following unless otherwise indicated:

1. Install unions, in piping NPS 2 and smaller, adjacent to each valve and at final connection to each piece of equipment.
2. Install flanges, in piping NPS 2-1/2 and larger, adjacent to flanged valves and at final connection to each piece of equipment.

3.6 IDENTIFICATION

A. Identify exposed sanitary waste and vent piping.

B. Comply with requirements for identification specified in Section 22 05 53 "Identification for Plumbing Piping and Equipment."

3.7 FIELD QUALITY CONTROL

A. During installation, notify authorities having jurisdiction at least 24 hours before inspection must be made. Perform tests specified below in presence of authorities having jurisdiction.

1. Roughing-in Inspection: Arrange for inspection of piping before concealing or closing-in after roughing-in and before setting fixtures.
2. Final Inspection: Arrange for final inspection by authorities having jurisdiction to observe tests specified below and to ensure compliance with requirements.
B. Reinspection: If authorities having jurisdiction find that piping will not pass test or inspection, make required corrections and arrange for reinspection.

C. Test sanitary waste and vent piping according to procedures of authorities having jurisdiction or, in absence of published procedures, as follows:

1. Test for leaks and defects in new piping and parts of existing piping that have been altered, extended, or repaired.
   a. If testing is performed in segments, submit separate report for each test, complete with diagram of portion of piping tested.

2. Leave uncovered and unconcealed new, altered, extended, or replaced waste and vent piping until it has been tested and approved.
   a. Expose work that was covered or concealed before it was tested.

3. Roughing-in Plumbing Test Procedure: Test waste and vent piping except outside leaders on completion of roughing-in.
   a. Close openings in piping system and fill with water to point of overflow, but not less than 10-foot head of water.
   b. From 15 minutes before inspection starts to completion of inspection, water level must not drop.
   c. Inspect joints for leaks.

4. Finished Plumbing Test Procedure: After plumbing fixtures have been set and traps filled with water, test connections and prove they are gastight and watertight.
   a. Plug vent-stack openings on roof and building drains where they leave building. Introduce air into piping system equal to pressure of 1-inch wg.
   b. Use U-tube or manometer inserted in trap of water closet to measure this pressure.
   c. Air pressure must remain constant without introducing additional air throughout period of inspection.
   d. Inspect plumbing fixture connections for gas and water leaks.

5. Repair leaks and defects with new materials and retest piping, or portion thereof, until satisfactory results are obtained.

D. Test force-main piping according to procedures of authorities having jurisdiction or, in absence of published procedures, as follows:

1. Leave uncovered and unconcealed new, altered, extended, or replaced force-main piping until it has been tested and approved.
   a. Expose work that was covered or concealed before it was tested.

2. Cap and subject piping to static-water pressure of 50 psig above operating pressure, without exceeding pressure rating of piping system materials.
   a. Isolate test source and allow to stand for four hours.
   b. Leaks and loss in test pressure constitute defects that must be repaired.
3. Repair leaks and defects with new materials and retest piping, or portion thereof, until satisfactory results are obtained.

3.8 CLEANING AND PROTECTION

A. Clean interior of piping. Remove dirt and debris as work progresses.

B. Protect sanitary waste and vent piping during remainder of construction period to avoid clogging with dirt and debris and to prevent damage from traffic and construction work.

C. Place plugs in ends of uncompleted piping at end of day and when work stops.

D. Exposed PVC Piping: Protect plumbing vents exposed to sunlight with two coats of water-based latex paint.

E. Repair damage to adjacent materials caused by waste and vent piping installation.

3.9 PIPING SCHEDULE

A. Flanges and unions may be used on aboveground pressure piping unless otherwise indicated.

B. Aboveground, soil and waste piping NPS 3 and smaller shall be any of the following:

1. Service class, cast-iron soil pipe and fittings; gaskets; and gasketed joints.
2. Hubless, cast-iron soil pipe and fittings and hubless, single-stack aerator fittings; CISPI hubless-piping couplings; and coupled joints.
3. Solid-wall PVC pipe, PVC socket fittings, and solvent-cemented joints.

C. Aboveground, soil and waste piping NPS 4 and larger shall be any of the following:

1. Service class, cast-iron soil pipe and fittings; gaskets; and gasketed joints.
2. Hubless, cast-iron soil pipe and fittings and hubless, single-stack aerator fittings; CISPI hubless-piping couplings; and coupled joints.
3. Solid-wall PVC pipe, PVC socket fittings, and solvent-cemented joints.

D. Aboveground, vent piping NPS 3 and smaller shall be any of the following:

1. Service class, cast-iron soil pipe and fittings; gaskets; and gasketed joints.
2. Hubless, cast-iron soil pipe and fittings; hubless-piping couplings; and coupled joints.
3. Solid-wall PVC pipe, PVC socket fittings, and solvent-cemented joints.

E. Aboveground, vent piping NPS 4 and larger shall be any of the following:

1. Service class, cast-iron soil pipe and fittings; gaskets; and gasketed joints.
2. Hubless, cast-iron soil pipe and fittings; hubless-piping couplings; and coupled joints.
3. Solid-wall PVC pipe, PVC socket fittings, and solvent-cemented joints.

F. Underground, soil, waste, and vent piping NPS 3 and smaller shall be any of the following:

1. Service class, cast-iron soil piping; gaskets; and gasketed joints.
2. Hubless, cast-iron soil pipe and fittings; hubless-piping couplings; and coupled joints.
3. Solid wall PVC pipe, PVC socket fittings, and solvent-cemented joints.
G. Underground, soil and waste piping NPS 4 and larger shall be any of the following:
   1. Service class, cast-iron soil piping; gaskets; and gasketed joints.
   2. Hubless, cast-iron soil pipe and fittings; hubless-piping couplings; coupled joints.
   3. Solid-wall PVC pipe; PVC socket fittings; and solvent-cemented joints.

H. Aboveground sanitary-sewage force mains NPS 1-1/2 and NPS 2 shall be the following:
   1. Galvanized-steel pipe, pressure fittings, and threaded joints.

I. Aboveground sanitary-sewage force mains NPS 2-1/2 to NPS 6 shall be the following:
   1. Grooved-end, galvanized-steel pipe; grooved-joint, galvanized-steel-pipe appurtenances; and grooved joints.

J. Underground sanitary-sewage force mains NPS 4 and smaller shall be any of the following:
   1. Hard copper tube, Type L; copper pressure fittings; and soldered joints.
   2. Ductile-iron, mechanical-joint piping and mechanical joints.
   3. Ductile-iron, push-on-joint piping and push-on joints.
   4. Ductile-iron, grooved-joint piping and grooved joints.
   5. Fitting-type transition coupling for piping smaller than NPS 1-1/2 and pressure transition coupling for NPS 1-1/2 and larger if dissimilar pipe materials.

K. Underground sanitary-sewage force mains NPS 5 and larger shall be any of the following:
   1. Hard copper tube, Type L; copper pressure fittings; and soldered joints.
   2. Ductile-iron, mechanical-joint piping and mechanical joints.
   3. Ductile-iron, push-on-joint piping and push-on joints.
   4. Ductile-iron, grooved-joint piping and grooved joints.
   5. Pressure transition couplings if dissimilar pipe materials.

END OF SECTION 22 13 16
SECTION 22 13 19
SANITARY WASTE PIPING SPECIALTIES

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. FOG disposal systems.

1.3 DEFINITIONS

B. PVC: Polyvinyl chloride.
C. Ductile - Iron

1.4 ACTION SUBMITTALS

A. Shop Drawings: Submit manufacturer's data for review before any work is commenced

1.5 RELATION TO OTHER WORK

A. Refer to the section, "General Plumbing Provisions", for related requirements. Refer to other sections of Division 22 and to all other applicable portions of the Drawings and Specifications.

1.6 INFORMATIONAL SUBMITTALS

A. Seismic Qualification Data: For FOG disposal systems, accessories, and components, from manufacturer.

1.  Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.
2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.
3. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.

1.7 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For sanitary waste piping specialties to include in emergency, operation, and maintenance manuals.
PART 2 - PRODUCTS

2.1 ASSEMBLY DESCRIPTIONS

A. Sanitary waste piping specialties shall bear label, stamp, or other markings of specified testing agency.

B. Comply with NSF 14 for plastic sanitary waste piping specialty components.

C. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing, and marked for intended location and application.

2.2 BACKWATER VALVES

A. Horizontal, Cast-Iron Backwater Valves:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   b. MIFAB, Inc.
   c. WATTS.
   d. Zurn Industries, LLC.

3. Size: Same as connected piping.
5. Cover: Cast iron with access to check valve.
6. Type Check Valve: Removable, bronze, swing check, factory assembled.
7. Extension: ASTM A 74, Service class; full-size, cast-iron, soil-pipe extension to field-installed cleanout at floor; replaces backwater valve cover.

B. Drain-Outlet Backwater Valves:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   b. WATTS.
   c. Zurn Industries, LLC.

2. Size: Same as floor drain outlet.
3. Body: Cast iron or bronze made for vertical installation in bottom outlet of floor drain.
4. Check Valve: Removable ball float.
5. Inlet: Threaded.
6. Outlet: Threaded or spigot.

2.3 CLEANOUTS

A. Cast-Iron Exposed Cleanouts:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
b. MIFAB, Inc.
c. Tyler Pipe; a subsidiary of McWane Inc.
d. WATTS.
e. Zurn Industries, LLC.

2. Standard: ASME A112.36.2M.
3. Size: Same as connected drainage piping
4. Body Material: As required to match connected piping.
5. Closure Plug Size: Same as or not more than one size smaller than cleanout size.

B. Cast-Iron Exposed Floor Cleanouts:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   b. Josam Company.
   c. Oatey.
   d. Sioux Chief Manufacturing Company, Inc.
   e. Tyler Pipe; a subsidiary of McWane Inc.
   f. WATTS.
   g. Zurn Industries, LLC.

2. Standard: ASME A112.36.2M for cleanout.
3. Size: Same as connected branch.
4. Body or Ferrule: Cast iron.
5. Clamping Device: Required.
6. Outlet Connection: Threaded.
7. Adjustable Housing Material: Cast iron with threads.
8. Frame and Cover Shape: Round.
9. Riser: ASTM A 74, Service class, cast-iron drainage pipe fitting and riser to cleanout.

C. Cast-Iron Wall Cleanouts:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   b. MIFAB, Inc.
   c. WATTS.
   d. Zurn Industries, LLC.

2. Standard: ASME A112.36.2M. Include wall access.
3. Size: Same as connected drainage piping.
4. Body: Hubless, cast-iron soil pipe test tee as required to match connected piping.
5. Closure Plug:
   a. Countersunk head.
   b. Drilled and threaded for cover attachment screw.
   c. Size: Same as or not more than one size smaller than cleanout size.

2.4 **AIR-ADMITTANCE VALVES**

A. Fixture Air-Admittance Valves:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. Studor, Inc.

2. Standard: ASSE 1051, Type A for single fixture or Type B for branch piping.
3. Housing: Plastic.
4. Operation: Mechanical sealing diaphragm.
5. Size: Same as connected fixture or branch vent piping.

B. Stack Air-Admittance Valves:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. Studor, Inc.

2. Standard: ASSE 1050 for vent stacks.
3. Housing: Plastic.
4. Operation: Mechanical sealing diaphragm.
5. Size: Same as connected stack vent or vent stack.

C. Wall Box for Air-Admittance Valves:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. Studor, Inc.

2. Description: White plastic housing with white plastic grille, made for recessed installation. Include bottom pipe connection and space to contain one air-admittance valve.
3. Size: About 9 inches wide by 8 inches high by 4 inches deep.

2.5 **ROOF FLASHING ASSEMBLIES**

A. Roof Flashing Assemblies:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   b. Thaler Metal Industries Ltd.
   c. Zurn Industries, LLC.

2. Description: Manufactured assembly made of 6.0-lb/sq. ft., 0.0938-inch- thick, lead flashing collar and skirt extending at least 6 inches from pipe, with galvanized-steel boot reinforcement and counterflash ing fitting.
   b. Low-Silhouette Vent Cap: With vandal-proof vent cap.
c. Extended Vent Cap: With field-installed, vandal-proof vent cap.

2.6 THROUGH-PENETRATION FIRESTOP ASSEMBLIES

A. Through-Penetration Firestop Assemblies:

1. Manufacturers: Subject to compliance with requirements, provide products by the following:
   a. ProSet Systems Inc.


3. Size: Same as connected soil, waste, or vent stack.

4. Sleeve: Molded-PVC plastic, of length to match slab thickness and with integral nailing flange on one end for installation in cast-in-place concrete slabs.


6. Special Coating: Corrosion resistant on interior of fittings.

2.7 MISCELLANEOUS SANITARY DRAINAGE PIPING SPECIALTIES

A. Open Drains:

1. Description: Shop or field fabricate from ASTM A 74, Service class, hub-and-spigot, cast-iron soil-pipe fittings. Include P-trap, hub-and-spigot riser section; and where required, increaser fitting joined with ASTM C 564 rubber gaskets.

2. Size: Same as connected waste piping.

B. Deep-Seal Traps:

1. Description: Cast-iron or bronze casting, with inlet and outlet matching connected piping and cleanout trap-seal primer valve connection.

2. Size: Same as connected waste piping.

   a. NPS 2: 4-inch-minimum water seal.

   b. NPS 2-1/2 and Larger: 5-inch-minimum water seal.

C. Floor-Drain, Trap-Seal Primer Fittings:

1. Description: Cast iron, with threaded inlet and threaded or spigot outlet, and trap-seal primer valve connection.

2. Size: Same as floor drain outlet with NPS 1/2 side inlet.

D. Air-Gap Fittings:

1. Standard: ASME A112.1.2, for fitting designed to ensure fixed, positive air gap between installed inlet and outlet piping.

2. Body: Bronze or cast iron.

3. Inlet: Opening in top of body.

4. Outlet: Larger than inlet.

5. Size: Same as connected waste piping and with inlet large enough for associated indirect waste piping.
E. Sleeve Flashing Device:
   1. Description: Manufactured, cast-iron fitting, with clamping device that forms sleeve for pipe floor penetrations of floor membrane. Include galvanized-steel pipe extension in top of fitting that will extend 2 inches above finished floor and galvanized-steel pipe extension in bottom of fitting that will extend through floor slab.
   2. Size: As required for close fit to riser or stack piping.

F. Stack Flashing Fittings:
   1. Description: Counterflashing-type, cast-iron fitting, with bottom recess for terminating roof membrane, and with threaded or hub top for extending vent pipe.
   2. Size: Same as connected stack vent or vent stack.

G. Vent Caps:
   1. Description: Cast-iron body with threaded or hub inlet and vandal-proof design. Include vented hood and setscrews to secure to vent pipe.
   2. Size: Same as connected stack vent or vent stack.

H. Expansion Joints:
   2. Body: Cast iron with bronze sleeve, packing, and gland.
   3. End Connections: Matching connected piping.
   4. Size: Same as connected soil, waste, or vent piping.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install backwater valves in building drain piping.
   1. For interior installation, provide cleanout deck plate flush with floor and centered over backwater valve cover, and of adequate size to remove valve cover for servicing.

B. Install cleanouts in aboveground piping and building drain piping according to the following, unless otherwise indicated:
   1. Size same as drainage piping up to NPS 4. Use NPS 4 for larger drainage piping unless larger cleanout is indicated.
   2. Locate at each change in direction of piping greater than 45 degrees.
   3. Locate at minimum intervals of 50 feet for piping NPS 4 and smaller and 100 feet for larger piping.
   4. Locate at base of each vertical soil and waste stack.

C. For floor cleanouts for piping below floors, install cleanout deck plates with top flush with finished floor.

D. For cleanouts located in concealed piping, install cleanout wall access covers, of types indicated, with frame and cover flush with finished wall.

E. Install fixture air-admittance valves on fixture drain piping.
F. Install stack air-admittance valves at top of stack vent and vent stack piping.

G. Install air-admittance-valve wall boxes recessed in wall.

H. Install roof flashing assemblies on sanitary stack vents and vent stacks that extend through roof. Comply with requirements in Section 07 62 00 "Sheet Metal Flashing and Trim."

I. Install flashing fittings on sanitary stack vents and vent stacks that extend through roof. Comply with requirements in Section 07 62 00 "Sheet Metal Flashing and Trim."

J. Install deep-seal traps on floor drains and other waste outlets, if indicated.

K. Install floor-drain, trap-seal primer fittings on inlet to floor drains that require trap-seal primer connection.
   1. Exception: Fitting may be omitted if trap has trap-seal primer connection.
   2. Size: Same as floor drain inlet.

L. Install air-gap fittings on draining-type backflow preventers and on indirect-waste piping discharge into sanitary drainage system.

M. Install sleeve and sleeve seals with each riser and stack passing through floors with waterproof membrane.

N. Install vent caps on each vent pipe passing through roof.

O. Install frost-resistant vent terminals on each vent pipe passing through roof. Maintain 1-inch clearance between vent pipe and roof substrate.

P. Install expansion joints on vertical stacks and conductors. Position expansion joints for easy access and maintenance.

Q. Install frost-proof vent caps on each vent pipe passing through roof. Maintain 1-inch clearance between vent pipe and roof substrate.

3.2 CONNECTIONS

A. Comply with requirements in Section 22 13 16 "Sanitary Waste and Vent Piping" for piping installation requirements. Drawings indicate general arrangement of piping, fittings, and specialties.

B. Install piping adjacent to equipment to allow service and maintenance.

3.3 FLASHING INSTALLATION

A. Comply with requirements in Section 07 62 00 "Sheet Metal Flashing and Trim."

B. Fabricate flashing from single piece unless large pans, sumps, or other drainage shapes are required.

C. Install sheet flashing on pipes, sleeves, and specialties passing through or embedded in floors and roofs with waterproof membrane.
1. Pipe Flashing: Sleeve type, matching pipe size, with minimum length of 10 inches, and skirt or flange extending at least 8 inches around pipe.
2. Sleeve Flashing: Flat sheet, with skirt or flange extending at least 8 inches around sleeve.
3. Embedded Specialty Flashing: Flat sheet, with skirt or flange extending at least 8 inches around specialty.

D. Set flashing on floors and roofs in solid coating of bituminous cement.

E. Secure flashing into sleeve and specialty clamping ring or device.

F. Install flashing for piping passing through roofs with counterflashing or commercially made flashing fittings, according to Section 07 62 00 "Sheet Metal Flashing and Trim."

G. Extend flashing up vent pipe passing through roofs and turn down into pipe, or secure flashing into cast-iron sleeve having calking recess.

3.4 LABELING AND IDENTIFYING

A. Distinguish among multiple units, inform operator of operational requirements, indicate safety and emergency precautions, and warn of hazards and improper operations, in addition to identifying unit.

1. Nameplates and signs are specified in Section 22 05 53 "Identification for Plumbing Piping and Equipment."

3.5 FIELD QUALITY CONTROL

A. Tests and Inspections:

1. Leak Test: After installation, charge system and test for leaks. Repair leaks and retest until no leaks exist.
2. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

3.6 PROTECTION

A. Protect drains during remainder of construction period to avoid clogging with dirt or debris and to prevent damage from traffic or construction work.

B. Place plugs in ends of uncompleted piping at end of each day or when work stops.

END OF SECTION 22 13 19
SECTION 22 13 19.13
SANITARY DRAINS

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. Floor drains.
   2. Floor sinks.

1.3 DEFINITIONS

A. Refer to the section, "General Mechanical Provisions", for related requirements. Refer to other sections of Division 22 and to all other applicable portions of the Drawings and Specifications.

1.4 SUBMITTALS

A. Submit manufacturer's data for review before any work is commenced

1.5 RELATION TO OTHER WORK

A. Refer to the section, "General Plumbing Provisions", for related requirements. Refer to other sections of Division 22 and to all other applicable portions of the Drawings and Specifications.

PART 2 - PRODUCTS

2.1 DRAIN ASSEMBLIES

A. Sanitary drains shall bear label, stamp, or other markings of specified testing agency.

B. Comply with NSF 14 for plastic sanitary piping specialty components.

2.2 FLOOR DRAINS

A. Cast-Iron Floor Drains
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      b. MIFAB, Inc.
      c. WATTS.
      d. Zurn Industries, LLC.
   2. Standard: ASME A112.6.3
B. Stainless-Steel Floor Drains, ASME A112.3.1
   1. Manufacturers: Subject to compliance with requirements, provide products by the following:
      a. Zurn Industries, LLC.

C. Stainless-Steel Floor Drains, ASME A112.6.3
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      b. Josam Company.
      c. Sioux Chief Manufacturing Company, Inc.
      d. WATTS.
      e. Zurn Industries, LLC.

2.3 FLOOR SINKS
A. Cast-Iron Floor Sinks
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      b. Wade; a subsidiary of McWane Inc.
      c. Watts; a Watts Water Technologies company.
      d. Zurn Industries, LLC.

B. Stainless-Steel Floor Sinks, ASME A112.6.7:
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      b. Watts; a Watts Water Technologies company.
      c. Zurn Industries, LLC.

PART 3 - EXECUTION
3.1 INSTALLATION
A. Install floor drains at low points of surface areas to be drained. Set grates of drains flush with finished floor, unless otherwise indicated.
   1. Position floor drains for easy access and maintenance.
   2. Set floor drains below elevation of surrounding finished floor to allow floor drainage.
3. Set with grates depressed according to the following drainage area radii:
   a. Radius, 30 Inches or Less: Equivalent to 1 percent slope, but not less than 1/4-inch total depression.
   b. Radius, 30 to 60 Inches: Equivalent to 1 percent slope.
   c. Radius, 60 Inches or Larger: Equivalent to 1 percent slope, but not greater than 1-inch total depression.

4. Install floor-drain flashing collar or flange, so no leakage occurs between drain and adjoining flooring.
   a. Maintain integrity of waterproof membranes where penetrated.

5. Install individual traps for floor drains connected to sanitary building drain, unless otherwise indicated.

3.2 CONNECTIONS

A. Comply with requirements in Section 22 13 16 "Sanitary Waste and Vent Piping" for piping installation requirements. Drawings indicate general arrangement of piping, fittings, and specialties.

B. Comply with requirements in Section 22 13 19 "Sanitary Waste Piping Specialties" for backwater valves, air admittance devices and miscellaneous sanitary drainage piping specialties.

C. Install piping adjacent to equipment to allow service and maintenance.

3.3 LABELING AND IDENTIFYING

A. Distinguish among multiple units, inform operator of operational requirements, indicate safety and emergency precautions, and warn of hazards and improper operations, in addition to identifying unit. Nameplates and signs are specified in Section 22 05 53 "Identification for Plumbing Piping and Equipment."

3.4 PROTECTION

A. Protect drains during remainder of construction period to avoid clogging with dirt or debris and to prevent damage from traffic or construction work.

B. Place plugs in ends of uncompleted piping at end of each day or when work stops.

3.5 TRAP PRIMERS

A. Trap primer outlet should extend vertically a minimum of 12" before a change in direction to horizontal is made. The horizontal line to the trap primer connection shall be installed sloping to the trap it serves. Provide a minimum size of 12" x 12" stainless steel access cover for each trap primer.

END OF SECTION 22 13 19.13
SECTION 22 14 13
FACILITY STORM DRAINAGE PIPING

PART 1 - GENERAL

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

1.2 RELATION TO OTHER WORK
A. Refer to the section, "General Plumbing Provisions", for related requirements. Refer to other sections of Division 22 and to all other applicable portions of the Drawings and Specifications.

1.3 SUMMARY
A. Section Includes:
   2. Hubless, cast-iron soil pipe and fittings.
   3. Ductile-iron pipe and fittings.
   4. PVC pipe and fittings.
   5. Specialty pipe and fittings.

1.4 SUBMITTALS
A. Submit manufacturer’s data for review before any work is commenced.

1.5 QUALITY ASSURANCE
A. Piping materials shall bear label, stamp, or other markings of specified testing agency.

1.6 FIELD CONDITIONS

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS
A. Components and installation shall be capable of withstanding the following minimum working pressure unless otherwise indicated:
   1. Storm Drainage Piping: 10-foot head of water.
   2. Storm Drainage, Force-Main Piping: 150 psig

2.2 HUB-AND-SPIGOT, CAST-IRON SOIL PIPE AND FITTINGS
A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   1. AB & I Foundry; a part of the McWane family of companies.
   2. Charlotte Pipe and Foundry Company.
   3. NewAge Casting.
   4. Tyler Pipe; a part of McWane family of companies.
B. Pipe and Fittings:
   1. Marked with CISPI collective trademark and NSF certification mark.
   2. Class: ASTM A 74, **Service** class.

C. Gaskets: ASTM C 564, rubber.

D. Caulking Materials: ASTM B 29, pure lead and oakum or hemp fiber.

### 2.3 HUBLESS, CAST-IRON SOIL PIPE AND FITTINGS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   1. AB & I Foundry; a part of the McWane family of companies.
   2. Charlotte Pipe and Foundry Company.
   3. NewAge Casting.
   4. Tyler Pipe; a part of McWane family of companies.

B. Pipe and Fittings:
   1. Marked with CISPI collective trademark and NSF certification mark.
   2. Standard: ASTM A 888 or CISPI 301.

C. CISPI, Hubless-Piping Couplings:
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. ANACO-Husky.
      b. Charlotte Pipe and Foundry Company.
      d. Fermco Inc.
      e. Ideal Clamp Products, Inc.
      f. Matco-Norca.
      g. MIFAB, Inc.
      h. Mission Rubber Company, LLC; a division of MCP Industries.
      i. NewAge Casting.
      j. Tyler Pipe; a subsidiary of McWane Inc.

   2. Couplings shall bear CISPI collective trademark and NSF certification mark.
   4. Description: Stainless-steel corrugated shield with stainless-steel bands and tightening devices; and ASTM C 564, rubber sleeve with integral, center pipe stop.

D. Heavy-Duty, Hubless-Piping Couplings:
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. ANACO-Husky.
      b. Charlotte Pipe and Foundry Company.
      c. Clamp-All Corp.
e. Ideal Clamp Products, Inc.
f. MIFAB, Inc.
g. Mission Rubber Company, LLC; a division of MCP Industries.
h. NewAge Casting.
i. Tyler Pipe; a subsidiary of McWane Inc.

3. Description: Stainless-steel shield with stainless-steel bands and tightening devices; and ASTM C 564, rubber sleeve with integral, center pipe stop.

E. Cast-Iron, Hubless-Piping Couplings:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   b. MG Piping Products Company.

3. Description: Two-piece ASTM A 48/A 48M, cast-iron housing; stainless-steel bolts and nuts; and ASTM C 564, rubber sleeve with integral, center pipe stop.

2.4 DUCTILE-IRON PIPE AND FITTINGS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. American Ductile Iron Pipe.
2. McWane Ductile.

B. Ductile-Iron, Mechanical-Joint Piping:

1. Ductile-Iron Pipe: AWWA C151/A21.51, with mechanical-joint bell and plain spigot end unless grooved or flanged ends are indicated.
3. Glands, Gaskets, and Bolts: AWWA C111/A21.11, ductile- or gray-iron glands, rubber gaskets, and steel bolts.

C. Ductile-Iron, Push-on-Joint Piping:

1. Ductile-Iron Pipe: AWWA C151/A21.51, with push-on-joint bell and plain spigot end unless grooved or flanged ends are indicated.

D. Ductile-Iron, Grooved-Joint Piping:

2. Ductile-Iron, Grooved-End Pipe Appurtenances:
   a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      1) Anvil International.
      2) Shurjoint Piping Products USA Inc.
      3) Smith-Cooper International.
      4) Star Pipe Products.
      5) Victaulic Company.
   c. Grooved Mechanical Couplings for Ductile-Iron Pipe: ASTM F 1476, Type I. Include ferrous housing sections with continuous curved keys; EPDM-rubber center-leg gasket suitable for hot and cold water; and bolts and nuts.

2.5 PVC PIPE AND FITTINGS
   A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      2. GF Piping Systems.
      3. JM Eagle.
      7. Rocky Mountain Colby Pipe Company.
      8. Silver-line Plastics.
   C. Solid-Wall PVC Pipe: ASTM D 2665; drain, waste, and vent.
   D. Use of PVC in return air plenums (i.e., office area) and through fire rated assemblies will not be permitted.
   E. Cellular-Core PVC Pipe: ASTM F 891, Schedule 40.
   F. PVC Socket Fittings: ASTM D 2665, made to ASTM D 3311, drain, waste, and vent patterns and to fit Schedule 40 pipe.
   G. Adhesive Primer: ASTM F 656.

2.6 SPECIALTY PIPE FITTINGS
   A. Transition Couplings:
1. General Requirements: Fitting or device for joining piping with small differences in ODs or of different materials. Include end connections same size as and compatible with pipes to be joined.

2. Fitting-Type Transition Couplings: Manufactured piping coupling or specified-piping-system fitting.

3. Unshielded, Nonpressure Transition Couplings:
   a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      2) Fernco Inc.
      3) Mission Rubber Company, LLC; a division of MCP Industries.
      4) Plastic Oddities.
   c. Description: Elastomeric sleeve, reducing or transition pattern. Include shear ring and corrosion-resistant-metal tension band and tightening mechanism on each end.
   d. Sleeve Materials:
      2) For Plastic Pipes: ASTM F 477, elastomeric seal or ASTM D 5926, PVC.
      3) For Dismimilar Pipes: ASTM D 5926, PVC or other material compatible with pipe materials being joined.

4. Shielded, Nonpressure Transition Couplings:
   a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      2) Mission Rubber Company, LLC; a division of MCP Industries.
   c. Description: Elastomeric or rubber sleeve with full-length, corrosion-resistant outer shield and corrosion-resistant-metal tension band and tightening mechanism on each end.
   d. End Connections: Same size as and compatible with pipes to be joined.

5. Pressure Transition Couplings:
   a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      2) EBAA Iron, Inc.
      3) Ford Meter Box Company, Inc. (The).
      4) JCM Industries, Inc.
      5) Romac Industries, Inc.
   c. Description: Metal, sleeve-type couplings same size as pipes to be joined, and with pressure rating at least equal to and ends compatible with pipes to be joined.
d. Gasket Material: Natural or synthetic rubber.

e. Metal Component Finish: Corrosion-resistant coating or material.

B. Dielectric Fittings:

1. General Requirements: Assembly of copper alloy and ferrous materials with separating nonconductive insulating material. Include end connections compatible with pipes to be joined.

2. Dielectric Unions:

   a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

      1) A.Y. McDonald Mfg. Co.
      2) Capitol Manufacturing Company.
      3) Central Plastics Company.
      4) HART Industrial Unions, LLC.
      5) Jomar Valve.
      6) Matco-Norca.
      7) WATTS.
      8) Zurn Industries, LLC.

   b. Description:

      1) Standard: ASSE 1079.
      2) Pressure Rating: 150 psig minimum at 180 deg F.
      3) End Connections: Solder-joint copper alloy and threaded ferrous.

3. Dielectric Flanges:

   a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

      1) Central Plastics Company.
      2) Matco-Norca.
      3) WATTS.
      4) Zurn Industries, LLC.

   b. Description:

      1) Standard: ASSE 1079.
      2) Factory-fabricated, bolted, companion-flange assembly.
      3) Pressure Rating: 150 psig minimum at 180 deg F.
      4) End Connections: Solder-joint copper alloy and threaded ferrous; threaded solder-joint copper alloy and threaded ferrous.

4. Dielectric-Flange Insulating Kits:

   a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

      1) Advance Products & Systems, Inc.
      2) Calpico, Inc.
      3) Central Plastics Company.
4) GPT; an EnPro Industries company.

b. Description:

1) Nonconducting materials for field assembly of companion flanges.
2) Pressure Rating: 150 psig
3) Gasket: Neoprene or phenolic.
4) Bolt Sleeves: Phenolic or polyethylene.

5. Dielectric Nipples:

a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1) Grinnell Mechanical Products.
2) Matco-Norca.
3) Precision Plumbing Products.
4) Victaulic Company.

b. Description: Electroplated steel nipple.


d. Pressure Rating: 300 psig at 225 deg F.

e. End Connections: Male threaded or grooved.

f. Lining: Inert and noncorrosive, propylene.

PART 3 - EXECUTION

3.1 PIPING INSTALLATION

A. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems.

1. Indicated locations and arrangements were used to size pipe and calculate friction loss, expansion, pump sizing, and other design considerations.
2. Install piping as indicated unless deviations from layout are approved on coordination drawings.

B. Install piping in concealed locations unless otherwise indicated and except in equipment rooms and service areas.

C. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.

D. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal.

E. Install piping to permit valve servicing.

F. Install piping at indicated slopes.

G. Install piping free of sags and bends.

H. Install fittings for changes in direction and branch connections.
I. Install piping to allow application of insulation.

J. Use of PVC in return air plenums (i.e., office area) and through fire rated assemblies will not be permitted.

K. Make changes in direction for piping using appropriate branches, bends, and long-sweep bends.
   1. Do not change direction of flow more than 90 degrees.
   2. Use proper size of standard increasers and reducers if pipes of different sizes are connected.
      a. Reducing size of drainage piping in direction of flow is prohibited.

L. Lay buried building piping beginning at low point of each system.
   1. Install true to grades and alignment indicated, with unbroken continuity of invert. Place hub ends of piping upstream.
   2. Install required gaskets according to manufacturer's written instructions for use of lubricants, cements, and other installation requirements.
   3. Maintain swab in piping and pull past each joint as completed.

M. Install piping at the following minimum slopes unless otherwise indicated:
   1. Building Storm Drain: 2 percent downward in direction of flow for piping NPS 3 and smaller; 1 percent downward in direction of flow for piping NPS 4 and larger.
   2. Horizontal Storm Drainage Piping: 2 percent downward in direction of flow.

N. Install cast-iron soil piping according to CISPI’s "Cast Iron Soil Pipe and Fittings Handbook," Chapter IV, "Installation of Cast Iron Soil Pipe and Fittings."
   1. Install encasement on underground piping according to ASTM A 674 or AWWA C105/A 21.5.

O. Install aboveground PVC piping according to ASTM D 2665.

P. Install underground PVC piping according to ASTM D 2321.

Q. Install underground, ductile-iron, force-main piping according to AWWA C600.
   1. Install buried piping inside building between wall and floor penetrations and connection to storm sewer piping outside building with restrained joints.
   2. Anchor pipe to wall or floor. Install thrust-block supports at vertical and horizontal offsets.
   3. Install encasement on piping according to ASTM A 674 or AWWA C105/A 21.5.

R. Install force mains at elevations indicated.

S. Plumbing Specialties:
   1. Install backwater valves in storm drainage gravity-flow piping.
      a. Comply with requirements for backwater valves specified in Section 22 14 23 "Storm Drainage Piping Specialties."
2. Install cleanouts at grade and extend to where building storm drains connect to building storm sewers in storm drainage gravity-flow piping.
   a. Install cleanout fitting with closure plug inside the building in storm drainage force-main piping.
   b. Comply with requirements for cleanouts specified in Section 22 14 23 "Storm Drainage Piping Specialties."

3. Install drains in storm drainage gravity-flow piping.
   a. Comply with requirements for drains specified in Section 22 14 23 "Storm Drainage Piping Specialties."

T. Do not enclose, cover, or put piping into operation until it is inspected and approved by authorities having jurisdiction.

U. Install escutcheons for piping penetrations of walls, ceilings, and floors.

3.2 JOINT CONSTRUCTION


C. Hubless, Cast-Iron Soil Piping Coupled Joints:

D. Threaded Joints: Thread pipe with tapered pipe threads according to ASME B1.20.1.
   1. Cut threads full and clean using sharp dies.
   2. Ream threaded pipe ends to remove burrs and restore full ID. Join pipe fittings and valves as follows:
      a. Apply appropriate tape or thread compound to external pipe threads unless dry seal threading is specified.
      b. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged.
      c. Do not use pipe sections that have cracked or open welds.

E. Grooved Joints: Cut groove ends of pipe according to AWWA C606. Lubricate and install gasket over ends of pipes or pipe and fittings. Install coupling housing sections, over gasket, with keys seated in piping grooves. Install and tighten housing bolts.

F. Flanged Joints: Align bolt holes. Select appropriate gasket material, size, type, and thickness. Install gasket concentrically positioned. Use suitable lubricants on bolt threads. Torque bolts in cross pattern.

G. Plastic, Nonpressure-Piping, Solvent-Cemented Joints: Clean and dry joining surfaces. Join pipe and fittings according to the following:
1. Comply with ASTM F 402 for safe-handling practice of cleaners, primers, and solvent cements.
2. PVC Piping: Join according to ASTM D 2855 and ASTM D 2665 appendices.

H. Joint Restraints and Sway Bracing:
1. Provide joint restraints and sway bracing for storm drainage piping joints to comply with the following conditions:
   a. Provide axial restraint for pipe and fittings 5 inches and larger, upstream and downstream of all changes in direction, branches, and changes in diameter greater than two pipe sizes.
   b. Provide rigid sway bracing for pipe and fittings 4 inches and larger, upstream and downstream of all changes in direction 45 degrees and greater.
   c. Provide rigid sway bracing for pipe and fittings 5 inches and larger, upstream and downstream of all changes in direction and branch openings.

3.3 SPECIALTY PIPE FITTING INSTALLATION

A. Transition Couplings:
   1. Install transition couplings at joints of piping with small differences in ODs.
   2. In Drainage Piping: nonpressure transition couplings.
   4. In Underground Force-Main Piping:
      a. NPS 1-1/2 and Smaller: Fitting-type transition couplings.
      b. NPS 2 and Larger: Pressure transition couplings.

B. Dielectric Fittings:
   1. Install dielectric fittings in piping at connections of dissimilar metal piping and tubing.
   2. Dielectric Fittings for NPS 2 and Smaller: Use dielectric nipples.
   3. Dielectric Fittings for NPS 2-1/2 to NPS 4: Use dielectric flanges.
   4. Dielectric Fittings for NPS 5 and Larger: Use dielectric flange kits.

3.4 VALVE INSTALLATION

A. General valve installation requirements for general-duty valve installations are specified in the following Sections:
   1. Section 22 05 23.12 "Ball Valves for Plumbing Piping."
   2. Section 22 05 23.13 "Butterfly Valves for Plumbing Piping."
   3. Section 22 05 23.14 "Check Valves for Plumbing Piping."
   4. Section 22 05 23.15 "Gate Valves for Plumbing Piping."

B. Shutoff Valves:
   1. Install shutoff valve on each sump pump discharge.
   2. Install full port ball valve for piping NS 2 and smaller.
   3. Install gate valve for piping NPS 2-1/2 and larger.

C. Check Valves: Install swing-check valve, between pump and shutoff valve, on each sump pump discharge.
D. Backwater Valves: Install backwater valves in piping subject to backflow.
   1. Horizontal Piping: Horizontal backwater valves
   2. Install backwater valves in accessible locations.
   3. Comply with requirements for backwater valves specified in Section 22 14 23 "Storm Drainage Piping Specialties."

3.5 HANGER AND SUPPORT INSTALLATION

A. Comply with requirements for pipe hanger and support devices and installation specified in Section 22 05 29 "Hangers and Supports for Plumbing Piping and Equipment."

   1. Install carbon-steel pipe hangers for horizontal piping in noncorrosive environments.
   2. Install stainless-steel pipe hangers for horizontal piping in corrosive environments.
   3. Install carbon-steel pipe support clamps for vertical piping in noncorrosive environments.
   4. Install stainless-steel pipe support clamps for vertical piping in corrosive environments.
   5. Vertical Piping: MSS Type 8 or Type 42, clamps.
   6. Install individual, straight, horizontal piping runs:
      a. 100 Feet and Less: MSS Type 1, adjustable, steel clevis hangers.
      b. Longer Than 100 Feet: MSS Type 43, adjustable roller hangers.
      c. Longer Than 100 Feet if Indicated: MSS Type 49, spring cushion rolls.

   7. Multiple, Straight, Horizontal Piping Runs 100 Feet or Longer: MSS Type 44, pipe rolls. Support pipe rolls on trapeze.
   8. Base of Vertical Piping: MSS Type 52, spring hangers.

B. Support horizontal piping and tubing within 12 inches of each fitting, valve, and coupling.

C. Support vertical piping and tubing at base and at each floor.

D. Rod diameter may be reduced one size for double-rod hangers, with 3/8-inch minimum rods.

E. Install hangers for cast-iron soil piping with the following maximum horizontal spacing and minimum rod diameters:

   1. NPS 1-1/2 and NPS 2: 60 inches with 3/8-inch rod.
   2. NPS 3: 60 inches with 1/2-inch rod.
   3. NPS 4 and NPS 5: 60 inches with 5/8-inch rod.
   4. NPS 6 and NPS 8: 60 inches with 3/4-inch rod.
   5. NPS 10 and NPS 12: 60 inches with 7/8-inch rod.
   6. Spacing for 10-foot pipe lengths may be increased to 10 feet. Spacing for fittings is limited to 60 inches.

F. Install supports for vertical cast-iron soil piping every 15 feet.

G. Install hangers for PVC piping with the following maximum horizontal spacing and minimum rod diameters:

   1. NPS 1-1/2 and NPS 2: 48 inches with 3/8-inch rod.
   2. NPS 3: 48 inches with 1/2-inch rod.
   3. NPS 4 and NPS 5: 48 inches with 5/8-inch rod.
   4. NPS 6 and NPS 8: 48 inches with 3/4-inch rod.
   5. NPS 10 and NPS 12: 48 inches with 7/8-inch rod.
H. Install supports for vertical PVC piping every 48 inches.

I. Support piping and tubing not listed above according to MSS SP-58 and manufacturer's written instructions.

3.6 CONNECTIONS

A. Drawings indicate general arrangement of piping, fittings, and specialties.

B. Connect interior storm drainage piping to exterior storm drainage piping. Use transition fitting to join dissimilar piping materials.

C. Connect storm drainage piping to roof drains and storm drainage specialties.
   1. Install test tees (wall cleanouts) in conductors near floor, and floor cleanouts with cover flush with floor.
   2. Install horizontal backwater valves in pit with pit cover flush with floor.
   3. Comply with requirements for backwater valves, cleanouts and drains specified in Section 22 14 23 "Storm Drainage Piping Specialties."

D. Where installing piping adjacent to equipment, allow space for service and maintenance.

E. Make connections according to the following unless otherwise indicated:
   1. Install unions, in piping NPS 2 and smaller, adjacent to each valve and at final connection to each piece of equipment.
   2. Install flanges, in piping NPS 2-1/2 and larger, adjacent to flanged valves and at final connection to each piece of equipment.

3.7 IDENTIFICATION

A. Identify exposed storm drainage piping.

B. Comply with requirements for identification specified in Section 22 05 53 "Identification for Plumbing Piping and Equipment."

3.8 FIELD QUALITY CONTROL

A. During installation, notify authorities having jurisdiction at least 24 hours before inspection must be made. Perform tests specified below in presence of authorities having jurisdiction.
   1. Roughing-in Inspection: Arrange for inspection of piping before concealing or closing-in after roughing-in.
   2. Final Inspection: Arrange for final inspection by authorities having jurisdiction to observe tests specified below and to ensure compliance with requirements.

B. Test storm drainage piping according to procedures of authorities having jurisdiction or, in absence of published procedures, as follows:
   1. Test for leaks and defects in new piping and parts of existing piping that have been altered, extended, or repaired.
      a. If testing is performed in segments, submit separate report for each test, complete with diagram of portion of piping tested.
2. Leave uncovered and unconcealed new, altered, extended, or replaced storm drainage piping until it has been tested and approved.
   a. Expose work that was covered or concealed before it was tested.

3. Test Procedure:
   a. Test storm drainage piping on completion of roughing-in.
   b. Close openings in piping system and fill with water to point of overflow, but not less than 10-foot head of water. From 15 minutes before inspection starts until completion of inspection, water level must not drop. Inspect joints for leaks.

4. Repair leaks and defects with new materials and retest piping, or portion thereof, until satisfactory results are obtained.
5. Prepare reports for tests and required corrective action.

C. Test force-main piping according to procedures of authorities having jurisdiction or, in absence of published procedures, as follows:
   1. Leave uncovered and unconcealed new, altered, extended, or replaced force-main piping until it has been tested and approved.
      a. Expose work that was covered or concealed before it was tested.
   2. Cap and subject piping to static-water pressure of 50 psig above operating pressure, without exceeding pressure rating of piping system materials.
      a. Isolate test source and allow to stand for four hours. Leaks and loss in test pressure constitute defects that must be repaired.
   3. Repair leaks and defects with new materials and retest piping, or portion thereof, until satisfactory results are obtained.
   4. Prepare reports for tests and required corrective action.

D. Piping will be considered defective if it does not pass tests and inspections.

E. Prepare test and inspection reports.

3.9 CLEANING AND PROTECTION

A. Clean interior of piping. Remove dirt and debris as work progresses.

B. Protect drains during remainder of construction period to avoid clogging with dirt and debris and to prevent damage from traffic and construction work.

C. Place plugs in ends of uncompleted piping at end of day and when work stops.

3.10 PIPING SCHEDULE

A. Flanges and unions may be used on aboveground pressure piping unless otherwise indicated.

B. Aboveground storm drainage piping NPS 6 and smaller shall be any of the following:
   1. Service class, cast-iron soil pipe and fittings; gaskets; and gasketed joints.
2. Hubless, cast-iron soil pipe and fittings; CISPI, hubless-piping couplings; and coupled joints.
4. Copper Type DWV tube, copper drainage fittings, and soldered joints.
5. Solid-wall ABS pipe, ABS socket fittings, and solvent-cemented joints.
6. Solid-wall PVC pipe, PVC socket fittings, and solvent-cemented joints.

C. Aboveground, storm drainage piping NPS 8 and larger shall be any of the following:

1. Service class, cast-iron soil pipe and fittings; gaskets; and gasketed joints.
2. Hubless, cast-iron soil pipe and fittings; heavy-duty, hubless-piping couplings; and coupled joints.
4. Copper Type DWV tube, copper drainage fittings, and soldered joints.
5. Solid-wall PVC pipe, PVC socket fittings, and solvent-cemented joints.

D. Underground storm drainage piping NPS 6 and smaller shall be any of the following:

1. Service class, cast-iron soil pipe and fittings; gaskets; and gasketed joints.
2. Hubless, cast-iron soil pipe and fittings; cast-iron, hubless-piping couplings; and coupled joints.
4. Solid-wall PVC pipe, PVC socket fittings, and solvent-cemented joints.

E. Underground, storm drainage piping NPS 8 and larger shall be any of the following:

1. Service class, cast-iron soil pipe and fittings; gaskets; and gasketed joints.
2. Hubless, cast-iron soil pipe and fittings; cast-iron, hubless-piping couplings; and coupled joints.
3. Solid-wall PVC pipe, PVC socket fittings, and solvent-cemented joints.
4. Cellular-core, sewer and drain series, PVC pipe; PVC socket fittings; and solvent-cemented joints.

END OF SECTION 22 14 13
SECTION 22 14 23
STORM DRAINAGE PIPING SPECIALTIES

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 RELATION TO OTHER WORK
A. Refer to the section, "General Plumbing Provisions", for related requirements. Refer to other sections of Division 22 and to all other applicable portions of the Drawings and Specifications.

1.3 SUMMARY
A. Section Includes:
   1. Metal roof drains.
   2. Miscellaneous storm drainage piping specialties.
   3. Cleanouts.
   4. Backwater valves.

1.4 SUBMITTALS
A. Submit manufacturer's data for review before any work is commenced.

1.5 QUALITY ASSURANCE
A. Drainage piping specialties shall bear label, stamp, or other markings of specified testing agency.

PART 2 - PRODUCTS

2.1 MATERIALS
A. Drains shall be of the type and materials as scheduled on the drawings.
B. Provide all necessary bolts, clamping rings and appurtenances to effect a complete installation.
C. Roof drain bearing pan where required shall be by roof drain manufacturer.

2.2 METAL ROOF DRAINS
A. Cast-Iron, Large-Sump, General-Purpose Roof Drains:
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      b. MIFAB, Inc.
      c. Wade; a subsidiary of McWane Inc.
      d. WATTS.

B. Cast-Iron, Medium-Sump, General-Purpose Roof Drains:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   b. Marathon Roofing Products.
   c. MIFAB, Inc.
   d. Wade; a subsidiary of McWane Inc.
   e. WATTS.
   f. Zurn Industries, LLC.


C. Cast-Iron, Small-Sump, General-Purpose Roof Drains:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   b. MIFAB, Inc.
   c. Wade; a subsidiary of McWane Inc.
   d. WATTS.
   e. Zurn Industries, LLC.


D. Metal, Medium-Sump, Deck Roof Drains:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   b. MIFAB, Inc.
   c. Wade; a subsidiary of McWane Inc.
   d. WATTS.
   e. Zurn Industries, LLC.


2.3 MISCELLANEOUS STORM DRAINAGE PIPING SPECIALTIES

A. Conductor Nozzles:

1. Description: Bronze body with threaded inlet and bronze wall flange with mounting holes.
2. Size: Same as connected conductor.
2.4 CLEANOUTS

A. Cast-Iron Exposed Cleanouts:
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      b. MIFAB, Inc.
      c. Wade; a subsidiary of McWane Inc.
      d. WATTS.
      e. Zurn Industries, LLC.
   2. Standard: ASME A112.36.2M.
   3. Size: Same as connected branch.
   4. Closure Plug Size: Same as, or not more than, one size smaller than cleanout size.

B. Cast-Iron Exposed Floor Cleanouts:
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      b. Oatey.
      c. Sioux Chief Manufacturing Company, Inc.
      d. Wade; a subsidiary of McWane Inc.
      e. WATTS.
      f. Zurn Industries, LLC.
   2. Standard: ASME A112.36.2M.
   3. Size: Same as connected branch.

C. Plastic Floor Cleanouts:
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. Canplas LLC.
      b. IPS Corporation.
      c. NDS Inc.
      d. Plastic Oddities.
      e. Sioux Chief Manufacturing Company, Inc.
      f. Zurn Industries, LLC.
   2. Size: Same as connected branch.
   3. Body Material: PVC.
   4. Closure Plug: PVC.
   5. Riser: Drainage pipe fitting and riser to cleanout of same material as drainage piping.

D. Cast-Iron Wall Cleanouts:
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
b. MIFAB, Inc.
c. Wade; a subsidiary of McWane Inc.
d. WATTS.
e. Zurn Industries, LLC.

2. Standard: ASME A112.36.2M. Include wall access.
3. Size: Same as connected drainage piping.

E. Test Tees:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   b. MIFAB, Inc.
   c. WATTS.
   d. Zurn Industries, LLC.
2. Standard: ASME A112.36.2M and ASTM A 74, ASTM A 888, or CISPI 301.
3. Size: Same as connected drainage piping.
4. Body Material: Hub-and-spigot, cast-iron soil-pipe T-branch or no-hub, cast-iron soil-pipe test tee as required to match connected piping.
5. Closure Plug Size: Same as, or not more than, one size smaller than cleanout size.

2.5 BACKWATER VALVES

A. Cast-Iron, Horizontal Backwater Valves:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   b. MIFAB, Inc.
   c. WATTS.
   d. Zurn Industries, LLC.
3. Size: Same as connected piping.
5. Cover: Cast iron with access check valve.
6. Check Valve: Removable, bronze, swing check, factory assembled or field modified Extension: ASTM A 74, Service class; full-size, cast-iron soil-pipe extension to field-installed cleanout at floor; replaces backwater valve cover.

B. Cast-Iron, Drain-Outlet Backwater Valves:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   b. WATTS.
   c. Zurn Industries, LLC.
3. Size: Same as floor drain outlet.
4. Body Material: Cast iron or bronze made for vertical installation in bottom outlet of floor drain.
5. Check Valve: Removable ball float.
6. Inlet: Threaded.
7. Outlet: Threaded or spigot.

C. Plastic, Horizontal Backwater Valves:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. Canplas LLC.
   b. IPS Corporation.
   c. NDS Inc.
   d. Oatey.
   e. Plastic Oddities.
   f. Sioux Chief Manufacturing Company, Inc.
   g. Zurn Industries, LLC.

3. Size: Same as connected piping.
4. Body Material: PVC.
5. Cover: Same material as body with threaded access to check valve.
6. Check Valve: Removable swing check.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install roof drains at low points of roof areas according to roof membrane manufacturer's written installation instructions.
   1. Install flashing collar or flange of roof drain to prevent leakage between drain and adjoining roofing. Maintain integrity of waterproof membranes where penetrated.
   2. Install expansion joints, if indicated, in roof drain outlets.
   3. Position roof drains for easy access and maintenance.

B. Install conductor nozzles at exposed bottom of conductors where they spill onto grade.

C. Install cleanouts in aboveground piping and building drain piping according to the following instructions unless otherwise indicated:
   1. Use cleanouts the same size as drainage piping up to NPS 4. Use NPS 4 for larger drainage piping unless larger cleanout is indicated.
   2. Locate cleanouts at each change in direction of piping greater than 45 degrees.
   3. Locate cleanouts at minimum intervals of 50 feet for piping NPS 4 and smaller and 100 feet for larger piping.
   4. Locate cleanouts at base of each vertical storm piping conductor.

D. For floor cleanouts for piping below floors, install cleanout deck plates with top flush with finished floor.
E. For cleanouts located in concealed piping, install cleanout wall access covers, of types indicated, with frame and cover flush with finished wall.

F. Install horizontal backwater valves in floor with cover flush with floor.

G. Install drain-outlet backwater valves in outlet of drains.

H. Use of PVC in return air plenums (i.e., office area) and through fire rated assemblies will not be permitted.

I. Install test tees in vertical conductors and near floor.

J. Install wall cleanouts in vertical conductors. Install access door in wall if indicated.

K. Install through-penetration firestop assemblies for penetrations of fire- and smoke-rated assemblies.

3.2 CONNECTIONS

A. Comply with requirements for piping specified in Section 22 14 13 "Facility Storm Drainage Piping." Drawings indicate general arrangement of piping, fittings, and specialties.

3.3 FLASHING INSTALLATION

A. Fabricate flashing from single piece of metal unless large pans, sumps, or other drainage shapes are required.

B. Install sheet flashing on pipes, sleeves, and specialties passing through or embedded in floors and roofs with waterproof membrane.

C. Set flashing on floors and roofs in solid coating of bituminous cement.

D. Secure flashing into sleeve and specialty clamping ring or device.

3.4 PROTECTION

A. Protect drains during remainder of construction period to avoid clogging with dirt or debris and to prevent damage from traffic or construction work.

B. Place plugs in ends of uncompleted piping at end of each day or when work stops.

END OF SECTION 22 14 23
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. Submersible sump pumps.
   2. Sump-pump basins.

1.3 RELATION TO OTHER WORK
A. Refer to the section, "General Plumbing Provisions", for related requirements. Refer to other sections of Division 22 and to all other applicable portions of the Drawings and Specifications.

1.4 SUBMITTALS
A. Manufacturer's Literature and Data:
   1. Pump:
      a. Manufacturer and model.
      b. Operating speed.
      c. Capacity.
      d. Characteristic performance curves.
   
B. Certified copies of all the factory and construction site test data sheets and reports.
   
C. Complete operating and maintenance manuals including wiring diagrams, technical data sheets and information for ordering replaceable parts:
      1. Include complete list which indicates all components of the system.
      2. Include complete diagrams of the internal wiring for each item of equipment.
      3. Diagrams shall have their terminals identified to facilitate installation, operation and maintenance.

1.5 DELIVERY, STORAGE, AND HANDLING
A. Retain shipping flange protective covers and protective coatings during storage.
   
B. Protect bearings and couplings against damage.
   
C. Comply with manufacturer's written instructions for handling.
PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

B. UL Compliance: Comply with UL 778 for motor-operated water pumps.

2.2 SUBMERSIBLE SUMP PUMPS

A. Submersible, Fixed-Position, Single-Seal Sump Pumps

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. Stancor, Inc.
   b. Liberty Pumps.
   c. Grundfos Pumps Corp
   d. Zoeller Company.

2. Description: Factory-assembled and -tested sump-pump unit.

3. Pump Type: Submersible, end-suction, single-stage, close-coupled, overhung-impeller, centrifugal sump pump as defined in HI 1.1-1.2 and HI 1.3.

4. Pump Casing: Cast iron, with strainer inlet, legs that elevate pump to permit flow into impeller, and vertical discharge for piping connection.

5. Impeller: Statically and dynamically balanced, ASTM A 532/A 532M, abrasion-resistant cast iron, design for clear wastewater handling, and keyed and secured to shaft.

6. Pump and Motor Shaft: Stainless steel or steel, with factory-sealed, grease-lubricated ball bearings.

7. Seal: Mechanical.

8. Motor: Hermetically sealed, capacitor-start type; with built-in overload protection; lifting eye or lug; and three-conductor, waterproof power cable of length required and with grounding plug and cable-sealing assembly for connection at pump.

9. Controls:
   a. Enclosure: NEMA 250, Type 4X.
   b. Switch Type: Pedestal-mounted float switch with float rods and rod buttons.
   c. Automatic Alternator: Start pumps on successive cycles and start multiple pumps if one cannot handle load.
   d. Float Guides: Pipe or other restraint for floats and rods in basins of depth greater than 60 inches.
   e. High-Water Alarm: Cover-mounted, compression-probe alarm, with electric bell; 120 V ac, with transformer and contacts for remote alarm bell.

10. Control-Interface Features:
   b. Building Automation System Interface: Auxiliary contacts in pump controls for interface to building automation system and capable of providing the following:

      1) On-off status of pump.
      2) Alarm status.
2.3 SUMP-PUMP CAPACITIES AND CHARACTERISTICS

A. Unit Capacity: Min of 50 gpm per elevator

2.4 MOTORS

A. Comply with NEMA designation, temperature rating, service factor, enclosure type, and efficiency requirements for motors specified in Section 22 05 13 "Common Motor Requirements for Plumbing Equipment."

1. Motor Sizes: Minimum size as indicated. If not indicated, large enough so driven load will not require motor to operate in service factor range above 1.0.

B. Motors for submersible pumps shall be hermetically sealed.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine roughing-in for plumbing piping to verify actual locations of storm drainage piping connections before sump pump installation.

3.2 INSTALLATION

A. Pump Installation Standards: Comply with HI 1.4 for installation of sump pumps.

B. Sump: Provided by others. Minimum of 24” (length) x 24” (width) x 24” (depth) concrete basin in the elevator pit.

C. Provide a check and ball valve in the discharge of each pump.

3.3 CONNECTIONS

A. Comply with requirements for piping specified in Section 22 14 13 "Facility Storm Drainage Piping." Drawings indicate general arrangement of piping, fittings, and specialties.

B. Where installing piping adjacent to equipment, allow space for service and maintenance.

3.4 FIELD QUALITY CONTROL

A. Manufacturer's Field Service: Engage a factory-authorized service representative to test, inspect, and adjust components, assemblies, and equipment installations, including connections.

B. Perform the following tests and inspections:

1. Perform each visual and mechanical inspection.
2. Leak Test: After installation, charge system and test for leaks. Repair leaks and retest until no leaks exist.
3. Operational Test: After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation.
4. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
C. Pumps and controls will be considered defective if they do not pass tests and inspections.

D. Prepare test and inspection reports.

E. Adjust pumps to function smoothly, and lubricate as recommended by manufacturer.

F. Adjust control set points.

END OF SECTION 22 14 29
SECTION 22 33 00
ELECTRIC, DOMESTIC-WATER HEATERS

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 RELATION TO OTHER WORK
   A. Refer to the section, "General Plumbing Provisions", for related requirements. Refer to other sections of Division 22 and to all other applicable portions of the Drawings and Specifications.

1.3 SUMMARY
   A. Section Includes:
      1. Commercial, electric, storage, domestic-water heaters.
      2. Commercial, light-duty, storage, electric, domestic-water heaters.
      3. Domestic-water heater accessories.

1.4 PERFORMANCE REQUIREMENTS
   A. Seismic Performance: Commercial domestic-water heaters shall withstand the effects of earthquake motions determined according to ASCE/SEI 7.
      1. The term "withstand" means "the unit will remain in place without separation of any parts from the device when subjected to the seismic forces specified.

1.5 SUBMITTALS
   A. Submit manufacturer's data for review before any work is commenced

1.6 QUALITY ASSURANCE
   A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
   B. ASHRAE/IESNA Compliance: Applicable requirements in ASHRAE/IESNA 90.1.
   C. ASME Compliance: Where ASME-code construction is indicated, fabricate and label commercial, domestic-water heater storage tanks to comply with ASME Boiler and Pressure Vessel Code: Section VIII, Division 1.
   D. NSF Compliance: Fabricate and label equipment components that will be in contact with potable water to comply with NSF 61 Annex G, "Drinking Water System Components - Health Effects."

1.7 COORDINATION
   A. Coordinate sizes and locations of concrete bases with actual equipment provided.
1.8 **WARRANTY**

A. Special Warranty: Manufacturer’s standard form in which manufacturer agrees to repair or replace components of electric, domestic-water heaters that fail in materials or workmanship within specified warranty period.

1. Failures include, but are not limited to, the following:
   a. Structural failures including storage tank and supports.
   b. Faulty operation of controls.
   c. Deterioration of metals, metal finishes, and other materials beyond normal use.

2. Warranty Periods: From date of Substantial Completion.
   a. Commercial, Electric, Storage, Domestic-Water Heaters:
      1) Storage Tank: Five years.
      2) Controls and Other Components: Five years.
   b. Commercial, Light-Duty, Storage, Electric, Domestic-Water Heaters:
      1) Storage Tank: Five years.
      2) Controls and Other Components: Three years.
   c. Compression Tanks: Five years.

**PART 2 - PRODUCTS**

2.1 **COMMERCIAL, ELECTRIC, DOMESTIC-WATER HEATERS**

A. Commercial, Electric, Storage, Domestic-Water Heaters:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   b. Lochinvar, LLC.
   c. State Industries


   a. Tappings: Factory fabricated of materials compatible with tank and piping connections. Attach tappings to tank before testing.
      1) NPS 2 and Smaller: Threaded ends according to ASME B1.20.1.
      2) NPS 2-1/2 and Larger: Flanged ends according to ASME B16.5 for steel and stainless-steel flanges, and according to ASME B16.24 for copper and copper-alloy flanges.
   
   b. Pressure Rating: 150 psig.
   c. Interior Finish: Comply with NSF 61 Annex G barrier materials for potable-water tank linings, including extending lining material into tappings.
4. Factory-Installed Storage-Tank Appurtenances:
   
a. Anode Rod: Replaceable magnesium.
b. Drain Valve: Corrosion-resistant metal complying with ASSE 1005.
c. Insulation: Comply with ASHRAE/IESNA 90.1.
d. Jacket: Steel with enameled finish.
e. Heating Elements: Electric, screw-in or bolt-on immersion type arranged in multiples of three.
f. Temperature Control: Adjustable thermostat.
g. Safety Controls: High-temperature-limit and low-water cutoff devices or systems.
h. Relief Valves: ASME rated and stamped for combination temperature-and-pressure relief valves. Include one or more relief valves with total relieving capacity at least as great as heat input, and include pressure setting less than domestic-water heater working-pressure rating. Select one relief valve with sensing element that extends into storage tank.

5. Special Requirements: NSF 5 construction.

B. Commercial, Light-Duty, Storage, Electric, Domestic-Water Heaters:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   
b. Lochinvar, LLC.
c. State Industries

   
b. Pressure Rating: 150 psig.
c. Interior Finish: Comply with NSF 61 Annex G barrier materials for potable-water tank linings, including extending lining material into tappings.

4. Factory-Installed Storage-Tank Appurtenances:
   
a. Anode Rod: Replaceable magnesium.
b. Dip Tube: Required unless cold-water inlet is near bottom of tank.
c. Drain Valve: ASSE 1005.
d. Insulation: Comply with ASHRAE/IESNA 90.1.
e. Jacket: Steel with enameled finish.
f. Heat-Trap Fittings: Inlet type in cold-water inlet and outlet type in hot-water outlet.
g. Heating Elements: Two; electric, screw-in immersion type; wired for simultaneous operation unless otherwise indicated. Limited to 12 kW total.
h. Temperature Control: Adjustable thermostat.
i. Safety Control: High-temperature-limit cutoff device or system.
j. Relief Valve: ASME rated and stamped for combination temperature-and-pressure relief valves. Include relieving capacity at least as great as heat input, and include pressure setting less than domestic-water heater working-pressure rating. Select relief valve with sensing element that extends into storage tank.

5. Special Requirements: NSF 5 construction with legs for off-floor installation.
2.2 **DOMESTIC-WATER HEATER ACCESSORIES**

A. Domestic-Water Compression Tanks:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   
   a. AMTROL, Inc.
   b. Flexcon Industries.
   c. Honeywell.
   d. Pentair Pump Group.
   e. Smith, A. O. Corporation.
   f. State Industries.
   g. TACO Comfort Solutions, Inc.

2. Description: Steel pressure-rated tank constructed with welded joints and factory-installed butyl-rubber diaphragm. Include air precharge to minimum system-operating pressure at tank.

3. Construction:

   a. Tappings: Factory-fabricated steel, welded to tank before testing and labeling. Include ASME B1.20.1 pipe thread.
   b. Interior Finish: Comply with NSF 61 Annex G barrier materials for potable-water tank linings, including extending finish into and through tank fittings and outlets.
   c. Air-Charging Valve: Factory installed.

4. Capacity and Characteristics:

   b. Capacity Acceptable: 10 gal. minimum.

B. Drain Pans: Corrosion-resistant metal with raised edge. Comply with ANSI/CSA LC 3. Include dimensions not less than base of domestic-water heater, and include drain outlet not less than NPS 3/4 with ASME B1.20.1 pipe threads or with ASME B1.20.7 garden-hose threads.

   1. Provide galvanized steel (24 gage min.) or other corrosion resistant material plastic or PVC accepted metal safety pan with a minimum depth of 1-1/2 inches and of sufficient size and shape to receive all drippings and/or condensate from the water storage tank or heater. The pan shall be drained by an indirect waste pipe no less than one (1) inch in diameter or the diameter of the outlet of the required relief valve(s) whichever is larger.
   2. The pan drain shall extend full-size and terminate over a suitably located indirect waste receptor or floor drain or extend to the exterior of the building and terminate no less than six (6) inches or more than twenty-four (24) inches above grade.
   3. When the discharge from the relief valve(s) is to be discharged into the safety pan, it shall be piped full-size of the valve outlet pipe size to a point not more than two (2) inches or no less than one (1) inch above the pan floor level rim.
   4. The discharge from the relief valve shall be piped full-size separately to the outside of the building or to another approved terminal as provided for safety pan drain terminals but in no case shall the discharge from a relief valve be trapped.

C. Piping-Type Heat Traps: Field-fabricated piping arrangement according to ASHRAE/IESNA 90.1.

D. Heat-Trap Fittings: ASHRAE 90.2.
E. Manifold Kits: Domestic-water heater manufacturer's factory-fabricated inlet and outlet piping for field installation, for multiple domestic-water heater installation. Include ball-, butterfly-, or gate-type shutoff valves to isolate each domestic-water heater and calibrated balancing valves to provide balanced flow through each domestic-water heater.

1. Comply with requirements for ball-, butterfly-, or gate-type shutoff valves specified in Section 22 05 23.12 "Ball Valves for Plumbing Piping," Section 22 05 23.13 "Butterfly Valves for Plumbing Piping," and Section 22 05 23.15 "Gate Valves for Plumbing Piping."

2. Comply with requirements for balancing valves specified in Section 22 11 19 "Domestic Water Piping Specialties."

F. Pressure-Reducing Valves: ASSE 1003 for water. Set at 25-psig-maximum outlet pressure unless otherwise indicated.

G. Combination Temperature-and-Pressure Relief Valves: ASME rated and stamped. Include relieving capacity at least as great as heat input, and include pressure setting less than domestic-water heater working-pressure rating. Select relief valves with sensing element that extends into storage tank.

H. Pressure Relief Valves: ASME rated and stamped. Include pressure setting less than domestic-water heater working-pressure rating.


J. Shock Absorbers: ASSE 1010 or PDI-WH 201, Size A water hammer arrester.

K. Domestic-Water Heater Stands: Manufacturer's factory-fabricated steel stand for floor mounting, capable of supporting domestic-water heater and water. Include dimension that will support bottom of domestic-water heater a minimum of 18 inches above the floor.

L. Domestic-Water Heater Mounting Brackets: Manufacturer's factory-fabricated steel bracket for wall mounting, capable of supporting domestic-water heater and water.

2.3 **SOURCE QUALITY CONTROL**

A. Factory Tests: Test and inspect domestic-water heaters specified to be ASME-code construction, according to ASME Boiler and Pressure Vessel Code.

B. Hydrostatically test commercial domestic-water heaters to minimum of one and one-half times pressure rating before shipment.

C. Electric, domestic-water heaters will be considered defective if they do not pass tests and inspections. Comply with requirements in Section 01 40 00 "Quality Requirements" for retesting and reinspecting requirements and Section 01 73 00 "Execution" for requirements for correcting the Work.

D. Prepare test and inspection reports.

**PART 3 - EXECUTION**

3.1 **DOMESTIC-WATER HEATER INSTALLATION**

A. Commercial, Electric, Domestic-Water Heater Mounting: Install commercial, electric, domestic-water heaters on concrete base.
1. Exception: Omit concrete bases for commercial, electric, domestic-water heaters if installation on stand, bracket, suspended platform, or directly on floor is indicated.

2. Maintain manufacturer's recommended clearances.

3. Arrange units so controls and devices that require servicing are accessible.

4. Install dowel rods to connect concrete base to concrete floor. Unless otherwise indicated, install dowel rods on 18-inch centers around the full perimeter of concrete base.

5. For supported equipment, install epoxy-coated anchor bolts that extend through concrete base and anchor into structural concrete floor.

6. Place and secure anchorage devices. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.

7. Install anchor bolts to elevations required for proper attachment to supported equipment.

8. Anchor domestic-water heaters to substrate.

B. Install electric, domestic-water heaters level and plumb, according to layout drawings, original design, and referenced standards. Maintain manufacturer's recommended clearances. Arrange units so controls and devices needing service are accessible.

1. Install shutoff valves on domestic-water-supply piping to domestic-water heaters and on domestic-hot-water outlet piping. Comply with requirements for shutoff valves specified in Section 22 05 23.12 "Ball Valves for Plumbing Piping," Section 22 05 23.13 "Butterfly Valves for Plumbing Piping," and Section 22 05 23.15 "Gate Valves for Plumbing Piping."

C. Install combination temperature-and-pressure relief valves in top portion of storage tanks. Use relief valves with sensing elements that extend into tanks. Extend commercial-water-heater relief-valve outlet, with drain piping same as domestic-water piping in continuous downward pitch, and discharge by positive air gap onto closest floor drain.

D. Install combination temperature-and-pressure relief valves in water piping for electric, domestic-water heaters without storage. Extend commercial-water-heater relief-valve outlet, with drain piping same as domestic-water piping in continuous downward pitch, and discharge by positive air gap onto closest floor drain.

E. Install water-heater drain piping as indirect waste to spill by positive air gap into open drains or over floor drains. Install hose-end drain valves at low points in water piping for electric, domestic-water heaters that do not have tank drains. Comply with requirements for hose-end drain valves specified in Section 22 11 19 "Domestic Water Piping Specialties."

F. Install thermometers on outlet piping of electric, domestic-water heaters. Comply with requirements for thermometers specified in Section 22 05 19 "Meters and Gages for Plumbing Piping."

G. Install thermometers on inlet and outlet piping of residential, electric, domestic-water heaters. Comply with requirements for thermometers specified in Section 22 05 19 "Meters and Gages for Plumbing Piping."

H. Assemble and install inlet and outlet piping manifold kits for multiple electric, domestic-water heaters. Fabricate, modify, or arrange manifolds for balanced water flow through each electric, domestic-water heater. Include shutoff valve and thermometer in each domestic-water heater inlet and outlet, and throttling valve in each electric, domestic-water heater outlet. Comply with requirements for valves specified in Section 22 05 23.12 "Ball Valves for Plumbing Piping," Section 22 05 23.13 "Butterfly Valves for Plumbing Piping," and Section 22 05 23.15 "Gate Valves for Plumbing Piping," and comply with requirements for thermometers specified in Section 22 05 19 "Meters and Gages for Plumbing Piping."
I. Install pressure-reducing valve with integral bypass relief valve in electric, domestic-water booster-heater inlet piping and water hammer arrester in booster-heater outlet piping. Set pressure-reducing valve for outlet pressure of 25 psig. Comply with requirements for pressure-reducing valves and water hammer arresters specified in Section 22 11 19 "Domestic Water Piping Specialties."

J. Install piping-type heat traps on inlet and outlet piping of electric, domestic-water heater storage tanks without integral or fitting-type heat traps.

3.2 CONNECTIONS

A. Comply with requirements for piping specified in Section 22 11 16 "Domestic Water Piping." Drawings indicate general arrangement of piping, fittings, and specialties.

B. Where installing piping adjacent to electric, domestic-water heaters, allow space for service and maintenance of water heaters. Arrange piping for easy removal of domestic-water heaters.

3.3 IDENTIFICATION

A. Identify system components. Comply with requirements for identification specified in Section 22 05 53 "Identification for Plumbing Piping and Equipment."

3.4 FIELD QUALITY CONTROL

A. Perform tests and inspections.

1. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installations, including connections, and to assist in testing.
2. Leak Test: After installation, charge system and test for leaks. Repair leaks and retest until no leaks exist.
3. Operational Test: After electrical circuitry has been energized, start units to confirm proper operation.
4. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

B. Electric, domestic-water heaters will be considered defective if they do not pass tests and inspections. Comply with requirements in Section 01 40 00 "Quality Requirements" for retesting and reinspecting requirements and Section 01 73 00 "Execution" for requirements for correcting the Work.

C. Prepare test and inspection reports.

END OF SECTION 22 33 00
SECTION 22 42 13.13
COMMERCIAL WATER CLOSETS

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. Water closets.
2. Flushometer valves and tanks.
3. Toilet seats.
4. Supports.

1.3 RELATION TO OTHER WORK

A. Refer to the section, "General Plumbing Provisions", for related requirements. Refer to other
sections of Division 22 and to all other applicable portions of the Drawings and Specifications

1.4 SUBMITTALS

A. Submit manufacturer's data for review before any work is commenced.

PART 2 - PRODUCTS

2.1 FLOOR-MOUNTED, BOTTOM-OUTLET WATER CLOSETS

A. Water Closets: Floor mounted, bottom outlet, top spud.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the
following:

b. Gerber Plumbing Fixtures LLC.
c. Kohler Co.
d. Mansfield Plumbing Products LLC.
e. Sloan Valve Company.
f. TOTO USA, INC.
g. Zurn Industries, LLC.

2. Bowl:

b. Material: Vitreous china.
c. Type: Siphon jet.
d. Style: Flushometer valve.

3. Toilet Seat: IAPMO/ANSI Z124.5, Type A (residential), Shape 3 (elongated rim), open
front, without cover, and shaped to match bowl.
2.2 FLUSHOMETER VALVES

A. Battery-Powered, Solenoid-Actuator, Piston Flushometer Valves:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

   b. Gerber Plumbing Fixtures LLC.
   c. Hydrotek International, Inc.
   d. Kohler Co.
   e. Moen Incorporated.
   f. Sloan Valve Company.
   g. TOTO USA, INC.
   h. Zurn Industries, LLC.

4. Features: Include integral check stop and backflow-prevention device.
5. Material: Brass body with corrosion-resistant components.
7. Panel Finish: Chrome plated or stainless steel.
8. Actuator: Solenoid complying with UL 1951, and listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
9. Trip Mechanism: Battery-powered electronic sensor complying with UL 1951, and listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

2.3 TOILET SEATS

A. Toilet Seats:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

   b. Bemis Manufacturing Company.
   c. Centoco Manufacturing Corporation.
   d. Church Seats; Bemis Manufacturing Company.
   e. Kohler Co.
   f. Olsonite Seat Co.
   g. TOTO USA, INC.
   h. Zurn Industries, LLC.


PART 3 - EXECUTION

3.1 INSTALLATION

A. Water-Closet Installation:
1. Install level and plumb according to roughing-in drawings.
2. Install floor-mounted water closets on bowl-to-drain connecting fitting attachments to piping or building substrate.

B. Support Installation:

1. Install supports, affixed to building substrate, for floor-mounted, back-outlet water closets.
2. Use carrier supports with waste-fitting assembly and seal.
3. Install floor-mounted, back-outlet water closets attached to building floor substrate, onto waste-fitting seals; and attach to support.
4. Install wall-mounted, back-outlet water-closet supports with waste-fitting assembly and waste-fitting seals; and affix to building substrate.

C. Flushometer-Valve Installation:

1. Install flushometer-valve, water-supply fitting on each supply to each water closet.
2. Attach supply piping to supports or substrate within pipe spaces behind fixtures.
3. Install lever-handle flushometer valves for accessible water closets with handle mounted on open side of water closet.
4. Install actuators in locations that are easy for people with disabilities to reach.
5. Install fresh batteries in battery-powered, electronic-sensor mechanisms.

D. Install toilet seats on water closets.

E. Wall Flange and Escutcheon Installation:

1. Install wall flanges or escutcheons at piping wall penetrations in exposed, finished locations and within cabinets and millwork.
2. Install deep-pattern escutcheons if required to conceal protruding fittings.
3. Comply with escutcheon requirements specified in Section 22 05 18 "Escutcheons for Plumbing Piping."

F. Joint Sealing:

1. Seal joints between water closets and walls and floors using sanitary-type, one-part, mildew-resistant silicone sealant.
2. Match sealant color to water-closet color.
3. Comply with sealant requirements specified in Section 07 92 00 "Joint Sealants."

3.2 CONNECTIONS

A. Connect water closets with water supplies and soil, waste, and vent piping. Use size fittings required to match water closets.

B. Comply with water piping requirements specified in Section 22 11 16 "Domestic Water Piping."

C. Comply with soil and waste piping requirements specified in Section 22 13 16 "Sanitary Waste and Vent Piping."

D. Where installing piping adjacent to water closets, allow space for service and maintenance.
3.3 ADJUSTING

A. Operate and adjust water closets and controls. Replace damaged and malfunctioning water closets, fittings, and controls.

B. Adjust water pressure at flushometer valves to produce proper flow.

C. Install fresh batteries in battery-powered, electronic-sensor mechanisms.

3.4 CLEANING AND PROTECTION

A. Clean water closets and fittings with manufacturers’ recommended cleaning methods and materials.

B. Install protective covering for installed water closets and fittings.

C. Do not allow use of water closets for temporary facilities unless approved in writing by Owner.

END OF SECTION 22 42 13.13
SECTION 22 42 16.13
COMMERCIAL LAVATORIES

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. Lavatories.
      2. Faucets.
      5. Supports.

1.3 RELATION TO OTHER WORK
   A. Refer to the section, "General Plumbing Provisions", for related requirements. Refer to other sections of Division 22 and to all other applicable portions of the Drawings and Specifications.

1.4 SUBMITTALS
   A. Submit manufacturer's data for review before any work is commenced.

PART 2 - PRODUCTS

2.1 WALL-MOUNTED LAVATORIES
   A. Lavatory: Vitreous china, wall mounted, with back.
      1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
         b. Kohler Co.
         c. Mansfield Plumbing Products LLC.
         d. Peerless Pottery Sales, Inc.
         e. Sloan Valve Company.
         f. Zurn Industries, LLC.
      2. Fixture:
         b. Type: For wall hanging.
   B. Lavatory: Wheelchair, vitreous china, wall mounted.
      1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
b. Kohler Co.
c. Mansfield Plumbing Products LLC.
d. Peerless Pottery Sales, Inc.
e. Sloan Valve Company.
f. Zurn Industries, LLC.

2. Fixture:

b. Type: Slab or wheelchair.

3. Lavatory Mounting Height: Handicapped/elderly according to ICC A117.1.

2.2 SOLID-BRASS, MANUALLY OPERATED FAUCETS

A. NSF Standard: Comply with NSF 372 for faucet materials that will be in contact with potable water.

B. Lavatory Faucets: solid-brass valve.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

b. Bradley Corporation.
c. Chicago Faucets; Geberit Company.
d. Delta Faucet Company.
e. Elkay Manufacturing Co.
f. Gerber Plumbing Fixtures LLC.
g. GROHE America, Inc.
h. Kohler Co.
i. Moen Incorporated.
j. Speakman Company.
k. Zurn Industries, LLC.


3. General: Include hot- and cold-water indicators; coordinate faucet inlets with supplies and fixture hole punchings; coordinate outlet with spout and fixture receptor.

2.3 SOLID-BRASS, AUTOMATICALLY OPERATED LAVATORY FAUCETS

A. NSF Standard: Comply with NSF 372 for faucet materials that will be in contact with potable water.

B. Lavatory Faucets: Automatic-type, battery-powered, electronic-sensor-operated, solid-brass valve.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

b. Bradley Corporation.
c. Kohler Co.
3. 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.
4. General: Include hot- and cold-water indicators; coordinate faucet inlets with supplies and fixture hole punchings; coordinate outlet with spout and fixture receptor.

### 2.4 LAMINAR-FLOW, FAUCET-SPOUT OUTLETS

**A. NSF Standard:** Comply with NSF 372 for faucet-spout-outlet materials that will be in contact with potable water.

**B. Manufacturers:** Subject to compliance with requirements, provide products by one of the following:

1. AM Conservation Group, Inc.
2. Chronomite Laboratories, Inc.
3. NEOPERL, Inc.
4. T&S Brass and Bronze Works, Inc.

**C. Description:** Chrome-plated-brass, faucet-spout outlet that produces non-aerating, laminar stream. Include external or internal thread that mates with faucet outlet for attachment to faucets where indicated and flow-rate range that includes flow of faucet.

### 2.5 SUPPLY FITTINGS

**A. NSF Standard:** Comply with NSF 372 for supply-fitting materials that will be in contact with potable water.

**B. Standard:** ASME A112.18.1/CSA B125.1.

**C. Supply Piping:** Chrome-plated-brass pipe or chrome-plated copper tube matching water-supply piping size. Include chrome-plated-brass or stainless-steel wall flange.

**D. Supply Stops:** Chrome-plated-brass, one-quarter-turn, ball-type or compression valve with inlet connection matching supply piping.

**E. Standard:** ASME A112.18.2/CSA B125.2.

**F. Drain:** Grid type with NPS 1-1/4 offset and straight tailpiece.

### 2.6 SUPPORTS

**A. Type II Lavatory Carrier:**

1. **Standard:** ASME A112.6.1M.
B. Type III Lavatory Carrier:
   1. Standard: ASME A112.6.1M.

PART 3 - EXECUTION

3.1 EXAMINATION
A. Examine roughing-in of water supply and sanitary drainage and vent piping systems to verify actual locations of piping connections before lavatory installation.
B. Examine counters and walls for suitable conditions where lavatories will be installed.
C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION
A. Install lavatories level and plumb according to roughing-in drawings.
B. Install supports, affixed to building substrate, for wall-mounted lavatories.
C. Install accessible wall-mounted lavatories at handicapped/elderly mounting height for people with disabilities or the elderly, according to ICC/ANSI A117.1.
D. Install wall flanges or escutcheons at piping wall penetrations in exposed, finished locations. Use deep-pattern escutcheons if required to conceal protruding fittings. Comply with escutcheon requirements specified in Section 22 05 18 "Escutcheons for Plumbing Piping."
E. Seal joints between lavatories, counters, and walls using sanitary-type, one-part, mildew-resistant silicone sealant. Match sealant color to fixture color. Comply with sealant requirements specified in Section 07 92 00 "Joint Sealants."
F. Install protective shielding pipe covers and enclosures on exposed supplies and waste piping of accessible lavatories. Comply with requirements in Section 22 07 19 "Plumbing Piping Insulation."

3.3 CONNECTIONS
A. Connect fixtures with water supplies, stops, and risers, and with traps, soil, waste, and vent piping. Use size fittings required to match fixtures.
B. Comply with water piping requirements specified in Section 22 11 16 "Domestic Water Piping."
C. Comply with soil and waste piping requirements specified in Section 22 13 16 "Sanitary Waste and Vent Piping."

3.4 ADJUSTING
A. Operate and adjust lavatories and controls. Replace damaged and malfunctioning lavatories, fittings, and controls.
B. Adjust water pressure at faucets to produce proper flow.
C. Install fresh batteries in battery-powered, electronic-sensor mechanisms.
3.5 CLEANING AND PROTECTION

A. After completing installation of lavatories, inspect and repair damaged finishes.

B. Clean lavatories, faucets, and other fittings with manufacturers’ recommended cleaning methods and materials.

C. Provide protective covering for installed lavatories and fittings.

D. Do not allow use of lavatories for temporary facilities unless approved in writing by Owner.

END OF SECTION 22 42 16.13
PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division-01 Specification sections, apply to work of this section.

1.2 SCOPE OF DIVISION

A. Work shall include all materials, equipment and labor necessary for a complete and properly functioning mechanical installation in accordance with all applicable codes, and contract drawings and specifications. Work shall include all work specified in Division-23, HVAC.

B. Pay for all required licenses, fees, inspections and permits.

1.3 RELATION TO OTHER WORK

A. Work Not in Division 23: Related work not included in this division consists of requirements given in the following as may be included in the contract documents:

1. Other divisions which may include work (such as concrete, steel, painting, ceiling systems, structure and other work) related to the work of Division 23.

B. Work of Division 23: Any or all sections of Division 23 may include a paragraph or paragraphs under the heading, "Relation to other Work". Where such a paragraph is indicated and work directly related to the section is listed or described, such work shall be considered as relating directly to the indicated section. Any related work (directly related or otherwise) which may be omitted by reference from the "Relation to Other Work" paragraph of such section(s), shall be provided as necessary and required whether or not such work is included by reference. Such listing or description of related work within a section is given only as a convenience to the Contractor; omission of other related sections or described work does not in any way exclude the provision of such work.

C. The mechanical contractor shall coordinate with the controls vendor for all control related equipment that is provided by the controls vendor and installed by the mechanical contractor. Refer to specification 23 09 23 for list of controls vendor supplied items to be installed by the mechanical contractor.

1.4 CODES

A. Install all work in accordance with the latest edition of all applicable regulations and governing codes, including the regulations of the utility companies serving the project.

B. Where a conflict in code requirements occurs the more stringent requirement shall govern.

1.5 STANDARDS

A. All equipment and devices shall bear U.L. label, the label of an industry recognized approved testing agency or A.G.A. certification for said item of equipment or device.

B. All electrical devices must be U.L. approved.
1.6 DRAWINGS

A. Architectural and structural drawings take precedence over mechanical drawings with reference to the building construction. Mechanical drawings are diagrammatic and indicate the general arrangement and extent of work. Architectural drawings indicate more exactly the desired relationship between diffusers, registers, lighting fixtures, equipment, electric panels and devices, plumbing fixtures, and other items which remain exposed in the completed building. Exact locations and arrangement of materials and equipment shall be determined, with the acceptance of the Architect/Engineer, as work progresses to conform in the best possible manner with the surroundings and with the adjoining work of other trades. Where locations of equipment, devices or fixtures are controlled by architectural features, establish such locations by referring to dimensions on Architectural drawings and not by scaling drawings.

1.7 DISCREPANcies

A. In case of differences between drawings and specifications, or where drawings and specifications are not clear or definitive, the more stringent requirement shall apply. Any such discrepancies shall be referred to Architect/Engineer for clarification and instructions.

1.8 ELECTRICAL PROVISIONS

A. Work of Division 23 shall include the electrical requirements which are indicated to be integral with mechanical work and which can be summarized to include (but not necessarily be limited to) the following:

1. Motors  
2. Unless shown otherwise, motor starters are to be furnished by mechanical contractor, installed by electrical contractor.  
3. In lieu of the mechanical contractor furnishing motor starters, the mechanical contractor can coordinate with the electrical contractor where the electrical contractor furnishes and installs a combination motor starter / disconnect switch.  
4. Control switch, pilot lights, interlocks and similar devices.  
5. Electrical heating coils and similar elements in mechanical equipment.  
6. Electrical work specified in Division-23 for the HVAC control system.  
7. Drip pans to protect electrical work.

B. Motors, Starters, Switches:

1. All motors 1HP and above associated with mechanical equipment that are not being provided with a variable frequency drive shall be provided with a motor starter.  
2. For motors under 1HP that are required to be controlled shall be coordinated with the building automation system to ensure start / stop control is achieved. Provide all relays, wiring and devices as required to achieve desired control.

C. Drip Pans: Where possible, do not run mechanical piping directly above electrical (or electronic) equipment which is sensitive to moisture; otherwise provide drip pans under mechanical piping. Locate pan below piping and extend 6" on each side of piping and lengthwise 18" beyond equipment. Fabricate pans 2" deep, of reinforced sheet metal with rolled edges and soldered or welded seams; 20 gage copper, or 16 gage steel with 2 oz. zinc finish hot dipped after fabrication. Provide 3/4" copper drainage piping, properly discharged to a waste receptor.

D. Motors: Refer to “Electric Motors, Premium Efficiency Type”.
1.9 ELECTRICAL/MECHANICAL WORK

A. Definitions: Definitions for the purpose of mechanical/electrical control and power coordination are as follows: (Note: The use of the words, "Provide", "furnish" and "install" are intended only for use in describing the coordination indicated by this paragraph and do not necessarily have the same definitions when used outside of the context of this paragraph.) Any items which do not fall within the scope of this paragraph shall be coordinated as individually specified.

1. "Furnish" means to procure an item and to deliver it to the project for installation.
2. "Install" means to determine (in coordination with others as necessary) the appropriate intended location of an item and to set and connect it in place.
3. "Provide" means to both furnish and install.
4. Power Circuit: Circuit which carries main electric power to apparatus to which the power circuit is connected.
5. Control Circuit: Circuit which carries electrical signals directing the performance of a controller, but which does not carry the main electric power. (See NEC, Section 430-71.) Such circuits shall also include those which serve a dual control and power function (e.g., a line voltage thermostat circuit which both activates and powers a small fan motor).
6. Controller: A device, or group of devices, which serves to govern, in some predetermined manner, electric power delivered to apparatus to which the controller is connected and includes any switch or device normally used to start and stop a motor. (See NEC, Article 100, Definitions, "Controller", and Section 430-81(a).)
7. Control Device: A device which reacts to an operating condition (pressure, temperature, flow, humidity, etc.) and which initiates transmission of an electrical control signal which causes operation of a controller or which causes operation of pressure switches, etc.
8. Auxiliary Control Device: A device (such as a low voltage control transformer, electric relay, etc.) which is located in a control circuit and which carries or responds to (but does not initiate) an electrical control signal initiated by a control device.

B. Work of Division-23 includes (but is not necessarily limited to):

1. Provide:
   a. All controllers which are generally manufactured or shipped as integral with Division-23 equipment (such as starters packaged with chillers, etc.).
   b. All electric motors and other electrical power consuming equipment (such as electric air heating coils, electric boilers, electric hot water heaters, etc.) which are specified in Division 23.
   c. All control circuits (including conduit and boxes) from the Division-26 panels to point of use including the necessary circuit breakers.
   d. All other control circuits, including conduit and boxes.
   e. All control connections to equipment.
   f. All control connections to controllers, switches, motors and other mechanical systems electrical power consuming equipment (such as electric air heating coils, electric boilers, electric hot water heaters, etc.).
   g. Auxiliary control devices.
   h. All control devices (thermostats, pressure switches, flow switches, humidistats, etc.) and make control circuit connections thereto.
   i. Any and all pneumatic and electronic and electric control devices and electric or pneumatic connections thereto.
2. Furnish:
   a. All controllers which are generally manufactured and/or shipped as separate but companion items to Division-23 equipment (such as centrifugal chiller starters which are matched with the chillers but are not physically an integral part of the chiller assembly.)

C. Work of Division-26 includes (but is not necessarily limited to):

   1. Provide:
      a. All power circuits, including conduit and boxes.
      b. All power connections to controllers, switches, motors and other mechanical systems electrical power consuming equipment (such as electric air heating coils, electric boilers, electric hot water heaters, etc.).
      c. All remote motor disconnects (remote from the related controller) at all locations required by NEC and connections thereto except those disconnects which are specified in Division-23 to be provided as part of the equipment itself.
      d. If coordinated with the mechanical contractor, all combination starter / disconnect switches required for mechanical motors.
      e. All controllers (except those which are generally manufactured or shipped as separate but companion items to Division-23 equipment such as centrifugal chiller starters).

   2. Install:
      a. All controllers which are generally manufactured and/or shipped as separate but companion items to Division-23 equipment (e.g., chiller starters).
      b. Motor starters or variable frequency drives furnished by the mechanical contractor for motors associated with mechanical equipment.

1.10 AUXILIARIES AND ACCESSORIES

   A. Include all auxiliaries and accessories for complete and properly operating systems.

1.11 INVESTIGATION OF SITE

   A. Check site and existing conditions thoroughly before bidding. Advise Architect/Engineer of discrepancies or questions noted before bidding.

1.12 ASBESTOS

   A. Should asbestos, or any other hazardous waste material, be encountered during the execution of the work, or should the presence of asbestos or any other hazardous material be suspected, immediately notify the Owner and suspend all work in the affected area. The Owner will activate an assessment study to determine the presence of asbestos, or other hazardous material, and evaluate what condition it is in. Removal of asbestos, or other hazardous material, if required, will be conducted by a qualified Contractor, and will be done under separate contract.

1.13 COORDINATION

   A. Provide all required coordination and supervision where work of this division connects to or is affected by work of others.
1.14 PROVISIONS FOR OPENINGS

A. Provide all openings required for work performed under Division-23. Provide sleeves or other approved methods to allow passage of items installed under any Section of Division-23.

1.15 INTERRUPTION OF EXISTING SERVICES

A. Any interruption of existing services shall be coordinated in advance with the Owner's Representative. Shutdown time and duration of critical services shall be decided by the Owner. Contractor shall provide shutoff valves at point of tie-in to minimize downtime.

1.16 CLEANING AND PROTECTION

A. Ductwork: Keep the interior of the duct system free from dirt and rubbish and other foreign matter. All fan motors, switches, and other items shall also be protected from dirt, rubbish and other foreign matter during building construction. Thoroughly clean all components of the ductwork and remove all dirt, scale, oil and other foreign substances which may have accumulated during the installation process.

B. Equipment: All mechanical equipment provided shall be thoroughly cleaned of all dirt, oil, concrete, etc. Any dents, scratches or other visible blemishes shall be corrected, and the appearance of the equipment made "like new" and to the satisfaction of the Architect/Engineer.

C. Upon completion, and before final acceptance of the work, all debris, rubbish, leftover materials, tools and equipment shall be removed from the site.

D. Protection of Work Until Final Acceptance: Protect all materials and equipment from damage, entrance of dirt and construction debris from the time of installation until final acceptance. Any materials and equipment which are damaged shall be repaired to "as new" condition or replaced at the direction of the Architect/Engineer. Where factory finishes occur and damage is minor, finishes may be touched up. If, in the opinion of the Architect/Engineer the damage is excessive, factory finish shall be replaced to "new" condition.

1.17 SHOP DRAWINGS

A. Submit shop drawings for all items, services and systems included in the project.

B. Shop drawings shall clearly show the following:

1. Technical and descriptive data in detail equal to or greater than the data given in the item specification. Indicate all characteristics, special modifications and features. Where performance and characteristic data is shown on the drawings or specified, submitted data shall be provided in a degree which is both quantitatively and qualitatively equal to that specified and shown so that comparison can be made. Present data in detail equal to or greater than that given in item specification and include all weights, deflections, speeds, velocities, pressure drops, operating temperatures, operating curves, temperature ranges, sound ratings, dimensions, sizes, manufacturers' names, model numbers, types of material used, operating pressures, full load amperages, starting amperages, fouling factors, capacities, set points, chemical compositions, certifications and endorsements, operating voltages, thicknesses, gauges and all other related information as applicable to particular item.

2. Exceptions to or deviations from the contract documents. Should Architect/Engineer accept any items having such deviations which are not clearly brought to
Architect/Engineer's attention, in writing, on item submittal, then Contractor is responsible for correction of such deviations regardless of when such deviations are discovered.

C. Additional Requirements: See specific sections of the Specifications for any additional requirements.

1.18 SHOP DRAWINGS TECHNICAL INFORMATION SUBMITTALS

A. All submittals are to be submitted electronically in the form of PDF. Electronic submittal file names must be formatted with the specification section number followed by the title of the specification section. One PDF file shall be provided for each specification section that requires submittals to be provided.

B. A cover page shall have adequate space for Contractor, Subcontractor and Engineer review stamps and indicate the following minimum data:

1. Project Name
2. Project Address
3. Contractor Name
4. Subcontractor Name
5. Specification Section Number
6. Specification Section Name
7. Submittal Date

C. All shop drawings and equipment submittals shall be submitted complete based on specification division. Partial submittals of each specification section will not be accepted.

D. All submittals shall have been reviewed for compliance by the Contractor and associated subcontractor prior to submission to the Engineer. A stamp bearing the name of the reviewer and date review was completed shall be on the cover page of the submittal.

E. Submittal data shall be logically grouped based on equipment tags or like material. For submittals that contain data on multiple materials or equipment, it shall be clearly noted by equipment tag or applicable material.

F. Manufacturer’s data indicating multiple options or choices shall be clearly noted as to what is applicable to the material and equipment being provided. Information not applicable should be struck through or extracted.

1.19 SHOP DRAWINGS FOR PIPING SYSTEMS AND DUCT SYSTEMS

A. Shop drawings for piping systems and duct systems shall be performed by the installing subcontractors. Shop drawings shall show all required maintenance and operational clearances required. Title drawings shall include identification of project and names of Architect, Engineer, Contractor, subcontractor and/or supplier, date, be numbered sequentially and shall indicate the following:

1. Architectural and structural backgrounds with room names and numbers, etc., including but not limited to plans, sections, elevations, details, etc.
   a. Fabrication and Erection dimensions.
   b. Arrangements and sectional views.
   c. Necessary details, including complete information for making connections with other work.
   d. Kinds of materials and finishes.
e. Descriptive names of equipment.
f. Modifications and options to standard equipment required by the contract.

B. Also provide shop drawings, using architectural reflected ceiling plans, which indicate locations of the following (to be verified by Contractor): Air distribution devices, sprinkler heads, lights, access panels, fire alarm, speakers, projectors or any system device intended to be installed in the ceiling.

C. Shop drawings shall be submitted in electronic PDF format and shall bear the review stamp from the mechanical subcontractor and general contractor / CM that it has been reviewed for compliance.

D. See specific sections of specifications for further requirements.

1.20 AIR HANDLING UNIT AND DUCTWORK CONFIGURATION SHOP DRAWINGS

A. Contractor shall submit a shop drawing for all system and shall meet the following requirements:

1. Be drawn at not less than a scale of 1/4" = 1'-0". Contractor may elect to use a larger scale if he desires (i.e., if drawing of unit is at 1/4" = 1'-0", 1/2" = 1'-0" may be used.).
2. Clearly show all proposed ductwork configuration changes (sizes, routing, and similar differences) which are different in any respect from the Drawings.
3. Where proposed changes affect any other work such as structure, housekeeping pads, piping, equipment, electrical work or any other work, shop drawings shall clearly show those proposed changes.
4. Where Drawings show units in plan only, shop drawings shall show proposed units in plan and also in elevation.
5. Shop drawings shall also show exact locations of related work (such as bar joists, columns, beams, sound attenuators, and like items) which affect the proposed ductwork routing and unit location and configuration.
6. Each section of each air handling unit shall be clearly identified (i.e., coil section, fan section, filter section, mixing box section, etc.).

B. Failure to submit these shop drawings together at the same time with the air handling unit shop drawings will result in total disapproval of the proposed air handling units. Time delays or other reasons will not be considered.

C. Shop drawings shall be submitted in electronic PDF format and shall bear the review stamp from the mechanical subcontractor and Contractor that it has been reviewed for compliance.

1.21 ELECTRONIC FILES

A. CADD files will be available on a limited basis to qualified firms at the Architect’s / Engineer’s prerogative. Recipients are cautioned that these files may not accurately show actual conditions as constructed. Users are responsible to verify actual field conditions. These files are not intended to be used as shop drawings.

B. Any requests for electronic files shall be preceded by processing the required electronic file release form and submitting to the Engineer for authorization. Request for electronic files should be submitted through the Contractor for submission to the Architect / Engineer.
1.22 OPERATING INSTRUCTIONS
A. Submit for checking a specific set of written operating instructions on each item which requires instructions to operate. After acceptance, insert information in each Technical Information Brochure. Refer also to other sections which may describe operating instructions.

1.23 MAINTENANCE INFORMATION
A. Submit for acceptance Maintenance Information consisting of manufacturer's printed instruction and parts lists for each major item of equipment. After acceptance, insert information in each Technical Information Brochure. Refer also to other sections which may describe maintenance.

1.24 MANUFACTURER'S CHECK-OUT
A. Check out by Manufacturer's Representative (for major items of equipment): At completion of construction and after performance verification information as above-mentioned has been gathered, submitted and accepted, provide one copy of this information to the manufacturer's representative. Work required under this section shall include having the representative examine the performance verification information, check the equipment in the field while it is operating, and sign a Check-Out Memo for record. Submit a copy of the memo on each major item of equipment for each brochure. Accepted memos shall be inserted on each brochure with the performance verification information and submittal data. Memos shall be submitted and accepted before Instruction in Operation to Owner or a request for final inspection.

1.25 SYSTEM GUARANTEE
A. The work required under Division-23 shall include a one-year guarantee. This guarantee shall be by the Contractor to the Owner to replace for the Owner any defective workmanship, equipment, or material which has been furnished under this Contract at no cost to the Owner for a period of one year from the date of acceptance of the System. This guarantee shall also include reasonable adjustments of the system required for proper operation during the guarantee period. Explain the provisions of guarantee to Owner at the "Instruction in Operation Conference".

1.26 INSTRUCTION TO OWNER
A. Submit all required items for checking one week before final inspection of the building is scheduled. When all items are accepted and placed in the proper brochures, the Contractor shall give notice in writing that he is ready to give the Owner an “Instruction in Operation Conference”. After the above mentioned request is received the Contractor will be notified of the time the conference can be held with the Owner. At the conference, the Contractor shall review with the Owner all appropriate information. At the end of the conference, seven copies of a memo certifying Instruction in Operation and Completed Demonstration shall be signed by the Contractor, Subcontractor and Owner and one copy inserted in each brochure.

1.27 MATERIALS AND EQUIPMENT
A. Each bidder represents that his bid is based upon the materials and equipment described in this division of the specifications.

1. Submittal shall include the name of the material or equipment for which it is to be substituted, substituted equipment model numbers, drawings, cuts, performance and test
data and any other data or information necessary for the Architect/Engineer to determine that the equipment meets all specification and requirements. If the Architect/Engineer accepts any proposed substitutions, such acceptance will be set forth in writing.

2. Substituted equipment with all accessories installed or optional equipment where permitted and accepted, must conform to space requirements. Any substituted equipment that cannot meet space requirements, whether accepted or not, shall be replaced at the Contractor's expense. Any modifications of related systems of this or other trades as a result of substitutions shall be made at the Contractor's expense, and Contractor shall so state in his written request for substitution.

B. Acceptable Manufacturers: Materials and Equipment specified in these contract documents are accepted only in regard to general performance and quality. It shall be the Contractor's responsibility to ensure that acceptable materials and equipment meet or exceed the efficiencies, capacities, electrical characteristics, performance and quality of the equipment herein specified. Acceptable equipment must also generally conform, without extensive modification of related systems to the accessories, weights, space and maintenance requirements, etc., of the specified equipment. Any modification to related systems of this or other trades shall be made at the Contractor's expense and the Contractor shall be responsible for coordination between trades. Any difference in capacity, efficiency, electrical characteristics, weights or quality of product, etc., between specified materials and equipment and acceptable alternates shall be submitted to the Architect/Engineer for acceptance within 30 days of Notice to Proceed.

C. If no prior approval for substitutions or alternate manufacturers have been provided, the bid must conform with the requirements of the plans and specifications. No equipment substitutions or alternate manufacturers will be considered once the project bidding has ended.

PART 2 - PRODUCTS

2.1 Section part not applicable.

PART 3 - EXECUTION

3.1 Section part not applicable.

END OF SECTION 23 01 00
SECTION 23 05 00
BASIC MECHANICAL MATERIALS AND METHODS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS
A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division-01 Specification sections, apply to work of this section, in addition to the following:

1.2 SCOPE
A. Materials listed herein are general mechanical materials to be used under the Division 23 sections of the specifications unless specifically noted otherwise in the particular section or on the drawings.

1.3 RELATION TO OTHER WORK
A. Refer to the section, "General Mechanical Provisions", for related requirements. Refer to other sections of Division 23 and to all other applicable portions of the Drawings and Specifications. This section relates to all sections of Division 23 as may be applicable to the work of each section.

1.4 STANDARDS
A. Quality and weight of materials shall comply with requirements and specifications of the appropriate standards of the American Society of Testing and Materials.

PART 2 - PRODUCTS

2.1 MATERIALS AND EQUIPMENT, GENERAL
A. All materials and equipment shall be new and without blemish or defect.
B. Equipment and materials shall be products which will meet with the acceptance of the agency inspecting the work. Where acceptance is contingent upon having the products examined, tested and certified by Underwriters Laboratory or other recognized testing laboratory, the product shall be so examined, tested and certified.
C. Where no specific indication as to the type or quality of material or equipment is indicated, a standard item or system shall be furnished with all options, features and capabilities to meet the project requirements.
D. Performance and Capacity:
   1. Performance as delineated in schedules and in the specifications shall be interpreted as minimum performance. In some cases equipment may be sized to allow for future requirements or for other reasons which may not be stated on the Drawings or in the Specifications; provide equipment and systems with the capacities, capabilities and features indicated to provide the maximum or minimum (as appropriate) conditions.
E. Operating conditions and capacities must be as follows:
   1. No overloading.
2. No operation at conditions outside of maximum and minimum limits recommended by the manufacturer and accepted by the Architect/Engineer.
3. Compatible with all systems.

F. Unless otherwise specified, all equipment and materials furnished must be as follows:
   1. Recommended by the manufacturer for the application.
   2. Installed in accordance with the manufacturer's recommendations for the application except where specifications and drawings clearly indicate otherwise.

2.2 ACCESS DOORS AND PANELS

A. Locations: Provide access doors and panels (access units) as necessary for access to items which are concealed and which may require service or maintenance or other reason for accessibility. Examples of such items include, but are not limited to, the following: valves, cleanouts, pipe unions, expansion joints and connectors, dampers, coils, junction boxes, duct heaters, terminal units, HVAC control system devices and similar types of items.

B. Access units: Shall be manufactured by the Milcor Division of Inland-Ryerson, Boico, Nystrom or Ventfabrics. Types are as follows (Milcor style designations are used for example only):

<table>
<thead>
<tr>
<th>Location</th>
<th>Door/Panel Type</th>
</tr>
</thead>
<tbody>
<tr>
<td>Drywall</td>
<td>Style &quot;DW&quot;</td>
</tr>
<tr>
<td>Masonry or tile</td>
<td>Style &quot;M-stainless&quot;</td>
</tr>
<tr>
<td>Acoustical tile</td>
<td>Style &quot;AT&quot;</td>
</tr>
<tr>
<td>Plaster</td>
<td>Style &quot;K&quot;</td>
</tr>
<tr>
<td>Fire-rated walls</td>
<td>Style &quot;Fire Rated&quot;</td>
</tr>
</tbody>
</table>

   (**or as indicated below)

C. Fire Rated Units:
   1. Frame and panel assembly shall bear a U.L. label reading, "frame and door assembly, rating 1-1/2-hour (B), temperature rise 30 minutes 250°F maximum".
   2. Have an automatic closing device and mechanism to release the latch bolt from the inside.
   3. Acceptable Manufacturers: Boico Style F, Inryco/Milcor Style VA, Nystrom Style APFR.

D. Non-fire Rated Units:
   1. Steel panels and frames.
   2. Locks and latches shall be as appropriate for the location and shall be cam-lock type latches, flush screw driver operated locks or cylindrical locks.
   3. Provide two keys for all doors. All doors shall be keyed the same.

E. Other Requirements:
   1. Doors and panels installed in glazed or ceramic tiled surfaces, in toilet rooms or in kitchens shall be stainless steel.
   2. Unless otherwise indicated, finish shall be rust inhibitive prime coat.

F. Sizes:
   1. Minimum size: 8" x 8".
2. Sizes of each unit shall be individually selected to allow the recommended and required service and maintenance and accessibility functions to be accomplished. These functions shall generally include, for example, valve removal, damper linkage resetting, control adjustment, lubrication, repair, replacement and similar tasks as may be necessary and recommended for the concealed item.

3. Sizes shall be of the following increments (unless otherwise approved) to allow the accessibility function to be accomplished: 8" x 8", 8" x 12", 12" x 12", 12" x 16", 16" x 16", 16" x 24", 24" x 24", 24" x 36", 30" x 30", 36" x 36" or 36" x 48".

4. No size smaller than 16" x 24" shall be allowed when a person must pass through the access opening in order to accomplish the desired accessibility function.

5. Every attic or furred space in which mechanical equipment is installed shall be accessible by an opening and passageway as large as the largest piece of the equipment and in no case less than 22 x 36 inches continuous from the opening to the equipment and its controls. The opening to the passageway shall be located not more than 20 feet from the equipment measured along the center line of such passageway.

2.3 PAINTING AND MARKING

A. All paint and materials used for painting shall be manufacturer's "first quality" product. For additional paint material requirements, refer to Section 09 91 01, Painting.

B. Marking: Refer also to sections describing identification of mechanical systems.

2.4 PIPE HANGERS AND SUPPORTING DEVICES

A. General: Refer to other sections of Division 23 for any requirements which may be additional to this section. Comply with the more stringent requirement if more than one method is specified or shown.

B. Pipe supporting devices specified herein shall apply to all Division 23 piping unless modified in subsequent sections of Division 23 (i.e., vibration isolation) or detailed on the drawings.

1. Pipe hangers for copper pipe shall be copper or copperplated and for steel pipe shall be zinc-plated, clevis type hangers.

2. Hangers for pressure piping shall be clevis type or accepted as equivalent. Pipe hangers shall be capable of vertical adjustment after erection of the piping. Piping shall not be hung from fire and/or smoke walls.

3. Vertical piping supports shall be constructed of carbon steel with rounded ears and two or four holes for clamping bolts. Steel, galvanized and cast iron piping riser clamps shall have galvanized finish. Copper and brass piping riser clamps shall have electro-plated copper or PVC coating finish.

4. Acceptable Manufacturers are Grinnell, PHD Manufacturing Inc., Fee and Mason, Michigan and Elcen.

C. Beam clamps may be used when supporting piping from steel structures.

D. Concrete inserts shall be placed in forms as work of Division 23 prior to the time that concrete is poured.

E. Lead tamp-ins may be used when installed in a concrete or masonry wall or other like vertical surface to support a vertical hanger. Lead tamp-ins will not be permitted to support hangers to the underside of a concrete slab.
F. For parallel runs of above ground suspended piping, an acceptable trapeze-type hanger may be used. Provide permanent, non-conductive type wrapping between copper pipe and steel trapeze hangers.

G. Powder set type fasteners or inserts shall not be used.

2.5 FLOOR, WALL OR CEILING PLATES OR ESCUTCHEONS IN EXPOSED AREAS

A. Shall be chrome-plated. Escutcheons for extended sleeves shall be of the type designed for that purpose. Split ring escutcheons will not be allowed.


C. Provide escutcheons or fabricated plates or collars at each location where pipe or duct passes through a finished surface. Escutcheons for flush sleeves shall be equivalent to Benton & Caldwell No. 3A chromium plated brass; for sleeves extending above floor shall be equivalent to Benton & Caldwell No. 36 chrome plated brass. Collars or plates for ducts and large diameter insulated pipe shall be fabricated of 18 gage galvanized copper bearing sheet steel, secured to structure and neatly fitted around duct or pipe.

2.6 SLEEVES

A. General: Lay out work and set sleeves in new or existing construction so that minimum cutting, drilling and patching is required. Seal all sleeves not used during construction period with grout. Seal unused penetrations and sleeves through fire rated barriers to prevent passage of smoke and heat using an Underwriters' Laboratories approved method; sealing method must be rated at least equivalent to the barrier being penetrated. Submit proposed method to show proof of UL approval.

B. Pipe Sleeves, Special Considerations: The following conditions require pipe sleeves as indicated:

1. Where subject to hydrostatic pressure: Sleeves installed in walls and floors subject to hydrostatic (water) pressures shall be "Link Seal" (Thunderline Corp) Type WS or accepted as equivalent.

2. Where piping is existing: When fire rated walls are to be erected where there is existing piping, provide Proset fire rated split wall system pipe sleeves, or accepted equivalent.

3. Where penetration is part of air duct or plenum system: Do not use plastic pipe for sleeves where floor being penetrated is part of an air plenum so that no fire or smoke hazard is introduced by use of plastic.

4. Where penetration is through fire rated barriers: Provide mild steel sleeves for penetrations of fire rated barriers.

C. Pipe Sleeves in Walls and Partitions:

1. Sleeves Above Grade: Use schedule 40 mild steel pipe or schedule 80 CPVC pipe. Provide sleeves built into wall, partition or beam of size to allow penetration by carrier pipe and insulation covering with not less than 1/4 inch minimum clear space between outer surface of carrier pipe covering (or carrier pipe surface if no covering is provided) and inner surface of sleeve.

2. Sleeves Below Grade in Exterior Walls: Schedule 40 steel hot dipped galvanized after fabrication or cast iron sleeve with not less than 1/4-inch x 3-inch center flange (water stop) around the exterior face of the wall.
3. Penetrations of fire rated barriers shall have only mild steel sleeves; plastic is not allowed.

D. Pipe Sleeves in Floors Above Grade: Use schedule 40 mild steel pipe or schedule 80 CPVC pipe. Provide sleeves built into wall, partition or beam of size to allow penetration by carrier pipe and insulation covering with not less than 1/4 inch minimum clear space between outer surface of carrier pipe covering (or carrier pipe surface if no covering is provided) and inner surface of sleeve. Set sleeves before floor is poured; extend not less than ½-inch above finished floor.

E. Pipe Sleeves in Floors on Grade: Sleeves shall be Schedule 40 steel or Schedule 80 CPVC plastic. Set sleeves before floor is poured. Size sleeves to allow penetration by carrier pipe and insulation covering with not less than 1/4 inch minimum clear space between outer surface of carrier pipe covering (or carrier pipe surface if no covering is provided) and inner surface of sleeve. Extend sleeve not less than ½ inch above finished floor.

F. Duct Sleeves: Sleeves or openings sized to pass mechanical ducts and covering shall be of framed steel construction in roof, wall, and partitions.

G. Sealing of Sleeves:
   1. Pipe Sleeves Below Grade and On Grade: Caulk annular space between pipe and sleeve using approved caulking material to a minimum one inch deep. Result shall be a water tight and vermin proof penetration.
   2. Pipe and Duct Sleeves Above Grade: Openings around pipes, ducts and other conduit passing through sleeves shall be made draft free and vermin-proof by solidly packing with mineral wool or fiberglass or by other such approved method.
   3. Pipe and Duct Sleeves Through Fire Rated Barriers: All penetrations through fire rated barriers (both walls and floors) shall comply with Division-07 or be as specified in this Division.

2.7 FIRE AND/OR SMOKE RATED FLOOR, PARTITION OR WALL PENETRATION SEALANT

A. Seal shall be composed of fire barrier product, putty, or caulking materials used either in combination or singularly. Acceptable Manufacturers are 3M Corporation or Dow Corning.

B. All sealing of floor, partition or wall systems shall be in accordance of the requirements of the associated tested assembly (i.e. UL, USG). Coordinate assembly requirements with architectural drawings and specifications.

2.8 EXCAVATION AND BACKFILL

A. Provide as necessary to accomplish work specified. Perform in accordance with applicable State and Local codes and accepted good practice and in accordance with other applicable sections or divisions.

2.9 BELT DRIVES

A. General: Equip each motor driven machine not direct connected with V-belt drive. Belts shall be of correct cross section to fit properly in sheave grooves and shall be carefully matched for each drive. Sheaves shall be cast iron or steel, bored to fit properly on shafts and secured with keys of proper size. The rating of each drive shall be as recommended by manufacturer for service but shall be at least 1.5 times nameplate rating of motor.
B. Speed Adjustment: Adjust fan speed by change(s) in sheave size as necessary to obtain proper design air flow with fan in its installed location. Fans may be first fitted with variable pitch drives until proper speed adjustment is made and then fitted with proper fixed pitch drive size, or alternate sizes of fixed pitch drives may be used until proper fan needed to deliver necessary air quantity.

C. Vibration of Air Handling Equipment and Fan Units: For air handling equipment and fans driven by motors 5-hp or greater, field vibration levels will not be acceptable if the maximum vibration velocity or displacement measurement exceeds the following values (when measurements are taken at the bearing supports using a vibration analyzer with the filter set at the operating fan speed):

<table>
<thead>
<tr>
<th>Fan Speed (RPM)</th>
<th>Maximum Vibration Level</th>
</tr>
</thead>
<tbody>
<tr>
<td>800 or Less</td>
<td>5 Mils (0.127 mm) max. displacement</td>
</tr>
<tr>
<td>801 and Greater</td>
<td>0.20 in/sec. (5 mm/s) max. velocity</td>
</tr>
</tbody>
</table>

D. Belt and Coupling Guards: Each belt drive shall be equipped with an OSHA approved guard. Guards shall be constructed of #12 U.S. standard gage 3/4-inch diamond mesh wire screen, or equivalent, welded to one inch steel angle frames, and shall enclose all belts and sheaves. Tops and bottoms of guards shall be of substantial sheet metal or not less than #18 U.S. standard gage. Braces or supports must not "bridge" sound and vibration isolators. Guards shall be designed with adequate provision for movement of motor required to adjust belt tension. Means shall also be provided to permit oiling, use of speed counters, and other maintenance and testing operations with guard in place. All direct drive equipment shall have coupling guards in accordance with Florida Department of Business Regulation safety regulations and OSHA.

2.10 BEARINGS

A. All bearings shall be 200,000-hour rated unless otherwise specified.

PART 3 - EXECUTION

3.1 EQUIPMENT ACCESS

A. Access Doors and Panels:

1. Locations: Provide access unit at the following locations.

   a. Where additionally specified in other sections of this Divisions 22 and 23 and where specifically indicated on the drawings.
   b. Where not specifically indicated on the drawings but where the work to be provided will require accessibility for purposes as described or as recommended by the manufacturer of the concealed item.
   c. At all locations where concealed equipment, fixtures, devices and similar items require accessibility for service, inspection, maintenance, repair, replacement and where such concealed item would not otherwise be accessible for such functions without the provision of an appropriately sized access unit.

B. Installation:

1. Definitions: For the purpose of coordination of responsibility, the following words are defined to describe the intended coordination.
a. "Furnish" means to procure an item and deliver it to the project for installation.
b. "Install" means to determine (in coordination with others as necessary) the intended appropriate location of an item and to set, connect and otherwise fix in place in a manner to allow intended operation and use.
c. "Provide" means to both furnish and install fully and completely in all aspects.

2. Furnishing Access Units: Access units shall be furnished as work of the Division which governs the item which is intended to be made accessible by the access unit.

3. Installing Access Units: Access units shall be installed as work of the Division which governs the surface, barrier, partition or other building component in and on which the access unit is to be placed.

4. Determination of Locations:
   
a. Where the work of Division 23 requires that the access unit be provided (i.e., both furnished and installed), then the responsibility for determination of the location at which the access unit is to be placed is also work of Divisions 23.

5. Determination of Sizes:
   
a. Unless an access unit size is indicated on the drawings or otherwise specified, the size of each access unit shall be determined as work of the Division which either provides or furnishes the access unit.
b. Sizes for access units which are provided or furnished as work of this Division shall be in compliance with sizing criteria of this Division.

3.2 PAINTING

A. Paint all exposed piping, insulation, equipment, structural bases, racks, in equipment rooms and on roof, furnished under Division 23 of these specifications. All exposed metal surfaces shall be given one prime coat and two finish coats. All insulated surfaces shall be given one sizing coat of glue sizing (omit this step if factory applied finish is suitable to receive prime coat), one prime coat and one finish coat. Factory painted or finished items do not require field painting but shall require "touch-up" with matching paint or finish where scratched.

B. Pipe hangers, saddles, supports, riser clamps and accessories shall be painted to match their piping.

C. Equipment not completely accessible for painting when set in place shall be thoroughly cleaned and painted before installation and suitably protected.

D. Piping concealed or provided with aluminum or PVC jacketing need not be painted.

3.3 HANGERS AND INSERTS

A. Refer also to other sections which may describe additional requirements for hanging and supporting. Comply with the more stringent requirement if more than one method is specified or shown.

B. Provide and properly locate hangers to adequately support piping and equipment. Arrange hangers to permit expansion and contraction.

C. The size of hanger for non-insulated pipes shall be suitable for pipe size to be supported. For insulated piping, the size of the hanger shall be suitable for the pipe size, plus the insulation and a 16-gauge half-circle galvanized sheet metal insulation saddle.
D. Isolation of copper pipe from steel hangers to consist of wrapping pipe at, and 1" each side of contact surface with not less than two layers of adhesive type plastic electrical insulating tape.

E. Pipe supports for piping 2" diameter and below may be supported directly from Epicure steel decking using Epicure standard hangers (200 lb. max. load). Piping above 2" shall be supported from steel beams.

F. Locate pipe supports as follows unless noted in other sections of these specifications or on the drawings:
   1. Horizontal cast iron pipe inside building - supported on each length of pipe.
   2. Vertical cast iron pipe inside building - supported at each floor level and at the base.
   3. Horizontal steel piping and copper tubing 1" diameter and under - support on 6' centers.
   4. Horizontal steel piping and copper tubing above 1" through 1-1/2" diameter - support on 8' centers.
   5. Horizontal steel piping and copper tubing larger than 1-1/2" diameter - support on 10' centers, except 24" diameter piping shall be supported by main roof beams (20' O.C. maximum).
   6. Support vertical cast iron, steel and copper piping at each floor penetration not to exceed 20 foot intervals.

3.4 ANCHORS
A. Install a suitable anchor on piping to prevent movement from expansion and contraction by welding or clamping securely to pipe at fitting or coupling. Approval of the Architect/Engineer of method of anchorage must be obtained before installation of work. Properly anchor piping to remove strains on equipment which would be caused by expansion and contraction. Adequately insulate anchors on piping, with operating fluid temperatures below 75°F, to prevent moisture condensation problems.

3.5 EXPANSION AND CONTRACTION PROVISIONS
A. Piping is designed with offsets and loops to provide for expansion and contraction. At such points, piping shall be cold sprung to equalize expansion when at operating temperatures. Install piping to maintain grade at all operating temperatures.

3.6 FLASHING
A. Flashing shall be done as work of other divisions.

3.7 SLEEVES FOR PIPING
A. Provide sleeves for all piping where pipe penetrations in walls, floors or other building structure are required. Sleeves in poured concrete shall have watertight seams and joints.

B. Extend sleeves through walls, partitions and ceilings to finished surface. Extend sleeves through finished floors to not less than 1/4 inch above finished surface. Extend sleeves in concrete floors in chases to not less than 1 inch above floor top surface. Sleeves installed above finished ceilings as part of fire/smoke rated wall assemblies shall extend not less than 1" beyond both wall faces.

C. Provide sleeves of adequate size to permit clearance for pipe movement and proper grading and sloping of pipes. Provide sleeves for insulated pipe of adequate size to clear insulation.
D. Caulk space between sleeve’s inner surface and pipe’s outer surface (including insulation surface if pipe is insulated) with approved with fire rated safining material. Provide flexible fire-retardant sealant if pipe is subject to expansion or contraction. Final result shall be an approved fire and smoke stop at pipe and sleeve assembly.

E. Sleeves in walls and slabs subject to hydrostatic pressures shall be water tight at twice the hydrostatic pressure expected to be encountered at the location of the penetration.

3.8 SLEEVES FOR DUCTWORK

A. Ductwork sleeves shall be provided in accord with current SMACNA recommendations or as otherwise detailed on Drawings. Refer also section describing duct systems.

3.9 ESCUTCHEONS

A. Provide chrome plated brass escutcheons (for 1/4 or 1 inch projecting sleeves as required) at each point where an uninsulated pipe passes thru a finished surface.

3.10 CONCRETE BASES AND STRUCTURAL STEEL

A. Concrete bases and structural steel to support equipment and piping installed under each specification section or Division 23 and not specifically shown on the structural or architectural plans shall be included and provided for this work.

3.11 SEALANT

A. Fire/smoke sealant shall be installed in strict compliance with the manufacturer's installation instructions.

END OF SECTION 23 05 00
SECTION 23 05 13
ELECTRIC MOTORS, PREMIUM EFFICIENCY TYPE

PART 1 - GENERAL

1.1 RELATED DOCUMENTS
   A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division-01 Specification sections, apply to work of this section.
   B. Division 26 – Electrical.

1.2 SCOPE
   A. This Section describes electric motors which are higher efficiency. These motors require less energy than standard electric motors which do not meet this specification.
   B. This specification covers 3/4 HP or larger horizontal, 3 phase, integral horsepower, drip proof, squirrel cage induction motors in the NEMA frame sizes through 449.

1.3 RELATION TO OTHER WORK
   A. Refer to the section, "General Mechanical Provisions", for related requirements. Refer to other sections of Division-23 and to all other applicable portions of the Drawings and Specifications.

1.4 STANDARDS
   A. All motors shall be in accordance with the latest version of NEMA Standard MG-1. Motors shall also comply with the applicable portions of the National Electric Code.

1.5 SUBMITTALS
   A. Independent motor submittals for motors that are part of air handling unit or pumping equipment shall be provided for all motors 1 HP or greater.

PART 2 - PRODUCTS

2.1 VOLTAGE FREQUENCY
   A. Motors through 100 hp shall be rated 230/460 volts with 200 or 575 volts as optional; motors above 100 hp shall be rated 460 volts with 575 volts as optional. Motors will be rated for operation on a 3 phase, 60 Hertz power supply. Refer to Electrical Drawings.

2.2 COORDINATION
   A. Where variable frequency drives are used to vary the speed and power consumption of electric motors, such motors must be high efficiency type and must be considered with the actual variable frequency drives which are provided so that optimum matching of variable frequency drive to driven motor is obtained.

2.3 OPERATING CHARACTERISTICS
   A. Torques: Motors shall meet or exceed the locked rotor (starting) and minimum breakdown torques specified in NEMA standards for Design B for the ratings specified.
B. Currents: Locked rotor (starting) currents shall not exceed NEMA Design B maximum values for the specified rating. Motors shall be capable of a 20 second stall at six times full load current without injurious heating to the motor components.

C. Efficiency: Motors shall have full load efficiency which will meet or exceed the values for NEMA Premium® efficiency motors as listed in NEMA 1-2006, Table 12-12 when tested in accordance with NEMA test standard MG1-12.53a, IEEE Test Procedure 112, Method B, using accuracy improvement by segregated loss determination including stray load loss measurements. The minimum efficiency shall be guaranteed.

2.4 SERVICE FACTOR AND AMBIENT
A. Motors shall be rated for a 1.15 service factor in a 40°C ambient.

2.5 INSULATION
A. For constant speed application motors, provide full Class B insulation system.
B. For motors with variable frequency drive, provide with Class F insulation suitable for operation down to 10%.

2.6 FRAME SIZE
A. Horsepower/frame relationship shall conform to the latest NEMA Standard for T frame motors.

2.7 ENCLOSURE
A. Motors shall be drip proof construction.
B. Motor frame and endshields shall be of cast aluminum construction using alloys with low copper content.

2.8 BEARINGS
A. All motors shall have anti-friction bearings, sized for a L-10 life of at least 125,000 hours L-10 life for a direct connected load.
B. Aluminum endshields shall have a cast-in steel or cast iron bearing insert.
C. Bearing housing shall be regreasable with provisions for purging old grease.
D. Bearings shall be preloaded with a bearing loading spring to minimize noise and increase bearing life.

2.9 OTHER REQUIREMENTS
A. Conduit Box shall be diagonally split and rotatable in 90 degree increments.
B. External hardware shall be plated to resist corrosion.
C. External paint shall withstand industrial environments.
D. Nameplates shall be of stainless steel or aluminum and stamped per NEMA Standard MG1-10.37. Nameplate information shall include the nominal efficiency value per Standard MG1-12.53b and the manufacturer's minimum guaranteed efficiency value.

2.10 SHOP DRAWINGS

A. In addition to shop drawing requirements of the section entitled, "General Mechanical Provisions", provide motor data including horsepower; rpm; frame size; nominal efficiency and nominal power factor at full load, 75% load and 50% load; guaranteed efficiency and guaranteed power factor at full load, 75% load and 50% load.

PART 3 - EXECUTION

3.1 MOTOR LOCATIONS

A. Provide NEMA Premium® efficiency motors for the following as provided on this project:

1. All motors of 3/4 HP and above for all Division 23 motors.

END OF SECTION 23 05 13
SECTION 23 05 15
INSTRUCTIONS AND MAINTENANCE MANUALS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division-01 Specification sections, apply to work of this section.

1.2 SCOPE

A. Provide complete written and verbal operating and maintenance instruction to the Owner for all mechanical systems.

1.3 RELATION TO OTHER WORK

A. Refer to the section, "General Mechanical Provisions", for related requirements. Refer to other sections of Divisions 22 and 23 and to all other applicable portions of the Drawings and Specifications.

B. This section directly relates in particular to sections which describe the following:

1. Valves and piping systems components requiring maintenance and which are involved in the dynamic function of the systems.
2. Pumps and related flow devices.
3. Plumbing equipment (heat exchangers, packaged systems, etc.)
4. HVAC equipment (all air handling equipment, terminal units, filter assemblies, etc).
5. Control systems.

PART 2 - PRODUCTS

2.1 INSTRUCTIONS AND MAINTENANCE MANUALS

A. Provide three Instructions and Maintenance Manuals, each complete as follows:

2. Title sheet with job name, Contractor's, subcontractor's control subcontractor and related contractor's or material supplier's names, addresses and phone numbers.
3. Index of contents.
4. A signed copy of acknowledgment of instructions to the Owner or his authorized representative. Two additional copies of the signed acknowledgment shall be sent directly to the Architect as soon as possible after receipt.
5. Typewritten operating instructions for the Owner's personnel describing the following for each piece of equipment and systems:

    a. How to start and stop each piece of equipment.
    b. How to set equipment and systems for normal operation.
    c. Normal restarting procedures before contacting the service contractor.
    d. Complete description of functions and operations of each piece of equipment including description of how equipment operates in conjunction with automatic control systems.
    e. Instructions for cleaning, oiling, greasing, fueling and similar tasks.
6. Approved shop drawings and submittal data and parts and maintenance booklet for each item of material and equipment furnished under this Division, including (but not limited to) the following:

   a. Spare parts list and source of supply for each equipment item.
   b. List of valves with location, service, size, model and operating position.
   c. Diagrams clearly indicating automatic control hook-up.

7. Any as-built wiring diagrams as called for in other sections of this division as needed to show how equipment controls interface with related systems.


B. Electronic versions of all instruction and maintenance manuals shall also be provided in PDF form on a thumb drive.

   1. All files shall be organized in a folder structure.
   2. Folders shall be named with the applicable specification section and title.
   3. File names shall begin with a description of the content (i.e., O&M, Warranty, Shop Drawing, etc.) and then include the description of the equipment or material for which the document applies.

PART 3 - EXECUTION

3.1 VERBAL INSTRUCTION

A. Provide verbal, hands-on, operating and maintenance instruction to Owner's authorized personnel for each equipment item and system. Instruction shall be given by competent personnel.

1. Duration: Total instruction period for all systems of this Divisions 22 and 23 shall be not less than fifteen (15) working days. The Owner reserves the right to audio-tape or video-tape the instruction procedure.

3.2 MANUFACTURERS' SERVICE REPRESENTATIVES

A. Verbal instruction at the site for the following equipment items and systems shall be given jointly by the contractor and the authorized manufacturer's service representative. (Contractor and manufacturer's service representative shall provide instruction to Owner for each equipment item of no less duration than the hours indicated in parenthesis. Duration shall be greater if otherwise specified).

   1. Water Cooled Chillers. (48 hours)
   2. Pumps. (16 hours)
   3. Heat Exchanger. (8 hours)
   4. Air Handling Units. (48 hours)
   5. Exhaust Fans. (24 hours)
   6. Terminal Units. (8 hours)
   7. Controls – Refer to 23 09 23 for requirements.

END OF SECTION 23 05 15
SECTION 23 05 18
PIPING: CONDENSATE DRAIN

PART 1 - GENERAL

1.1 RELATED DOCUMENTS
A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division-01 Specification sections, apply to work of this section.

1.2 SCOPE
A. Provide condensate drain piping from cooling coil drain pans.

1.3 RELATION TO OTHER WORK
A. Refer to the section, "General Mechanical Provisions", for related requirements. Refer to other sections of Division-23 and to all other applicable portions of the Drawings and Specifications.

B. This section directly relates in particular to sections (which may or may not be included in this division) which describe the following:
   1. Air handling equipment with cooling coils.
   2. Insulation.

1.4 SHOP DRAWINGS
A. Refer to Section entitled "General Mechanical Provisions".

PART 2 - PRODUCTS

2.1 PIPE
A. Type M hard drawn copper conforming to ASTM Spec. B88.

2.2 FITTINGS
A. Wrought copper, solder joint, pressure type conforming to ANSI B16.22.

2.3 SOLDER

PART 3 - EXECUTION

3.1 GENERAL
A. Piping shall be sloped uniformly toward drain, and provided with trap seal having a depth, in inches, equivalent to one and one-half (1-1/2) times the total static pressure of the respective fan system. Traps shall be assembled using elbows and tees with threaded brass plugs to permit cleaning of trap and drain line. Piping shall be installed in a neat manner and shall be not smaller than full size of the equipment drain connection or three-quarters inch (3/4") whichever is larger.
3.2 JOINTS AND CONNECTIONS

A. General: Joints and connections shall be made permanently air, gas, and water tight.

B. Solder Joints: Cut pipe square using cutting tool which does not crimp pipe. Remove all burrs using pipe reamer and taking care not to flare the pipe end. Thoroughly clean the outside of pipe and the interior of the fittings using a fine sand cloth. Apply noncorrosive paste flux to the cleaned surfaces immediately and apply solder and heat, in accordance with manufacturer's instructions, to complete joint.

C. Equipment Connections: Connections to copper drain nipples may be made with solder joints provided care is exercised not to damage equipment, its insulation or finish. Connections to equipment having steel nipples shall be made using screwed to solder adapters with teflon tape applied to male threads prior to assembly.

3.3 ROUTING

A. Unless otherwise indicated, route pipe discharge as follows:

1. Roof Mounted Equipment: To nearest roof drain.
2. Interior Equipment: To nearest floor drain.

3.4 INSULATION

A. Insulate if so specified in section describing insulation.

END OF SECTION 23 05 18
SECTION 23 05 48
VIBRATION ISOLATION EQUIPMENT

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of Contract, including General and Supplementary
   Conditions and Division-01 Specification sections, apply to work of this section.

1.2 SCOPE

A. Provide vibration isolation supports for all equipment and piping as may be required to
   prevent transmission of vibration to building structure. This shall include air handling units,
   fans, piping, pumps and similar items.

1.3 RELATION TO OTHER WORK

A. Refer to the section, "General Mechanical Provisions", for related requirements. Refer to
   other sections of Division-23 and to all other applicable portions of the drawings and
   specifications.

1.4 SHOP DRAWINGS

A. Refer to Section entitled "General Mechanical Provisions". Submittal data shall show type,
   point loading information, size and deflection of each isolator proposed and any other
   information as may be required for the Architect/Engineer to check isolator selections for
   compliance with specifications. Include clearly outlined procedures for installing and
   adjusting the isolators.

1.5 MANUFACTURERS

A. Products of the following manufacturers will be acceptable, provided they comply with all of
   the requirements of this specification: Consolidated Kinetics; Mason Industries; Amber-
   Booth; Keflex; Flexonics; Vibration Eliminator Company or equivalent. Any model numbers
   listed are from one or more of these manufacturers and are given to provide an example of
   item(s) required.

1.6 OTHER REQUIREMENTS

A. All vibration isolation equipment shall be both recommended by the manufacturer and
   approved by the Architect/Engineer for each particular application on this project.

PART 2 - PRODUCTS

2.1 BASIC REQUIREMENTS

A. Unless otherwise noted, spring type vibration isolators shall be used for all motor driven
   equipment. It shall be the responsibility of isolation manufacturer to determine the amount of
   spring deflection required for each isolator to achieve optimum performance, prevent the
   transmission of objectionable vibration and meet noise criteria referenced herein.
2.2 CORROSION PROTECTION

A. Steel components shall be phosphated and painted. All nuts, bolts and washers shall be zinc-electroplated. Structural steel bases shall be thoroughly cleaned of welded slag and primed with zinc-chromate or metal etching primer.

B. All isolators exposed to weather shall have steel parts PVC coated or hot-dip galvanized. Aluminum components shall be etched and painted. Nuts, bolts and washers may be zinc-electroplated.

2.3 BASIC ISOLATORS

A. General: Unit designations indicated are Architect/Engineer designations. Each of the following basic isolators may not be applicable to a specific installation application. See PART 3, "EXECUTION".

B. Spring Mounts, Open Type, Unrestrained (Unit SMOU): Free standing springs; laterally stable; minimum horizontal-to-vertical spring rate (Kx/Ky) of 1.0: 1/2-inch neoprene acoustical friction pads between bottom baseplate and the supporting surface; leveling bolts; provision for bolting the mount to the equipment (unless otherwise specified); spring diameters not less than 0.8 of the compressed height of the spring at rated load; springs shall have a minimum additional travel to full compression of 50% of the rated deflection; 1-inch minimum static deflection (unless otherwise specified); submittals shall include spring diameters, deflections, free spring heights, solid spring heights and operating heights. Be similar to Mason Type SLF; Korfund Series L; Amber-Booth Type SW.

C. Spring Mounts, Open Type, Restrained (Unit SMOR): Free standing springs; laterally stable; 1/2 inch neoprene acoustical friction pads between bottom baseplate and the supporting surface; leveling bolts; provision for bolting the mount to the equipment (unless otherwise specified); spring diameters not less than 0.8 of the compressed height of the spring at rated load; springs shall have a minimum additional travel to full compression of 50% of the rated deflection; 1-inch minimum static deflection (unless otherwise specified); restraint consisting of welded steel channel ends for outdoor installation and welded steel studs for indoor installation; restraint shall have restraining bolts connecting top plate and lower housing to limit vertical rise of isolated equipment when load is reduced; vertical clearance of 1/8 to 3/8 inch shall be maintained between spring top plate and housing (leveling bolts shall be adjusted to maintain this clearance). Submittal shall include spring diameters, deflections, free spring heights, solid spring heights and operating heights. Be similar to Mason Type SLR; Amber-Booth Type CT.

D. Spring Mounts, Housed, Unrestrained (Unit SMHU): Springs free standing within their housing; laterally stable; 1/2 inch neoprene acoustical friction pads between bottom baseplate and the supporting surface; leveling bolts; provision for bolting the mount to the equipment (unless otherwise specified); spring diameters not less than 0.8 of the compressed height of the spring at rated load; springs shall have a minimum additional travel to full compression of 50% of the rated deflection; 1-inch minimum static deflection (unless otherwise specified); welded steel housing; vertical clearance of 1/8 to 3/8 inch shall be maintained between spring top plate and housing (leveling bolts shall be adjusted to maintain this clearance). Submittal shall include spring diameters, deflections, free spring heights, solid spring heights and operating heights. Be similar to Mason Type C.

E. Neoprene and Spring Hangers, Vertical Deflection (Unit NSHV): Steel housing for undampened support of the spring: Provisions for attachment of hanger rods; reinforced neoprene washer and grommet to break up metal to metal contact; free standing spring; 1 inch minimum static deflection (unless otherwise specified) spring diameters not less than 0.8
of the compressed height of the spring at rated load; springs shall have a minimum additional travel to full compression of 50% of the rated deflection. Submittals shall include spring diameters, solid spring heights, free spring heights, deflections, overall hanger dimensions and maximum hanger rod diameter which can be accommodated by the hanger. Be similar to Mason Type DNHS: Amber-Booth Type BSR.

F. Neoprene and Spring Hangers, Vertical and Angular Deflection (Unit NSHVA): Shall contain a laterally stable steel spring and 0.3" reflection neoprene or fiberglass element in series. A neoprene neck shall be provided where the hanger rod passes through the steel box supporting the isolator mount to prevent metal to metal contact. Spring diameters and hanger box lower hole sizes shall be large enough to permit the hanger rod to swing through a 30 degree arc before contacting the hole and short circuiting the spring. Springs shall have a minimum additional travel to solid equal to 50% of the rated deflection. Mason Type 30N.

G. Neoprene and Spring Hangers, Vertical Deflection, Position Type (Unit NSHVP): Steel housing for undampened support of the spring; provisions for attachment of hanger rods; reinforced neoprene washer and grommet to break up metal to metal contact; free standing spring; 1 inch minimum static deflection (unless otherwise specified); spring diameters not less than 0.8 of the compressed height of the spring at rated load; springs shall have a minimum additional travel to full compression of 50% of the rated deflection; be capable of holding the supported item at fixed elevation during installation with secondary adjustment to transfer the load to the spring while maintaining a fixed position; scale and pointer to indicate the deflection. Submittals shall include spring diameters, solid spring heights, free spring heights, deflections, overall hanger dimensions and maximum hanger rod diameter which can be accommodated by the hanger. Be similar to Mason Type PCDNHS: Amber-Booth Type PBS.

H. Neoprene and Spring Hangers, Vertical and Angular Deflection, Position Type (Unit NSHVAP): Shall contain a laterally stable steel spring and 0.3" deflection neoprene or fiberglass element in series. A neoprene neck shall be provided where the hanger rod passes through the steel box supporting the isolator mount to prevent metal to metal contact. Spring diameters and hanger box lower hole sizes shall be large enough to permit the hanger rod to swing through a 30 degree arc before contacting the hole and short circuiting the spring. Springs shall have a minimum additional travel to solid equal to 50% of the rated deflection. Be capable of holding the supported item at the fixed elevation during installation with secondary adjustment to transfer the load to the spring while maintaining a fixed position; scale and pointer to indicate the deflection; similar to Mason Type PC30N.

I. Neoprene-In-Shear Hangers (Unit NH): Steel housing for undampened support of the neoprene; provisions for attachment of hanger rods; neoprene-in-shear isolator; similar to Mason Type HD, Amber-Booth Type HRD.

J. Neoprene-In-Shear Mounts (Unit NM): Double deflection neoprene-in-shear mountings shall have a minimum static deflection of 0.35". All metal surfaces shall be neoprene-covered. The top and bottom surfaces shall be neoprene ribbed and bolt holes shall be provided in the base. On equipment such as small vent sets and close coupled pumps, steel rails shall be used above the mountings to compensate for the overhang; steel rails shall be by same manufacturer as vibration isolators and equivalent to Mason Industries Type DNR. Mounts shall be Mason Industries Type ND, Consolidated Kinetics Type RD or Vibration Mounts and Controls Series RD.

K. Flexible Pipe Connectors: Same internal diameter as the pipe in which the connector is installed (not necessarily internal diameters of inlets or outlets of equipment).
1. Both recommended by the manufacturer and approved by the Architect/Engineer to be suitable for handling the conveyed fluid at all conditions (maximums and minimums of temperatures, pressures, velocities, etc.) encountered for each particular application.

2. Of proper design to absorb the combination of vibratory and/or expansion or contraction motions (lateral and/or axial and/or angular) encountered at each installation point (for example, do not use hose type where axial motion is encountered at the installation point unless so recommended by the manufacturer and approved by the Architect.

3. Stainless steel bellows type (Unit SSB): Heavy duty steel restraining rods and spacers; laminated steel bellows; steel flanges; permit axial, lateral and angular movement; rated to withstand 180°F operating temperature and 150 psig working pressure for chilled water; 250°F operating temperature and 150 psig working pressure for heating hot water; similar to Keflex Series 151 or 301.

4. Stainless steel hose type (Unit SSH): Rated to withstand 180°F operating temperature and 150 psig working pressure; have flanges except 2-1/2 inch and smaller sizes may have screw type fittings installed with a union at one end or with screw-on flanges at both ends; net flexible lengths shall be at least 6 pipe diameters for pipe up to 5 inch ID and not less than 36 inches for pipe 6 inch ID and greater; corrugated bellows with stainless steel wire braid restraining sheath; similar to Flexonics Type RW, RF or Series 400, Mason Type BSS, Keflex Series SSH.

L. Acoustic Seals (Unit AS): Consist of an S-shaped molded synthetic rubber seal attached with stainless steel clamps to the pipe wall sleeves and to carrier piping. Wall sleeves shall be two pipe sizes larger than the carrier pipe and/or its insulation. Amber-Booth Type 301.

M. Inertia Bases (Unit IB):

1. Weigh at least 1.5 times the weight of the particular machine being supported.
2. Rectangular welded structural channel steel perimeter frame.
4. Height saving support brackets.
5. Width and length at least 6 inches beyond machine's overall width and length (if necessary, larger for pumps as required to support suction and discharge wells).
6. Structural steel channel depth and concrete base depth shall be a minimum of 1/15th of the longest base dimension but not less than 6 inches.
7. Forms shall include 1/2 inch (or larger if necessary) steel reinforcing bars welded in place on 6 inch centers running both ways across the width and length in a layer 1-1/2 inches above the bottom of the base. Drilled steel members with sleeves welded below the holes to receive equipment anchor bolts.
8. Similar to Mason Type KSL Base.

N. Steel Equipment Frames (Unit SEF): Frames shall consist of structural steel sections sized, spaced and connected to form a rigid base which will not twist, rack, deform or deflect in any manner that will negatively affect the operation of the supported equipment or the performance of the vibration isolation mounts. Frames shall be of adequate size and plan form to support basic equipment units and motors plus any associated pipe elbow or duct elbow supports and electrical control elements or other components closely related and requiring resilient support in order to prevent vibration transfer from equipment to the building structure. Frames shall include side mounting brackets for attachment to Unit SMOU isolator or other specified isolator. The clearance between the underside of any frame or mounted equipment unit and the top of the building structure below shall be at least 2 inches.

O. Neoprene Pads (Unit NP): Waffle or ribbed pattern neoprene pads shall be fabricated from 40-50 Durometer neoprene. Mason Type W.
P. Isolation rails, curb mounted, for roof mounted air handling units (Unit IRCM): Curb mounted roof top units shall each be isolated with a continuous roof top isolation assembly consisting of extruded aluminum rails formed to fit curb and equipment with a flexible air and weather seal continuously joining the two rails and incorporating spring isolators sized for 1" static deflection. Flexible weather seals shall be 1/16th inch thick minimum reinforced Neoprene protected from direct sunlight and accidental puncture by an extruded aluminum shield and shall be capable of being replaced completely without disturbing the unit mounting. Springs shall be stable with a KX/KY (horizontal to vertical spring rate) of 1.0 or greater and be properly sized to support the load at 1" static deflection. Isolation assembly shall have Neoprene cushioned wind restraints which are not engaged in normal operation with sufficient capacity to resist wind load in any direction without distortion or damage to the isolated equipment. Entire assemblies shall be shipped in one piece to eliminate field joint and possible leakage. Mason Industries CMAB.

PART 3 - EXECUTION

3.1 GENERAL

A. All isolators shall be installed in strict accordance with the manufacturer's instructions and shall be properly adjusted prior to requesting final inspection or the performance of any vibration testing specified.

B. Each item of equipment (machinery, piping, etc.) which is provided with vibration isolation equipment shall rest in its intended, proper operating position (i.e. exactly level, etc.) after installation of vibration isolation equipment. Approval of such vibration isolation equipment by Architect/Engineer shall not relieve the Contractor of this responsibility.

C. Equipment which is specified to rest on concrete housekeeping pads shall have Unit NP pads unless otherwise indicated.

3.2 AIR HANDLING UNITS, FACTORY PACKAGED

A. Floor Mounted:
   1. Spring mounted (Unit SMOU) with 1 inch minimum static deflection when AHU motor is 5 hp. or less; spring mounts with 2 inch minimum static deflection when AHU motor is 7-1/2 hp. or greater. Instead of bolting the units to the spring mounts, provide height saving brackets.
   2. Flexible duct connections as specified in "Duct System Accessories" section.
   3. Flexible pipe connectors (Unit SSB).
   4. Steel equipment frame (Unit SEF) manufacturer's standard unit frame or base is not sufficiently stiff and rigid to permit point vibration isolation.
   5. Mount equipment on reinforced concrete pads as specified in other sections.

B. Suspended from Building Structure:
   1. Spring hangers (Unit NSHV) with 1-inch minimum static deflection when motor is 5-HP or less; spring hangers (Unit NSHV) with 2-inch minimum static deflection when motor is 7-1/2 HP or greater.
   2. Flexible duct connectors as specified in Section entitled "Ductwork".
3.3 MANUFACTURER’S SUPERVISION

A. The Contractor shall include in his price the cost of the vibration isolation manufacturer or his qualified representative for providing such supervision as may be necessary to assure correct installation and adjustment of the isolators. Upon completion of the installation and after system is put into operation, the manufacturer or his representative shall make a final inspection and submit his report to the Architect/Engineer in writing certifying the correctness of installation and compliance with approved submittal data.

END OF SECTION 23 05 48
SECTION 23 05 93
PERFORMANCE VERIFICATION, PRELIMINARY

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawing and general provisions of Contract, including General and Supplementary Conditions and Division-01 Specification sections, apply to work of this section.

1.2 SCOPE

A. Put all work in a state of readiness for final performance verification.

B. Final performance verification shall not begin until the systems are complete and operable in all respects and all related building systems are complete.

1.3 RELATION TO OTHER WORK

A. Refer to the section, "General Mechanical Provisions", for related requirements. Refer to other sections of Division 23 and to all other applicable portions of the Drawings and Specifications.

B. Refer to the section which describes "Performance Verification, Final".

PART 2 - PRODUCTS

This section not applicable.

PART 3 - EXECUTION

3.1 AIR SYSTEMS

A. Prepare the air side for balancing in the following manner:

1. All fans, blowers, and air handling equipment shall be mechanically checked and available to operate under design conditions.

2. All splitters, volume dampers, fire dampers, and vanes shall be in their neutral positions.

3. All grilles, diffusers, and like items, shall be installed with dampers, vanes, and blades in their neutral positions.

4. All controls, whether they are electronic, electric or pneumatic or a combination thereof, shall be mechanically checked and ready to operate under design code in an operable and non-overloading condition.

3.2 ADDITIONAL REQUIREMENTS

A. Complete Installation: The Contractor shall complete the equipment and system installation to the satisfaction of the Architect/Engineer (who will be the sole judge of its state of readiness) prior to advising, the writing, that final performance verification is ready to begin. The Contractor is hereby advised that the Certificate of Substantial Completion will not be issued prior to the completion of final performance verification work and that he should therefore, schedule all other work accordingly allowing no less than 60 days for completion of final performance verification.
B. Correction of Defects: The Contractor shall promptly and properly correct all defects in workmanship, material, installation and equipment of which he is aware prior to requesting that final performance verification work begin. Once the final performance verification work has begun, the Contractor shall promptly correct all defects in workmanship, materials, installation, and equipment as they are called to his attention by Architect/Engineer.

C. Drive Changes: Changes in pulleys or belts required for correct final balance during testing shall be made at no additional cost.

D. Scheduling and Coordination: The Contractor shall be responsible for proper scheduling and coordination of work involved in preliminary performance verification. This shall include, but is not necessarily limited to the timely provision of: mechanics, tools, equipment, correction of defects, equipment manufacturer's representatives, test modules, and all other items which may be required.

E. Report: Submit a written report describing and certifying in detail all preliminary performance verification items and tasks that have been performed. Approval of this report by the Architect/Engineer will precede final performance verification.

END OF SECTION 23 05 93
SECTION 23 05 94
PERFORMANCE VERIFICATION, FINAL

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division-01 Specification sections, apply to work of this section.

1.2 SCOPE

A. Provide the services of an independent test and balance agency to verify the performance of the complete heating, ventilating and air conditioning systems as described by Division 23. Performance verification shall be accomplished by established testing and balancing procedures as described in this section.

1.3 RELATION TO OTHER WORK

A. Refer to the section, "General Mechanical Provisions", for related requirements. Refer to other sections of Division 23 and to all other applicable portions of the Drawings and Specifications.

1.4 TEST AND BALANCE AGENCY

A. All performance verification shall be performed by an independent test and balance agency (herein referred to as the "T & B Agency") which is fully certified by and a current member of the Associated Air Balance Council (AABC).

1.5 CONTRACTUAL RELATIONSHIP

A. Performance verification shall be performed as a service of the T & B Agency directly to the Contractor with no other subcontractors as part of the agreement.

B. Performance verification is specified in this Division 23 only because it relates predominantly to Division 23 work. However, the inclusion in this Division 23 of this section covering performance verification shall not preclude the contractual agreement of the T & B Agency from contracting directly to the Contractor with no other subcontractors as part of such agreement.

1.6 AGENCY APPROVAL

A. Submit the name and qualifications of the proposed T & B Agency to the Architect/Engineer for approval within thirty (30) days of Notice to Proceed.

B. Include AABC National Project Certification Performance Guaranty.

1.7 WORK INCLUDED

A. The T & B Agency shall provide all labor, supervision, professional services, tools, test equipment and instruments (except as otherwise specified) to perform the following work and all other work of this section:
1. Review the automatic temperature control and air terminal unit specifications for their respective and combined effects on the testing and balancing procedures for the air and hydronic systems.

2. Where in the opinion of the T & B Agency conditions may exist in the system design or construction that may have the potential of adversely affecting system performance, then the T & B Agency shall identify the condition and submit in writing recommended correctives for consideration by the Architect/Engineer.

3. During construction, review those shop drawings which have relevance to performance verification to confirm that the required piping, ductwork and equipment, and their respective specialties and accessories such as gauges, valves, dampers, access doors, etc., are properly selected, sized and located to permit proper and complete testing and balancing to be accomplished.

4. Perform site inspections to verify compliance with documents, and observe pressure tests on ductwork.

5. Perform a complete air and hydronic test and balance of all heating, ventilating, air conditioning and exhaust air systems and all water and steam systems shown and described on the Construction Documents and as further described herein.


7. Furnish specifications to Contractor for properly sized fixed sheaves on fan systems after proper RPM has been established.

1.8 EXISTING SYSTEMS

A. Prior to balancing and testing the new systems, obtain test data on those existing systems which may be affected by the new work. Then, after the new work is provided, rebalance (if and as necessary) those existing systems so that they operate at the same conditions under which they were operating prior to the new work.

B. The above test data shall be provided as part of the test and balance report. The test data shall include the water and air flow rates and temperatures entering and leaving any equipment items which are part of the existing heating, ventilating and air conditioning system. However, only the fluid affected by the new work need be tested (for example, an air handling unit which is unaffected on its airside but which is affected on its waterside need only have water data obtained). Also, if a piping system branch serves a group of units, then only the flow at the existing branch need be measured and not necessarily the flow at each air handling unit served by the branch (unless measurement at each unit is the only way to obtain the branch total flow).

1.9 GUARANTY

A. The T & B Agency shall include a warranty period of ninety (90) days after completion and acceptance of test and balance work. During the warranty period, the Architect/Engineer may request a re-check or re-setting of any system component requiring testing and balancing. The T & B Agency shall provide technicians, instruments, and tools to assist the Architect/Engineer in conducting any test that he may require during this time. The foregoing shall be in addition to the A.A.B.C. National Project Certification Performance Guaranty which shall also be provided.

PART 2 - PRODUCTS

2.1 GENERAL

A. The tangible product of this section shall include the reports and documentation necessary to verify the systems' performance.
2.2 REPORT

A. The T & B Agency shall in the course of his work record the information herein specified. Recorded test data shall be at the final balanced condition for each system. Recorded data shall be arranged by system using the appropriate designation as established on the Construction Documents. Four (4) copies of the final report signed, bound and indexed shall be submitted to the Architect/Engineer for his approval or comments.

B. Where actual measurements recorded for the final balance show deviations of more than 10% from the design, the T & B Agency shall note same in the report and submit recommendations for corrective action to the Architect/Engineer for his consideration.

C. In those cases where recorded data can be reasonably interpreted to be inaccurate, inconsistent and/or erroneous, the Architect/Engineer may request additional testing and balancing. The T & B Agency shall at no additional cost perform such retesting and rebalancing as directed by and in the presence of the Architect/Engineer.

D. Where, in the opinion of the T & B Agency, there is excessive vibration, movement or noise from any piece of equipment, ductwork, pipes, etc., the T & B Agency shall note same in the report and submit recommendations for action to the Architect/Engineer.

E. The T & B Agency shall verify that each thermostat and the devices it is controlling, such as control valves, motorized dampers, VAV boxes, etc., operate in the exact sequence required.

F. Test Data: Include the following data in the Systems Test and Balance Report:

1. Motors:
   Manufacturer
   Model and serial number
   Rated amperage and voltage
   Rated horsepower
   Rated RPM
   Corrected full load amperage
   Measured amperage and voltage
   Calculated BHP
   Measured RPM
   Sheave size, type and manufacturer

2. Fans:
   Manufacturer
   Model or Serial number, BI or Air Foil - number of blades
   Rated CFM, measured CFM
   Rated RPM, measured RPM
   Measured pressures - Inlet and Outlet Static Pressure
   Pulley size, type and manufacturer
   Belt size and quantity
   Rated TSP
   Operating TSP & operating ESP (at discharge side of Supply Fan or suction side of Exhaust/Return Fan)

3. Air Systems (including inlets and outlets):
   Provide single line diagrammatic plan locating each air inlet and outlet and its reference number.
   Grille or diffuser reference number and manufacturer.
   Grille or diffuser location.
Design velocity.
Design CFM.
Effective area factor and size.
Measured velocity.
Measured CFM
Terminal Unit CFM

G. Other Report Requirements: Where any systems have equipment or components which are not covered by the above, then the Final Test and Balance Report shall include the following data as applicable to such equipment or systems to confirm actual operation:

1. All inlet and outlet areas.
2. All applicable duct, pipe and coil sizes.
3. Outside, inside, mixed and supply air conditions.
4. All speeds.
5. All voltage and ampere ranges.
6. Descriptions of each test method used.

2.3 INSTRUMENTATION

A. All test and balance equipment and instruments to be furnished by the T & B Agency shall have been calibrated within six (6) months of use on this work. A list of equipment and instruments to be used shall be submitted to the Architect/Engineer prior to commencing test and balancing operations and shall include equipment and/or instruments, name, manufacturer, serial number and certification of last calibration date. Instruments without calibration adjustment capability shall be accompanied with manufacturer's certification of accuracy. Test and balance equipment and instruments furnished by the Contractor to the T & B Agency shall be accompanied with certification as required above. The T & B Agency shall be responsible for the protection from damage due to accident, abuse or misuse, all equipment and instruments provided by the Contractor, and shall return same in good working condition at the completion of the test and balance work to the Contractor. The T & B Agency shall repair at his expense to original condition and accuracy or replace with like equipment and instruments damaged in the work.

2.4 DIAGRAMS

A. Provide a schematic diagram (i.e., one-line) of duct system(s) tested. Indicate on the diagram the relative location of all air distribution devices, VAV boxes, heating/cooling coils, points of data measurements (i.e., pitot traverse, temperature, static pressure) fans, air handling units, and similar equipment included in the system. Diagram shall identify each component tested. Said identification shall utilize the conventions shown on the drawings (i.e., AHU-1 or SF-6) and correlate with the data sheets provided in the Test and Balance Report.

2.5 LOGS AND FORMS

A. Logs and forms shall clearly indicate following:

1. All inlet and outlet areas.
2. All applicable duct, pipe and coil sizes.
3. Outside, inside, mixed and supply air conditions.
4. All fluid velocities, flow rates, temperatures and pressures at significant locations (e.g., fluid pressures before and after each pump and fan, temperatures and pressures at supply and return headers and at chiller and boiler inlets and outlets, etc.).
5. All fan speeds.
6. All motor ampere ranges.
7. Descriptions of each test method used.

B. Associated Air Balance Council log and data forms.

PART 3 - EXECUTION

3.1 GENERAL

A. Sheaves: The Contractor shall provide applicable fans with V-belt drives and fixed pitch sheaves. In order to provide the properly sized fixed pitch sheave, the Contractor shall initially provide fans with V-belt drives, variable pitch sheaves. The Contractor, upon completion of system balancing by the T & B Agency, will replace these adjustable pitch sheaves with fixed sheaves of the size and type specified by the T & B Agency. The Contractor shall tag the adjustable sheaves, transmit same to Owner, and receive written receipt by Owner of acceptance of these sheaves.

B. Load Conditions: All testing and balancing of systems shall be undertaken with maximum attainable load. Testing and balancing of all air handling systems shall be accomplished with ceiling tile in place and enclosing partitions and doors erected.

C. Observe all equipment and exposed piping for noise, movement or vibrations under normal operating conditions and report excesses to the Architect and Owner.

D. Where patented measuring stations are installed, each of these is to be read and recorded. In the hydronic systems, the permanent devices, such as flow tubes with mercury manometers, annular ring systems, venturi tubes with portable meters, etc. must be used for final measurements after they are completed, calibrated and in satisfactory condition.

3.2 PERFORMANCE VERIFICATION, PRELIMINARY

A. The Contractor, prior to commencement of the balancing by the T & B Agency, shall verify in writing:

1. That strainers have been removed and cleaned.
2. That all air filters have been installed and are in clean condition.
3. That expansion tanks have been inspected and that the system is not air bound and is completely filled with water.
4. That all air vents at coils and high points of the piping systems have been inspected and are installed and operating freely.
5. That all automatic valves, hand valves, and balancing valves have been left or fixed in the open position for full flow through all devices.
6. That all linkages between valves or dampers and their actuators are secure.
7. That all pumps and fans are operating at the specified RPM.

B. The Contractor shall confirm in writing that the systems as scheduled for balancing, are operational and complete and that all piping and ductwork have been pressure tested and accepted and all affected piping systems have been cleaned, flushed and refilled with prescribed treated water and vented.

3.3 PROTECTION OF WORK

A. The Contractor shall protect all mechanical devices during the testing and balancing period. The activities of the T & B Agency will include but not be limited to the adjustments of designated balancing devices including; adjustment of balancing dampers, adjustment of inlet
vane dampers, adjustment of air extractors, air splitters, or manual dampers, the adjustment of adjustable sheaves for fan speed, the adjustment of balancing valves, or similar devices. The existence of the T & B Agency shall not relieve the Contractor of his responsibility for the complete operation of the mechanical systems in conformance with the contract documents.

3.4 CORRECTION OF WORK

A. The Contractor shall at no additional cost to the Owner rectify discrepancies between the actual installation and contract documents when in the opinion of the T & B Agency the discrepancy will significantly affect system balance and performance.

3.5 COORDINATION AND ASSISTANCE

A. The Contractor shall assist the T & B Agency by providing all labor, equipment, tools and material required to operate all of the equipment and systems necessary for the testing and balancing of the systems and for the adjustment, calibration or repair of all electric or pneumatic or automated control devices and components. These services shall be available on each working day during the period of final testing and balancing. The Contractor shall assist the T & B Agency by arranging to have all ceilings, partitions, windows, and doors installed prior to the scheduled commencement of balancing within each specified area.

B. The Contractor shall provide to the approved T & B Agency a complete set of plans and specifications and an approved copy of all heating, ventilating and air conditioning equipment shop drawings. The Contractor shall include the cost of all pulley, belt, and drive changes, as well as balancing dampers required to achieve proper system balance recommended by the T & B Agency.

3.6 AIR SYSTEMS

A. The testing and balancing shall include, but is not limited to, the following requirements:

1. Adjust fan speeds to deliver the required cfm and static pressure, and record rpm and full load amperes.
2. Make pitot tube traverse of main supply ducts to verify design cfm. Seal duct access holes with rubber or metal snap-in plugs.
3. For each supply air system, verify the quantity of outside air and return air when the system is operating in the maximum cooling and full heating modes.
4. Test and adjust each diffuser, grille and register to within 10% of design requirements, and also adjust so as to minimize drafts in all areas.
5. Observe all equipment and exposed ductwork for noise, movement or vibration under normal operating conditions and report excesses to the Architect/Engineer.

B. After all air distribution devices have been balanced to distribute calculated design indicated air quantities and if temperature in any area (where such area does not have the particular zone temperature control thermostat located therein) of any zone is not maintained within 2 degrees plus or minus of the zone areas which does have the zone temperature control thermostat, then notify Architect/Engineer of such conditions and obtain approval to rebalance devices to obtain air quantities other than those indicated so that air temperature in entire zone will be as even as possible regardless of calculated design air quantities. After obtaining approval to rebalance, perform such necessary rebalancing.

END OF SECTION 23 05 94
PART 1 - GENERAL

1.1 RELATED DOCUMENTS
A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division-01 Specification sections, apply to work of this section.

1.2 SCOPE
A. Provide all work necessary to insulate all equipment, piping, ducts and other items related to the piping and duct systems.

1.3 RELATION TO OTHER WORK
A. Refer to the section, General Mechanical Provisions", for related requirements. Refer to other sections of Division-23 and to all other applicable portions of the Drawings and Specifications.
B. This section directly relates in particular to sections (which may or may not be included in this division) which describe the following:
   1. Duct systems.
   2. Cooling equipment.
C. Vessels, tanks, stacks, and other items which contain or convey fluids which are at such temperatures as to create condensation or surface temperatures which are hazardous or where heat loss or gain prohibits proper system operation.

1.4 SHOP DRAWINGS
A. General: Refer to the Section entitled "General Mechanical Provisions". Shop drawings shall contain complete descriptive and engineering data, including flame spread and smoke developed ratings (ASTM E84 test method) on all materials and adhesives. Where finishes, covers, or jackets are specified, provide complete data on same. Shop drawings shall contain specified information on: densities, conductivities, conductances, or resistances as required to establish conformance with the specified values or materials.
B. Industry Standards: Where compliance with an industry, society or association standard is specified or indicated, certification of such compliance shall be submitted with shop drawings.
C. Commencement of Work: Submit shop drawings before any work is commenced.

1.5 STORAGE OF MATERIALS
A. Do not store fiberglass insulation within the building until it has been "dried in". If no other dry space is available and this insulation must be installed or stored before the building is "dried in" and completely enclosed, provide polyethylene film cover for protection.

1.6 COMPLIANCE WITH CODES AND STANDARDS
A. Applicable Codes: The total insulation system including insulation, sealant, finishes, etc., shall comply with or exceed all code requirements.
B. NFPA: All materials and adhesives used shall conform to the requirements of NFPA 90A as to flame spread and smoke developed ratings.

1.7 DEFINITIONS AND TERMINOLOGY

A. Terminology: Throughout this section, insulation products may be described as regards the location, surface or other point at which they are to be applied. Except in special cases (where a detailed indication or description will be given), the majority of conditions can be defined in whole or in part by use of (but not necessarily limited to) any or all of the following words:

1. "Internal" or "External".
2. "Interior" or "Exterior".
3. "Concealed" or "Exposed".
4. "Protected" or "Unprotected".

B. Definitions: Wordage used to describe locations, surfaces or other points or conditions shall be defined as follows as related to this section. Where the ascertainment or determination of locations, surfaces and other conditions is obvious from the intent of use of the item (e.g., roof-mounted ductwork, underground piping, etc.) or from other information, then the following words may not be required. If any ambiguity should occur, provide bid based on the most severe condition; however, obtain clarification from Architect/Engineer prior to installation:

1. "Internal" and "External": Relates to an item or its surface which is to be insulated or uninsulated. Does not relate to the confines of the building, structure or other entity in which the item is located. (Examples: internal/external surfaces of ductwork, pipe, air handling units or other such items.)
2. "Interior": Relates to the location of an item as to whether the item is within a heated, ventilated, air conditioned or otherwise controlled environment of the building, structure or other entity in which the item is located. "Interior" is always "Protected". (Examples(s): Interior ductwork, interior piping, interior air handling units.)
3. "Exterior": Relates to the location of an item as to whether the item is outside (i.e., exterior to) a heated, ventilated, air conditioned or otherwise controlled environment of the building, structure, facility or other entity which the item serves or relates. "Exterior" generally means that the item is surrounded by the ambient outside environment. "Exterior" is considered "Unprotected" unless otherwise described. (Examples(s): exterior rooftop air handling units, exterior ductwork, exterior cooling tower.)
4. "Concealed" and "Exposed": Relates to the visibility of an item. "Concealed" implies out-of-sight from normal view by an occupant, user or employee of the facility when such person is performing their normal function. "Exposed" implies that the item is readily visible by such a person when that person is performing a normal function. (Examples(s): "Concealed interior ductwork" would be out-of-sight in a ceiling plenum, whereas "exposed interior ductwork" would be readily visible in a mechanical equipment room or in a room which intentionally had no ceiling system.)
5. "Protected" and "Unprotected": Relates to an exterior item which may or may not be sheltered from the outside elements but which exists in contiguous contact with the ambient environment without benefit of any direct heating, ventilating or air conditioning. (Example(s): Piping or ducts located in an open crawl space beneath a building would be "protected/concealed"; in an open parking garage such piping or ducts would be "protected/exposed". Piping or ducts on a rooftop would be "unprotected" and usually "exposed").
PART 2 - PRODUCTS

2.1 GENERAL

A. Materials: Materials listed are those used as basis of design; equivalent products of acceptable manufacturers will be accepted. Materials must be approved and recommended by the insulation product manufacturer for the particular application(s).

B. Flame and Smoke Ratings: Application of insulation materials may require, in many cases, that the final insulation system comply with NFPA 90A with regard to maintaining a flame spread rating of 25 or less and a smoke developed/fuel contributed valve of 50 or less. In such cases, verify that the materials comply with the indicated flame spread and smoke developed ratings.

C. Applicability: Products and manufacturers listed may not all be applicable. Use only those products and manufacturers which are indicated as being applicable to a specific insulation condition.

D. Acceptable Manufacturers: Manufacturers which are listed are those manufacturers who may make one or more of the insulation products required. Listing of a manufacturer does not necessarily mean the manufacturer is approved for all applicable insulation conditions. Each listed manufacturer must still comply with the specific requirements of each insulation condition to be acceptable for the particular application. Acceptable manufacturers of insulation-related products include (but are not necessarily limited to) the following: Armstrong; CertainTeed; Childers Products Co.; Knauf; Manville; Owens-Corning; Pittsburg Corning; Rubatex; Upjohn Co.; Duracote Corporation; Ferro Corporation; Dow Corning Corporation; Duro Dyne Corporation; Goodloe E. Moore, Inc.; 3M Co.; United McGill Corporation, Vimasco Corporation; Foster; Gustin-Bacon; Nomaco Inc.; Insulcoustic; Molded Acoustical Products; Lion Nokorode and other manufacturers as may be listed for a specific application.

2.2 BASIC MATERIALS

A. Cellular Glass Insulation: Preformed or block type as indicated or as applicable. Fire, water and vermin retardant; closed cell glass composition; density of 8.5-pcf. Comply with the following: ASTM C 552, "Specification for Cellular Glass Thermal Insulation"; Military Specification MIL-I-24244B. Flame spread rating of "5" and a smoke developed rating of "0" as per ASTM E 84. Recommended temperature applications from -450°F to 1200°F when installed in accord with manufacturer's recommendations. Pittsburg-Corning Foamglas.

B. Elastomeric Insulation: Preformed (tube), roll or sheet as indicated or as applicable. Nitrile, rubber based, closed cell structure. K factor of 0.28 at 75°F. In tube, roll or sheet form of 3/4-inch thickness or less, ASTM E 84 flame spread rating of "25" or less and smoke developed rating of "50" or less. Recommended temperature applications from -40°F to 220°F when installed in accord with manufacturer's recommendations. Do not install in return air plenums unless flame spread rating and smoke developed rating are within constraints of applicable codes. Manufacturers and/or series: Armstrong "Armaflex"; Manville "Aerotube"; "Rubatex"; Gustin-Bacon "Ultra-Foam".

C. Fiberglass Insulation: Inorganic fibrous glass. Flame spread of "25" or less and smoke developed rating of "50" or less per ASTM E 84.

1. Board: Rigid or semi-rigid form, faced or unfaced as indicated. Stiffness of 475 EI, 800 EI or 1400 EI as indicated.
2. Blanket: Flexible form; faced, unfaced or coated as indicated.
3. Preformed: Jacketed or unjacketed as indicated.

D. Calcium Silicate Insulation: Preformed or block type as indicated or as applicable. Asbestos free. Rigid hydrous calcium silicate. K factor of 0.42 at 200°F. Density: 14-pcf. Flame spread rating of "0" and smoke developed rating of "0" as per ASTM E 84. Recommended temperature applications up to 1200 °F. Use where indicated only on equipment and surfaces which generate heat; do not use as a cold-surface insulation.

2.3 INSULATION PRODUCTS, BASIC

A. Type I-1: Cellular glass block insulation. Field formed, fitted and finished as required for the application. Pittsburg-Corning Foamglas or equivalent.

B. Type I-2: Calcium silicate block insulation. Field formed, fitted and finished as required for the application. Owens-Corning Kaylo; Manville Thermo-12; or equivalent.

C. Type I-3: Elastomeric insulation. Field formed, fitted and finished as required for the application. Armaflex, Rubatex or equivalent.

D. Type I-4: Fiberglass flexible blanket insulation. Unfinished, non-combustible, wool-like; composed of long glass fibers bonded with a thermosetting resin. Thermal conductivity (K) of 0.23 at 100°F. Applicable where indicated for boilers, vessels, breaching and stacks operating at up to 1000°F. Finished or held in place by wire ties, metal lath, lagging or as indicated. Owens-Corning Thermal Insulating Wool TIW Type II or equivalent.

E. Type DI-1: Duct insulation, fiberglass flexible blanket wrap. Composed of flexible blanket of glass fiber factory laminated to a reinforced foil kraft (FRK) vapor barrier with a minimum 2-inch taping and stapling flange on one edge. Suitable for operation at temperatures from 40°F to 250°F. Thermal conductivity of 0.31 at 75°F. Minimum density of three-quarter (3/4) pound per cubic foot. Provide in thickness of (2.2) inches unless otherwise specified as 2-1/2 or 3-inch thickness. Owens-Corning All Service Faced Duct Wrap; Manville R-Series Microlite; CertainTeed Standard Duct Wrap; or equivalent.

F. Type DI-2: Duct insulation, fiberglass semi-rigid board. Composed of resin bonded glass fibers faced with a foil scrim-kraft (FSK) reinforced laminate of aluminum foil and kraft bonded to provide a metallic surface finish vapor barrier; alternate vapor barrier facing (if specifically indicated) is an all service jacket (ASJ) of high intensity white bleached, chemically treated kraft paper reinforced with fiberglass yarn mesh and laminated to aluminum foil with fire-retardant adhesive to impart a clean, white appearance. Conductivity (K) of not greater than 0.23 at 75°F. Provide in thickness of one (1) inch unless otherwise indicated. Provide with minimum density of 3-pcf unless 6-pcf is specifically indicated. CertainTeed Industrial Insulation Board Type IB-300 (or IB-600); Manville 800 Series Spin-Glas Type 814 (or 817); Owens-Corning 700 Series Industrial Insulation Board Type 703 (or Type 705); or equivalent.

2.4 INSULATION ADHESIVES, MASTICS, SEALANTS

A. Adhesive (Type A-E1): For joints and seams in elastomeric insulation (Type I-3) not requiring weather protection. Rubatex R-373 Insulation Adhesive; Armstrong 520 Adhesive or equivalent.

B. Joint Sealant (Type JS-CG1): Non-hardening vapor barrier sealant specifically designed for use with cellular glass insulation (Types PI-1, I-1): Foster's 35-40 Foamseal Sealant, Pittsburg-Corning Pittseal 111 Sealant or equivalent.
C. Adhesive (Type A-F1): For adhering fiberglass blanket and board insulations (Types DI-1, DI-2) to metal substrate such as ductwork. Insulcoustic I-C 201, Foster 85-20 or equivalent.

D. Mastic, General Purpose (Type M-GP1): Non hardening vapor barrier general purpose mastic. For use where indicated or otherwise applicable. Foster GPM 35-00 or equivalent.

2.5 INSULATION FINISHES, JACKETS AND COVERS

A. Finishing Coating (Type FC-E1): For weather protection of elastomeric insulations (Types I-3, PI-5). Rubatex 374 coating; Armstrong Armaflex Finish or equivalent.

B. Finish Mastic (Type FM-CG1): For cellular glass insulations (Types PI-1, I-1). Waterproof, weather, acid and alkali resistant asphalt mastic coating for use in the range of -40°F to 200°F (installation must be done when in the 50°F to 120°F range). Pittsburg-Corning Pittcote 300 Vapor and Weather Barrier Finish or equivalent.

C. Finish Fabric (Type FF-CG1): For cellular glass insulations (Types PI-1, I-1). 6 x 6 meshes per inch polyester fabric for reinforcing the finish mastic. Pittsburg-Corning PC Fabric 79 or equivalent.

D. Finish Fabric, General Purpose (Type FF-GP1): Nylon membrane. For use generally with fiberglass duct insulations (Types DI-1, DI-2) at joints or seams or as may be indicated. Apply using Foster GPM 35-00 or equivalent.

E. Jacket, Pipe, PVC (Type JP-PVC): All purpose, UL-rated, white vinyl jacket, with or without self-sealing feature. Pittsburg-Corning "UNI-JAC" or equivalent.

F. Jacket, Pipe, Aluminum (Type JP-A1): Aluminum jacketing, 0.016 inches thick, type 3003 alloy, H-14 temper, circumferentially corrugated, with a continuously laminated moisture barrier of one mil polyethylene film and a protective layer of 40 lb. virgin kraft paper. Childers Products Co. "Corolon"; General Aluminum Supply Co. (Gasco); Insulcoustic "Alcorjac" or equivalent.

2.6 RELATED PRODUCTS

A. Wire (Type W-1): Dead soft, 16-gauge, stainless steel.

B. Straps (Type ST-1): Stainless steel T-304 (18-8) soft annealed with deburred edge with stainless steel wing seals. Childers Products "Febstraps" or equivalent.

C. Tape (Type T-1): High tensile strength rope stock flat back paper pressure sensitive tape. Pittsburg-Corning "PC Tape No. 25" or equivalent.

D. Screws (Type S-1): Aluminum pan head type "A" slotted #8 by 1/2-inch.

PART 3 - EXECUTION

3.1 GENERAL

A. Field Forming, Fitting and Finishing: Where preformed insulation products are indicated as being acceptable for a particular application, provide field formed, fitted and finished insulation systems if such application is more practical (such as due to size, configuration or dimensions which may be outside of the availability ranges for size, dimension and/or thickness of preformed products).
B. Pre-installation:
   1. Do not apply insulation adhesives, materials or finishes until the item to be insulated has been completely installed and tested and proved tight and suitable for insulation.
   2. Prepare surfaces to be clean and dry before attempting to apply insulation.

C. Insulation Shields: Provide hanger or pipe support shields of 16 gage (minimum) galvanized steel over or embedded in the insulation. Shield shall extend halfway up the pipe insulation cover and at least 6" on each side of the hanger. Securely fasten shield with pipe straps at each end.

D. Valves, Cocks and Specialties: Insulate as for the related piping system in which they are located unless otherwise indicated.

E. Factory Pre-insulated Components: Where equipment and other system components are specified in other sections to have factory installed insulation, then no additional insulation is required as work of this section unless additional non-factory-installed insulation is specifically described. Examples of such equipment and components which may not require additional insulation include, but are not necessarily limited to, boiler vessels, chiller evaporators, air handling units, airside terminal units, and similar items.

F. Minimum Thicknesses: Insulation thicknesses which are indicated are minimum thicknesses. Contractor may provide the same insulation material in greater thickness as an aid to installation and handling procedures or due to material availability and procurement considerations.

G. Branch Runouts: Branch runouts are considered to be individual supply/return pipes to individual terminal heating or cooling units (duct mounted coils, airside terminal units with heating coils, fan coil units, humidifiers, and similar small equipment). The supply/return pipe to such units is not considered to be a branch runout if the length of the supply or return pipe exceeds 12'-0" in length to the coil/unit connection.

3.2 DUCT SYSTEMS

A. General:
   1. Locations and extent of both internal and external insulation for duct systems are described in section entitled "Ductwork" and/or by the "Duct Type and Location Schedule" on the Drawings.
   2. Internal Insulation: Ductwork which is required to be insulated internally (acoustically/thermally lined) shall be insulated as work of the section entitled "Ductwork".
   3. External Insulation: Ductwork which is required to be insulated externally shall be insulated as work of this section.
   4. Factory Insulation: Ductwork which is factory manufactured with internal or external insulation is not to be additionally insulated as work of this section unless specifically stated. Such factory insulated ductwork generally consists of flexible externally insulated ductwork and double walled acoustically thermally lined ductwork.

B. Interior, Concealed (e.g., ceiling plenums): Where external insulation is required, insulate externally with 2.2 inch thick fiberglass blanket wrap (Type DI-1). Adhere duct insulation using adhesive (Type A-F1) applied in accordance with the manufacturer's recommendations. Where duct width exceeds twenty-four inches (24"), the insulation shall be additionally secured to the bottom of the duct using mechanical fasteners spaced one foot (1') on center. Insulation shall be applied with edges tightly butted, and all joints and breaks in the vapor
barrier sealed using glass fabric and mastic applied in conformance with manufacturer's recommendations.

C. Interior, Exposed, (e.g., air handling unit rooms): Where external insulation is required, insulate with 1-inch thick semi-rigid fiberglass board (Type DI-2). Adhere to ductwork with adhesive (Type A-F1). Finish joints and seams with finish fabric (Type FF-GP1).

3.3 DUCT SYSTEMS EQUIPMENT

A. General: Insulate as follows unless detailed to a greater extent on the Drawings.

B. Fire damper and Fire/Smoke Damper External Surfaces:

1. Externally Insulated Duct Locations: Extend duct insulation up face of fire damper to damper sleeve. Seal insulation edges with 4-inch minimum width duct tape.

2. Internally Insulated Duct Locations: Provide additional external insulation from a point on the duct 12 inches from the fire damper to the fire damper and on the face of the fire damper to the fire damper sleeve. Seal insulation edges with 4-inch minimum width duct tape.

C. Air Distribution Devices: Insulate the backs of all ceiling diffusers and other air outlet devices installed in other than return air plenums as specified for interior concealed ducts.

END OF SECTION 23 07 00
SECTION 23 23 13
REFRIGERANT PIPE, VALVES AND SPECIALTIES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division-01 Specification sections, apply to work of this section.

1.2 SCOPE

A. Provide refrigerant piping systems, complete in all respects, between the system components and connected equipment.

1.3 RELATION TO OTHER WORK

A. Refer to the section, "General Mechanical Provisions", for related requirements. Refer to other sections of Division-23 and to all other applicable portions of the Drawings and Specifications.

1.4 SHOP DRAWINGS

A. Refer to the Section entitled "General Mechanical Provisions".

PART 2 - PRODUCTS

2.1 COPPER PIPE

A. Refrigerant system piping shall be refrigerant grade, dehydrated and sealed, seamless, uniformly dead soft temper.

2.2 FITTINGS

A. Refrigerant grade, wrought copper, long radius, solder joint type.

2.3 SOLDIER

A. Silver brazing alloy (Sil Fos) Fed. Spec. AA-S-56ld.

2.4 FLUX

A. Non-corrosive, specifically designed for silver brazing.

2.5 ACCESS VALVES

A. Schrader type designed for use with quick coupler hose fittings and provided with individual cap.

PART 3 - EXECUTION

3.1 PIPE SIZES

A. Refrigerant pipe sizes which may be shown on drawings are nominal. Provide sizes not less than sizes indicated and in compliance with size recommended by the manufacturer(s) at the
connected equipment. Provide change in sizes if such change is in accord with manufacturer's recommendation and with Architect/Engineer's approval. Size piping to maintain minimum velocity of 500-fpm in horizontal lines and 1000 fpm in vertical risers for proper oil return; provide double suction risers and hot gas risers as may be necessary to accomplish this.

3.2 REFRIGERANT SPECIALTIES

A. Refrigerant valves, driers, expansion valves, and similar items shall be provided with each system. Where refrigerant access valves are not furnished by the manufacturer, they shall be field installed to enable charging and checking the system.

3.3 JOINTS AND CONNECTIONS

A. General: All joints and connections shall be made permanently refrigerant tight.

B. Solder Joints: Cut tubing square using tubing cutters, with sharp cutting wheels, so as not to crimp the tubing ends. Remove all burrs using a pipe reamer and taking care not to flare the ends of the tube. Thoroughly clean the outside of the pipe and the inside of the fitting using a fine sand cloth. Apply non-corrosive paste flux to the cleaned surfaces immediately and apply silver solder and heat in accordance with manufacturer's instructions. Use care not to damage equipment or refrigerant specialty items when making up joints (protect from excessive heat).

C. Scale Prevention: During brazing, keep pipe system full of inert gas to prevent scale formation.

D. Mechanical Joints: Where the Contractor uses refrigerant tubing sets, follow the manufacturer's installation instructions explicitly, including the use of special tools, when making up the joints. Where precharged tubing and equipment is provided, do not cut into the system to install access valves.

3.4 HANGERS AND SUPPORTS

A. Refer to other sections describing hangers and supports. Isolate copper tubing from contact with any dissimilar metals.

3.5 EVACUATION AND CHARGING

A. When other than completely factory charged equipment and piping systems are used, they shall be evacuated and charged as follows: Charge the system with dry nitrogen and refrigerant and leak test all joints including factory piping within the units. Repair all leaks by disassembling and remaking the joint. After all leaks are corrected, evacuate the system to an absolute pressure of 0.2" mercury. System shall hold this vacuum for two hours with no noticeable rise in pressure. After passing vacuum test, break vacuum twice using refrigerant and re-evacuate for a minimum of two hours each time. Charge the system in the manner and with the type and amount of refrigerant recommended by the manufacturer and in accordance with accepted refrigeration practice.

3.6 REFRIGERANT PIPING CONDUIT

A. Install any refrigerant piping which is below slab or grade in Schedule 40 PVC piping. Size conduit as necessary to properly install piping. Provide long bend sweeps. Install so that conduit will drain and not trap water. Protect ends of conduit from entry by vermin, insects and water.
3.7 OTHER REQUIREMENTS

A. Arrange refrigerant piping generally as shown and such that service access is facilitated. Keep refrigerant lines as short and direct as possible with a minimum number of joints. Provide sleeves through floors, walls or ceilings, sized to permit installation of full-thickness insulation; seal air tight after installation of piping and insulation.

B. Provide flexible piping arrangement in hot gas discharge line of compressor. Such arrangement shall consist of a piping loop or similar measure to prevent transmission of objectional vibration.

C. Provide a removable core filter-drier in liquid line. In-line filter-driers are acceptable in individual circuits of less than 10-ton nominal capacity. Provide a full size valved bypass around this filter-drier. Provide shut-off valves to isolate the filter drier while flow is through the bypass and also a shutoff valve in the bypass so that filter-drier can be put into use.

D. Provide a refrigerant charging connection in the liquid line upstream from the filter-drier.

E. Provide a moisture indicating sight glass in the liquid line downstream from the filter-drier. Install in vertical line if possible and a sufficient distance downstream from any valve such that the resulting disturbance does not appear in the glass.

F. Provide a filter-drier with isolating shut-off valves and with valved bypass only if compressor is not equipped with a suction line filter or screen.

G. Keep piping free from traps unless otherwise indicated. Install vertical pipe plumb. Pitch horizontal piping only where slope is desirable.

H. Provide shut-off valves at inlet and outlet to all condensers, receivers and evaporators to permit isolation for service. If possible, use angle valves to minimize pressure drop. Use angle valves in all cases at receivers. Use globe valves only when angle valves are impractical.

I. Provide solenoid valves upright in horizontal lines only, unless their design allows installation in vertical pipe.

J. Where compressor(s) do not have pump down control and the compressor(s) associated evaporator coil(s) do not have bottom suction header connections and the evaporator coil(s) are located above the compressor(s), then loop suction lines(s) to top level of coil to prevent liquid slugging.

K. To prevent erratic operation of thermal expansion valve, provide a suction line trap next to evaporator coil suction outlet with expansion valve bulb located between coil and trap. Provide only in suction lines which are level leaving coil outlet or which rise on leaving coil outlet. Trap not required when evaporator coil outlet suction line drops to compressor or suction header immediately after expansion valve bulb.

END OF SECTION 23 23 13
SECTION 23 31 00
DUCTWORK

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division-01 Specification sections, apply to work of this section.

1.2 SCOPE

A. Provide complete duct systems as indicated. Systems shall include, but not be limited to, the following: outside air, exhaust air, and air conditioning supply and return air duct systems as shown on drawings. Drawing scales prohibit the indication of all offsets, fittings, and like items; however, these items shall be installed as required for the actual project conditions at no change in contract price.

B. Items Included: This section generally includes, but is not limited to, the following major items:

1. Low pressure sheet metal ductwork.
2. Acoustical thermal duct liner.
3. Low pressure flexible ducts.

1.3 RELATION TO OTHER WORK

A. Refer to the section, "General Mechanical Provisions" for related requirements. Refer to other sections of Division 23 and to other applicable portions of the Drawings and Specifications.

B. This section is directly related in particular to sections (which may or may not be included in this division) which describe the following:

1. Sections describing air handling equipment and fans.
2. Air distribution devices.
3. Terminal units.
4. Duct system accessories.
5. Insulation.

C. Coordinate shop drawings, ordering, delivery, and placement of all items affecting the duct systems including, but not limited to, the following items: air handling units, exhaust fans, supply fans, sound attenuators, duct mounted coils, access panels, air distribution devices, fire dampers, outside air louvers, hoods, filters, roof curbs, structural framing, roof construction, roofing, and the work of all trades to insure an orderly and timely progression of the work. Refer to the requirements of Section entitled "General Mechanical Provisions".

D. Refer to other sections which may describe additional sound attenuation measures which may relate to this section.

1.4 SHOP DRAWINGS

A. Refer to Section entitled "General Mechanical Provisions". Include complete data as applicable to this project on: all prefabricated duct and fittings; duct liner including mechanical fasteners and adhesives; duct sealing materials; duct joining and seaming.
methods; and all other items. If required by Architect, prepare and submit for approval completely detailed shop drawings of supply and return ductwork from any or each air handling unit through its transitions, bends and elbows until such ducts are extended beyond the air handling unit equipment area and/or congested areas; these shop drawings will not be required unless specifically called for elsewhere or unless significant deviation from the Drawings is necessitated by the equipment provided.

1.5 OTHER REQUIREMENTS

A. Provide all ductwork and components thereof in accord with manufacturer's recommendations. All ductwork dimensions indicated are nominal free clearance internal dimensions which do not include insulation thickness.

1.6 DEFINITIONS

A. "SMACNA" means "Sheet Metal and Air Conditioning Contractors National Association, Inc."

B. Low Pressure Ductwork: Any and all ductwork conveying air or other gases at velocities less than 2500 fpm and static pressure less than 2.0 inches wg. This ductwork may also be referred to in these specifications as "Low Velocity Ductwork". SMACNA "HVAC Duct Construction Standards, Metal and Flexible", Second Edition, 1995, shall govern construction of this ductwork unless otherwise specified.

1. Where and if fiberglass ductwork is specified, it shall be considered only for low pressure classification use and shall be constructed in accord with SMACNA "Fiberous Glass Duct Construction Standards", Fifth Edition, 1977.

C. High Pressure Ductwork: Any and all ductwork conveying air or other gases at velocities equal to or greater than 2500 fpm or static pressure equal to or greater than 2.0 inches wg. This ductwork may also be referred to in these specifications as "High Velocity Ductwork" or "Medium Pressure Ductwork", but shall be considered, in either terminology, to fall within pressure/velocity class (PV/C designation) 3 to 10. SMACNA "HVAC Duct Construction Standards, Metal and Flexible", Second Edition, 1995, shall govern construction of this ductwork unless otherwise specified.

1.7 PRESSURE/VELOCITY CLASSIFICATIONS

A. Pressure and velocity classifications (hereinafter called "P/VC") for ducts are defined as follows:

<table>
<thead>
<tr>
<th>P/VC Design Class</th>
<th>SMACNA Pressure Class</th>
<th>Static Pressure Rating</th>
<th>Positive or Negative Pressure</th>
<th>SMACNA Seal Class</th>
<th>Maximum velocity (fpm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>10 High</td>
<td>10&quot;</td>
<td>+</td>
<td>A</td>
<td>2000 up</td>
<td></td>
</tr>
<tr>
<td>6 Medium</td>
<td>6&quot;</td>
<td>+</td>
<td>A</td>
<td>2000 up</td>
<td></td>
</tr>
<tr>
<td>4 Medium</td>
<td>4&quot;</td>
<td>+</td>
<td>A</td>
<td>4000 dn</td>
<td></td>
</tr>
<tr>
<td>3 Medium</td>
<td>3&quot;</td>
<td>+ or -</td>
<td>B</td>
<td>4000 dn</td>
<td></td>
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<tr>
<td>2 Low</td>
<td>2&quot;</td>
<td>+ or -</td>
<td>C</td>
<td>2500 dn</td>
<td></td>
</tr>
<tr>
<td>1 Low</td>
<td>1&quot;</td>
<td>+ or -</td>
<td>C</td>
<td>2500 dn</td>
<td></td>
</tr>
<tr>
<td>½ Low</td>
<td>1/2&quot;</td>
<td>+ or -</td>
<td>C</td>
<td>2000 dn</td>
<td></td>
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</tbody>
</table>

B. See Part 3, EXECUTION, of this section for duct sealing requirements.
PART 2 - PRODUCTS

2.1 GENERAL

A. Materials shall comply with current SMACNA standards.

B. ASTM: Unless otherwise specified, ASTM material specifications applicable are:

<table>
<thead>
<tr>
<th>Material</th>
<th>Type</th>
<th>ASTM Number</th>
</tr>
</thead>
<tbody>
<tr>
<td>Galvanized steel</td>
<td>G90</td>
<td>A525</td>
</tr>
<tr>
<td>Stainless steel</td>
<td>304,316</td>
<td>A240</td>
</tr>
<tr>
<td>Cold rolled steel</td>
<td>20-28 ga.</td>
<td>A366</td>
</tr>
<tr>
<td>Cold rolled steel</td>
<td>18 ga.</td>
<td>A619</td>
</tr>
<tr>
<td>Aluminum</td>
<td>3003 H-14</td>
<td>B609</td>
</tr>
</tbody>
</table>

C. Special Materials, Gauges and Construction:

1. Special Materials: Where special duct material other than galvanized steel is required, such duct material (e.g., fiberglass, stainless steel, plastic such as polyvinylchloride, etc.) shall be specifically indicated.

2. Gauges: Gauges indicated in this section are for galvanized steel. Where greater or lesser gauges are specifically indicated for a sheet metal material other than galvanized steel, provide the indicated gauge. Comply with the SMACNA construction standard covering the required material if no gauge is given.

3. Construction: Comply with indicated special requirements (i.e., such as welding, soldering, etc.) where application requires.

2.2 LOW PRESSURE SHEET METAL DUCTWORK

A. Material: Prime quality forty-eight inch wide resquar tight coat galvanized steel conforming to the requirements of ASTM A-525 and/or A-527 as applicable to the intended use.

B. Construction:

1. Construct to comply with the pressure/velocity classification(s) indicated.

2. Use rectangular or round as indicated on drawings.


4. Gauge: As required by SMACNA for the dimensions and pressure/velocity classification involved.

C. Insulation:

1. Rectangular rigid sheet metal ductwork: shall be internally lined with acoustical thermal duct liner if so designated.

2. Round rigid sheet metal ductwork: Where low pressure round ductwork is designated to have internal acoustical/thermal liner, provide factory fabricated double wall ductwork as specified for high pressure round acoustically lined sound attenuating duct (i.e., factory fabricated double wall duct with perforated inner wall).

2.3 ACOUSTICAL THERMAL DUCT LINER

A. Line ductwork where indicated. Dimensions indicated are net inside dimensions. Liner shall be one inch thick, three pound density fiberglass duct liner with the surface in contact with moving air stream stabilized with black pigmented neoprene. Duct liner shall comply with
requirements of NFPA 90A as to flame spread and smoke developed ratings. Duct liner shall be factory treated with antimicrobial/antibacterial treatment to prevent formation & growth of bacteria.

B. Acceptable Manufacturers: Johns-Manville, Microtex; PPG Industries, Testrafine; or CertainTeed/Saint Gobain, Coated Ultralite.

C. Attachment: Attach to the interior of sheet metal ducts using a full coverage coat of Foster's 85-20 adhesive and mechanical fasteners applied as follows:

1. Horizontal Ducts: Install mechanical fasteners on underside of the tops of ducts over twelve inches in width and on the insides of ducts over sixteen inches in height.
2. Vertical Ducts: Install mechanical fasteners on all duct surfaces exceeding twelve inches.
3. Fastener Spacing: Install fasteners within two inches of the leading edge of each duct section and within three inches of the leading edge of cross joints in insulation within any given duct section. Pins shall thereafter be spaced at not more than fifteen inches on centers. Pins shall be installed in strict accordance with manufacturer's instructions.

D. Edge Stabilization: All exposed edges and the leading edge of all cross joints of liner shall be coated with Foster's 30-36.

2.4 LOW PRESSURE FIBERGLASS DUCTWORK

A. Material: One and one-half inch (1-1/2") thick glass fiber ductboard, meeting requirements of NFPA 90A and shall have a factory applied UL 181, Class 1 air duct listing label. Board shall be faced with aluminum foil. Inside surface shall be factory treated for microbial bacterial growth prevention.

1. Fabricated from or lined with non-corrosive, non-hydroscopic, permanently odorless, resilient, long staple, fabric grade glass fibers preformed into semi-rigid or rigid board.
2. Flexural rigidity rating of 800EI per ASTM test number D 1037 64 where neither width nor depth or duct exceeds 48 inches.
3. Flexural rigidity rating of 1400EI per ASTM test number D 1037 64 where width or depth exceeds or equals 48 inches.
4. Non-erosive when conveying air at velocities equal to or less than 2000 fpm.
5. Approved, fire retardant, moisture sealing, factory-applied jacket made of kraft paper and 2 mil minimum thickness aluminum foil.
6. Maximum thermal conductivity of 0.23 at 75°F mean temperature.

B. Fabrication: Ductwork fabrication shall be in accordance with SMACNA Fibrous Glass Manual, Duct Construction Standards, and current manufacturer's literature on approved fabrication methods.

C. Closure Systems: Closure systems shall be as specified by manufacturer of the ductboard to maintain the UL Class 1 duct label. Provide closure of all joints using 9/16” outward clinch staples, approximately two inches (2”) wide pressure sensitive tape. Use factory molded male-female joints wherever possible. Use appropriate UL and SMACNA approved tapes.

D. Acceptable Products: Johns-Manville Micro-Aire Type 475 or 800 as applicable; Owens Corning Fiberglass Type 800FR or 1400FR as applicable; or approved equal.
2.5 LOW PRESSURE FLEXIBLE DUCTS

A. General:

1. The inclusion of flexible ducts in this specification shall not be construed as approval of use on the project unless specifically shown on the Drawings.
2. Where used, provide in factory finished lengths not in excess of lengths required to make kink-free connections with minimum air pressure drop.

B. Insulated flexible ducts: Flexible duct shall be factory-fabricated preinsulated type with seamless vapor barrier. Duct shall bear UL 181 Class 1 Air Duct label and shall comply with NFPA 90A and 90B. Fiberglass insulation nominal 1" thickness with thermal conductance of 0.23 BTU/hr-ft²-°F maximum at 75°F mean temperature. Flexible duct shall have an operating range of minus 0.5" w.g. to plus 2" w.g. Core shall be continuous and consist of aluminized mylar laminated to corrosion resistant steel wire helix. Vapor barrier perm rating shall be 0.17 maximum per ASTM E96-A. Maximum working velocity shall be 4000 FPM. Flexible duct shall be Genflex SLR-25, Clevaflex Type KQ, Wire Mold type WG, Flexmaster Type 5B, or approved equal.

C. Un-insulated flexible ducts, steel: Flexible ductwork shall be constructed of all metal one ply hot-dipped galvanized steel, closely corrugated for strength and flexibility, with seams interlocked, folded flat, and knurled to insure tightness. Duct shall be listed as #UL181 "Flexible Air Duct", Class 1, and NFPA 90A. Products shall be Flexmaster Type NI-TL, Clevaform Type GS or approved equal.

D. Round branch take-off fittings for flexible duct:

1. Round duct branch take-off fitting shall be made of galvanized sheet metal designed for twist-in installation and to assure minimum air loss at the take-off. The fittings shall be of the conical converging type to reduce the pressure drop through the fittings. Provide a raised bead on the throat of the fitting to assure a tight positive connection. Products shall be Flexmaster Model CB-DE-BO3 or approved equal.
2. Provide each fitting with the following:
   a. Lockable quadrant damper.
   b. 45-degree extractor scoop.
   c. Insulation guard where used with internally lined ductwork.
3. Provide these "spin-in" type fittings at all connections between rigid sheet metal duct and flexible duct at the upstream end of the flexible duct.

PART 3 - EXECUTION

3.1 GENERAL

A. All duct systems shall be free of noise, chatter, vibration and pulsation under all conditions of operation. Remove, replace or reinforce as directed by the Architect/Engineer if necessary to correct such conditions.

B. If field conditions are determined to exist which would limit the guarantee of air delivery or system performance, due notice in writing shall be submitted to the Architect/Engineer of such conditions prior to starting fabrication.
C. Properly support and align ductwork. Ducts to be free of sag and bulge. Hang ductwork below concrete floors or roof deck with hangers set prior to pouring concrete, or from self drilling screw anchors. GUN POWDER SET ANCHORS ARE NOT PERMITTED.

D. Where it is necessary that ducts be divided due to pipes or other obstructions which must pass through these ducts, the Contractor shall, at locations as noted or directed, provide air-stream deflectors in the duct and the duct shall be increased in size to maintain equivalent area around deflectors. Such changes shall be in accord with standard SMACNA details and shall be shown on Contractor's As-Built Drawings.

E. Interior of ductwork visible through registers, grilles, or diffusers shall be painted flat black.

F. Do not route ductwork through transformer vaults and electrical equipment spaces and enclosures.

G. Construct all ductwork and accessories in accord with the latest indicated editions of applicable SMACNA construction standards. Sheet Metal and Air Conditioning Contractors' National Association.

H. Streamline all ductwork to the full extent practical and equip with proper and adequate devices to assure proper balance and quiet draftless distribution of indicated air quantities.

I. Protect all ductwork and system accessories from damage during construction until Architect/Engineer's final acceptance of project.

J. Prior to ductwork fabrication, verify if all ductwork as dimensioned and generally shown will satisfactorily fit allocated spaces. Take precautions to avoid space interferences with beams, columns, joists, pipes, lights, conduit, other ducts, equipment, etc. Notify Architect/Engineer if any spatial conflicts exist, and then obtain Architect/Engineer's approval of necessary routing. Make any such necessary revisions which are minor at no additional cost.

K. Carefully correlate all duct connections to air handling units and fans to provide proper connections, elbows and bends which minimize noise and pressure drop.

L. Provide all curved elbows with radius ratios of not less than 1.5 unless otherwise shown or approved by Architect/Engineer. Provide all mitered elbows with turning vanes.

M. Properly suspend all ductwork so that no objectionable conditions result (such as vibration, sagging, etc.).

N. Coordinate any and all dimensions at interfaces of dissimilar type of ductwork and at interfaces of ductwork with equipment so that proper overlaps, interfaces, etc., of insulation and continuity of vapor barriers are maintained.

O. If necessary where ducts interface and have different types of insulation, provide transitions so that internal free-clear dimensions of duct remain unchanged.

P. Install horizontal low pressure ductwork at a level which maximizes length of any vertical, rectangular or round rigid duct connections to rectangular diffuser necks; however, such vertical duct connections are not required to be over 24 inches in length.

Q. Make connections from any low pressure ductwork to terminal units (fan terminal units, variable volume boxes, etc.) with appropriate lengths of flexible duct unless other type of connection is indicated.
R. Install all flexible round duct without kinks or similar obstructions so that pressure drop is minimized. Cut and remove excess lengths as necessary.

S. Install horizontal rigid ductwork as high as practical above suspended ceilings so that movable light fixtures may be relocated without interference to meet any future partition relocation requirements.

T. Insulated Duct: Where ducts will be insulated, make provision for neat insulation finish around damper operating quadrants, splitter adjusting clamps, access doors, and similar operating devices. A metal collar equivalent in depth to insulation thickness and of suitable size to which insulation may be finished shall be mounted on duct.

3.2 LOW PRESSURE SHEET METAL DUCTS

A. If width or height of rectangular duct exceeds 12 inches, cross break or roll a cross bead in panels to increase stiffness; otherwise, use two gages heavier steel.

B. Provide corner closures. Longitudinal seams and transverse joints shall be flat and smooth inside. Make slip joints in direction of air flow. See governing SMACNA manual for transition requirements.

C. Fabricate offsets, turns and elbows with centerline radius equal to 1-1/2 times diameter when possible. No mitered offsets will be allowed. Provide double thickness turning vanes to assist in smooth flow of air in square elbows or elbows with centerline radius less than duct width or diameter.

3.3 LOW PRESSURE FLEXIBLE DUCTS

A. Flexible ducts shall not be used unless specifically indicated on drawings.

B. If flexible duct is indicated for use on this project, it must comply with the following requirements.

1. The extent of the use of flexible ductwork shall be limited to that shown on the drawings.
2. Flexible duct installation shall be per SMACNA Flexible Duct Installation Standards, and manufacturers latest printed instructions, whichever is stricter. In addition the following shall apply:
   a. Flexible duct between rigid duct and diffusers shall be a MAXIMUM of 8 feet in length and shall be fully extended with a maximum equivalent of (2) 90 degree bends (no bend shall be made with centerline radius of less than one duct diameter). No additional flexible duct shall be provided for future terminal device relocation unless otherwise specified.
   b. Flexible duct shall be supported at ends and at each 90 degree bend. Maximum permissible sag is 1/2 inch per foot of spacing between supports.
   c. Hanger or saddle material in contact with the flexible duct shall be of sufficient width to prevent any restriction of the internal diameter of the duct when the weight of the supported section rests on the hanger or saddle material. In no case will the material contacting the flexible duct be less than 1 inch wide. Narrower hanger material may be used in conjunction with a sheet metal saddle which meets the foregoing specifications. This saddle must be formed to cover one-half the circumference of the outside diameter of the flexible duct and must be rolled to fit neatly around the lower half of the duct's outer circumference.
d. Factory installed suspension systems integral to the flexible duct are an acceptable alternative hanging method when manufacturers recommended procedures are followed.

e. Hangers shall be adequately attached to the building structure (not pipe, conduit, etc.).

f. To prevent tearing of vapor barrier, do not support entire weight of flexible duct on any one hanger during installation. Avoid contact of flexible duct with sharp edges of hanger material. Damage to vapor barrier may be repaired with approved tape. If internal core is penetrated, replace flexible duct or treat as a connection.

3. Terminal devices connected by flexible duct shall be supported independently of the flexible duct.

3.4 OTHER SPECIAL DUCT SYSTEMS

A. Roof Mounted Exterior Ductwork:

1. Support all roof-mounted exterior ductwork with angle iron bracing firmly secured to roof construction and in such a manner to maintain watertight integrity of specified roofing system. All ductwork roof penetrations and ductwork support roof penetrations shall also be provided in such a manner to maintain watertight integrity of specified roofing system.

2. All roof-mounted exterior ductwork shall be completely and permanently weatherproof including connections at air conditioning units, roof penetration points and all other points.

3. Submit shop drawings completely describing all supporting systems for this external ductwork.

B. Perchloric Acid Fume Hood Exhaust Ductwork and Wash-Down System:

1. The fume hood manufacturer shall fabricate and install all perchloric acid fume hood exhaust ductwork, including exhaust fans and stacks. The ductwork shall be routed as shown on the drawings, shall be fabricated and installed by the mechanical contractor.

2. The fume hood manufacturer shall design, fabricate and install all perchloric acid fume hood exhaust washdown and drain systems. The respective washdown water supply and drain piping systems shall be connected to domestic water supply and drain connections provided at the locations shown on the plumbing drawings.

3.5 MISCELLANEOUS DUCT SYSTEM COMPONENTS

A. Spin-In Take-Off Fittings: Install around duct branch takeoff fittings according to manufacturer's installation instruction. Additionally seal fitting to rectangular duct with a thin bead of mastic sealant.

3.6 HANGERS AND SUPPORTS

A. General: Comply with latest applicable SMACNA construction standard. Where sprayed fireproofing occurs, install hangers before application of such treatment and withhold installation of ducts until after application.

B. Supports: Vertical risers and other duct runs where the method of support specified above is not applicable shall be supported by substantial angle brackets designed to meet field conditions and installed to allow for duct expansion.

C. Fasteners: Secure hangers to steel beams or metal deck with beam clamps or drop through connections from the metal or concrete deck.
3.7 **CHANGES IN SHAPE OR DIMENSION**

A. Where duct size or shape is changed to effect a change in area, the following shall apply:

1. Where the area at the end of the transformation results in an increase in area over that at the beginning, the slope of the transformation shall not exceed one inch in seven inches.
2. Where the area at the end of the transformation results in a decrease in area from that at the beginning, the slope of the transformation may be one inch in four inches, but one inch in seven inches is preferable, space permitting.
3. The angle of transformation at connections to heating coils or other equipment shall not exceed thirty degrees from a line parallel to the air flow on the entering side of the equipment, nor fifteen degrees on the leaving side. The angle of approach may be increased to suit limited space conditions when the transformation is provided with vanes approved by the Architect/Engineer.

3.8 **CHANGES IN DIRECTION**

A. Changes in direction shall be basically as indicated on the drawings and the following shall apply:

1. Supply duct turns of ninety degrees in low pressure duct shall be made with mitered elbows fitted with closely spaced turning vanes designed for maintaining a constant velocity through the elbow.
2. Return and exhaust duct turns of ninety degrees in low pressure duct shall be made with mitered elbows, as specified hereinbefore for supply ducts, unless radius elbows are indicated in which case they shall be constructed with a turning radius one and one-half (1-1/2) times the width (with width considered as the dimension in the plane of the turn) as measured to the duct centerline.
3. Tees in low pressure duct shall conform to the design requirements specified hereinbefore for elbows.
4. Branch take-offs in low pressure supply duct shall be made with extractors or splitter dampers, as indicated, in square take-offs.
5. In high pressure duct, branch take-offs and connections to flexible duct supplying air to terminal units shall be made with conical taps.

3.9 **IMPROPER MATERIALS OR CONFIGURATION**

A. If ductwork materials or ductwork configurations are installed which do not meet these specifications, Contractor shall remove such ductwork and replace with materials or configurations which are acceptable. Any delay in job progress will be the responsibility of the Contractor.

3.10 **OTHER REQUIREMENTS**

A. Insulated Duct: Where ducts will be insulated, make provision for neat insulation finish around damper operating quadrants, splitter adjusting clamps, access doors, and similar operating devices. A metal collar equivalent in depth to insulation thickness and of suitable size to which insulation may be finished shall be mounted on duct.

B. Control Devices: Properly install all control related devices which are part of the duct systems. See Section(s) describing control systems.

3.11 **SEALING OF DUCTS**

A. Duct seal classes are as follows:
1. Seal class "A": Seal all transverse joints, longitudinal seams and duct wall penetrations. Use for P/VC-4 (4" w.g.) and greater unless otherwise indicated.
2. Seal class "B": Seal all transverse joints and longitudinal seams. Use for P/VC-3 (3" w.g.) unless otherwise indicated.
3. Seal class "C": Seal all transverse joints. Use for P/VC-2 (2" w.g.) and lower unless otherwise indicated.

B. Where sealing is required it shall mean the following:

1. The use of adhesives, gaskets, tape systems or combinations thereof to close openings in the surface of the ductwork and field-erected plenums and casings through which air leakage would occur; or
2. The use of continuous welds;
3. The prudent selection and application of sealing methods by fabricators and installers, giving due consideration to the designated pressure class, pressure mode (positive or negative), chemical compatibility of the closure system, potential movement of mating parts, workmanship, amount and type of handling; cleanliness of surfaces, product shelf life, curing time and manufacturer-identified exposure limitations;
4. That these provisions are applicable to duct connections to equipment and to apparatus but are not for equipment and apparatus;
5. That where distinctions between seams and joints are made herein, a seam is defined as joining of two longitudinally (in the direction of air-flow) oriented edges of duct surface material occurring between two joints. Helical (spiral) lock seams are exempt from sealant requirements. All other duct surface connections made on the perimeter are deemed to be joints. Joints are inclusive of but not limited to girth joints; branch and sub-branch intersections; so-called duct collar tap-ins; fitting subsections; louver and air terminal connections to ducts; access door and access panel frames and jambs; duct, plenum and casing abutments to building structures; that sealing requirements herein do not contain provisions to:
   a. Resist chemical attack.
   b. Be dielectrically insulated.
   c. Be waterproof, weatherproof or ultraviolet ray resistant.
   d. Withstand temperatures higher than 120°F or lower than 40°F.
   e. Contain atomic radiation or serve in other safety-related construction.
   f. Be electrically grounded.
   g. Maintain leakage integrity at pressures in excess of the duct classification herein.
   h. Be underground below the water table.
   i. Be submerged in liquid.
   j. Withstand continuous vibration visible to the naked eye.
   k. Be totally leak-free within an encapsulating vapor barrier.
   l. Create closure in portions of the building structure used as ducts, e.g., ceiling plenums, shafts, pressurized compartments.

6. The requirements to seal apply to both positive pressure and negative pressure of operation.
7. Externally insulated ducts located outside of buildings shall be sealed prior to being insulated as though they were inside. If metal surfaces of ducts located on the exterior of buildings are exposed to weather, they shall receive exterior duct sealant. An exterior duct sealant is defined as a sealant that is marketed specifically as forming a positive air and water tight seal, bonding well to the metal involved, remaining flexible with metal movement and having a service temperature range of -30°F to 175°F. If exposed to direct sunlight it shall also be ultraviolet ray and ozone resistant or shall, after curing, be painted with a compatible coating that provides such resistance. The term sealant herein
is not limited to materials of adhesive or mastic nature but is inclusive of tapes and combinations of open weave fabric strips and mastics.

C. Materials and applications for sealing ducts:

1. General:
   a. Complete product data on all materials used for sealing ducts must be submitted for approval prior to any duct fabrication.
   b. All sealants must be specifically recommended by their manufacturer for the purpose of sealing ducts.

2. Liquid Sealant:
   a. Use only for slip type joints where sealant is to fill small space between overlapping pieces of metal. Do not use where metal clearances exceed 1/32-inch.
   b. Sealant must be specifically manufactured for the purpose of sealing ducts.

3. Mastics:
   a. Use in lieu of liquid sealant at Contractor's option.
   b. Use as a fillet, in grooves and between flanges.
   c. Do not use oil base caulking or glazing compounds.

4. Gaskets:
   a. Use soft elastomer butyl or neoprene rubber or extruded forms of sealants in flanged joints in addition to mastic.

5. Tape:
   a. Tape is not allowed on sheet metal ducts.

6. Combination of mastic and embedded fabric:
   a. Use mastic/mesh/mastic as a sealant where pressure/velocity classification equals and exceeds P/VC-3 and where any spaces between metal surfaces at transverse joints or longitudinal seams or duct wall penetrations exceeds 1/16-inch.
   b. Apply glove coat of mastic, then embed a continuous or overlapping strip of not less than 4-inch wide 10 x 10 fiberglass cloth into the mastic, then apply a final glove coat of mastic over the glass cloth.

7. Surface preparation:
   a. Surfaces to receive sealant should be adequately clean (free from oil, dust, dirt, rust, moisture, ice crystals and other substances that inhibit or prevent bonding). Use solvent and/or apply a face primer if necessary to obtain adequately clean surface for adhesion.

3.12 LEAKAGE TESTING

A. General:

1. Test the following duct systems:
a. All ducts which are (1) under positive or negative pressure and (2) which are directly connected to air moving device (air handling unit, exhaust fan, supply fan or similar air moving equipment) and (3) which convey 1000-cfm or greater through their largest portion.

b. All ducts which are (1) under positive or negative pressure and (2) which are part of a supply, return, outside and/or exhaust air system and (3) which are equal to or greater than 25 feet in length and (4) which may or may not be directly connected to an air moving device.

2. Portions of duct to be tested shall consist of all portions from the largest cross sectional area to the air distribution device connection or to the smallest inlet or outlet point, whichever is applicable.

3. Duct systems shall be constructed so that leakage does not exceed 5.00% of the air quantity handled by the respective fan.

B. Allowable Leakage:

1. Leakage shall be measured during leakage test at a test pressure which is equal to the pressure/velocity classification of the duct system (e.g., a P/VC-2 duct shall be tested at 2.0 in. w.g.s.p., a P/VC-1/2 duct at 0.5 in. w.g.s.p., etc.).

C. Test Procedure:

1. Test at time of duct installation and prior to installation of any field applied insulation and prior to any concealment in chases or similar enclosures.

2. Duct openings (both entry openings and outlet openings) shall be capped or sealed by taping or banding a flexible plastic sheet over each opening prior to pressurizing duct. The plastic sheet shall be of adequate strength and thickness to withstand the test pressures. Use other method of sealing duct openings providing objective of test is obtained and if method of sealing is approved by Architect/Engineer.

3. Use a fan having a minimum capacity of 300-cfm or 5% of the particular duct system design capacity, whichever is greater and which is capable of producing a duct test pressure of 150% of the duct test pressure.

4. Test fan shall be connected to a flow measuring assembly consisting of straightening vanes and an orifice plate mounted in a straight tube with appropriately located pressure taps. Orifice assembly shall be accurately calibrated with its own calibration curve. Pressures shall be measured with U-tube manometers and corresponding flow rates obtained from the orifice performance curve.

5. Connect test fan and orifice flow measuring assembly to the duct to be tested with a section of flexible duct.

6. Test for audible leaks as follows:

   a. Close off and seal all openings in the duct section to be tested. Connect the test apparatus to the duct by means of a section of flexible duct.

   b. Start the blower with its control damper closed (some small blowers popularly used for testing ducts may damage the duct because they can develop pressures up to 25 inches (W.G.).

   c. Gradually open the inlet damper until the duct pressure reaches 50% in excess of designed duct operating pressure.

   d. Survey all joints for audible leaks. Mark each leak and repair after shutting down blower. Do not apply a retest until sealing has been repaired if and where necessary.

7. After all audible leaks have been sealed, the leakage should be measured with the orifice section of the test apparatus as follows:
a. Start blower and open damper until pressure in duct reaches 25% in excess of designed duct operating pressure.

b. Total allowable leakage shall not exceed five (5) percent of the total system design air flow rate. When partial sections (such as supply section, return section, etc.) of the duct system are tested, the summation of the leakage for all sections shall not exceed the total allowable leakage.

8. Correct any duct leaks which are detected either audibly or by touch regardless of whether leakage through duct system is less than allowable test leakage.

3.13 DEFINITIONS OF DUCT TYPES

A. Refer to the "Duct Type and Location Schedule" on the Drawings for:

1. The type of ductwork and where it is to be installed.
2. The pressure/velocity class at each location.
3. Indication of whether the ductwork is to be insulated externally or internally lined or not insulated.

END OF SECTION 23 31 00
SECTION 23 33 00
DUCT SYSTEM ACCESSORIES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division-01 Specification sections, apply to work of this section.

1.2 SCOPE

A. Provide all necessary duct system accessories to assure proper balance, quiet and draftless distribution and conveyance, and minimization of turbulence, noise and pressure drop for all supply return, exhaust and ventilation air quantities indicated.

B. Items Included: This section generally includes, but is not limited to, the following items as may be applicable to this project:

1. Flexible duct connections.
2. Splitters.
3. Turning vanes.
5. Access doors.
6. Fire Dampers.
7. Smoke Dampers.
8. Fire/Smoke Dampers.

1.3 RELATION TO OTHER WORK

A. Refer to the section, "General Mechanical Provisions", for related requirements. Refer to other sections of Division 23 and to all other applicable portions of the Drawings and Specifications.

B. This section directly relates in particular to sections (which may or may not be included in this division) which describe the following:

1. Ductwork.
2. Air distribution devices.
3. All types of air handling equipment.

1.4 COORDINATION

A. Coordinate all items affecting the duct systems including but not limited to the following items: air handling units, exhaust fans, supply fans, sound attenuators, duct mounted coils, access panels air distribution devices, fire dampers, outside air louvers, hoods, filters, roof curbs, structural framing, roof construction, roofing, and the work of all trades to insure an orderly and timely progression of the work.

1.5 SHOP DRAWINGS

A. Include complete data on: access doors; flexible connectors; manual volume dampers including operating hardware; turning vanes; automatic shutters and all other items.

B. See section entitled, "General Mechanical Provisions".
1.6 OTHER REQUIREMENTS

A. Provide all components in accordance with manufacturer's recommendations.

B. All ductwork dimensions indicated which may affect items of this section are nominal free clearance internal dimensions which do not include insulation thickness.

1.7 DEFINITIONS

A. "SMACNA" means "Sheet Metal and Air Conditioning Contractors National Association, Inc.".

PART 2 - PRODUCTS

2.1 GENERAL

A. Be recommended by the manufacturer for the application.

B. Products listed in this Section or on the plans are based on a specific manufacturer to establish the desired style, quality and type. Equivalent products, complying with the requirements of this Section and the installation requirements of the plans, by the following manufacturers are acceptable:

1. Ventfabrics
2. Barber-Colman
3. Tuttle & Bailey
4. Dura-Dyne
5. Airsan
6. Titus
7. Anemostat
8. Young
9. Metalaire
10. United McGill

C. Products which are specified may not necessarily all be required on the projects; provide those products which are applicable.

2.2 FLEXIBLE DUCT CONNECTIONS

A. Provided where air handlers, fans and blowers connect to their ductwork.

B. At least 4 inches long.

C. Connected on each side to metal (either metal ductwork, air handling apparatus, or heavy gauge steel sleeves).

D. For use in high and/or low pressure duct systems.

E. Ventfabrics, Inc., "Ventglas Metaledge", or equivalent.

2.3 SPLITTERS

A. Provide for adjustment of air volume to their respective branches, where indicated. Constructed of at least the same gauge galvanized steel as the duct wherein they are used, and in no instance be less than twenty-two (22) US gauge. Use in low pressure duct systems only. Be adequately sized to close off air to applicable branches. Rigidly attached to pivot
rod and operating linkage. Install on raised insulated base when used in internally insulated ductwork. Splitter blades; formed in two thicknesses of metal so that entering edge presents rounded nose to air flow; length no less than one and one half times the width of the smaller branch served or twelve inches, whichever is larger. Hardware used for the construction, assembly, and operation of splitter dampers shall be as follows:

1. Operators for exposed splitters and those located above "lay-in" or accessible ceiling shall be Ventlok #690 splitter damper assembly.
2. Operators for concealed splitters shall be Ventlok #691 with #680 miter and #677 concealed regulator.

2.4 LOW PRESSURE METAL TURNING VANES

A. Provide in all elbows, bends and tees of all low velocity supply air ducts whether or not shown in detail; provide in all elbows, bends and tees of all other low velocity ducts where portions of such ducts convey air at greater than 700 fpm average velocity. Adequate rigidity and strength to be completely flutterproof; properly designed; permanently fixed type. Aluminum, or steel with acid/solvent chemical corrosion resistant coating, or galvanized steel. Air foil type in all mitered elbows, mitered bends and tees. Air foil type must be manufactured by Titus, Tuttle & Bailey, Anemostat, Waterloo, Metalaire, Barber-Colman or other approved manufacturer. Be Barber-Colman "Airturns", Tuttle and Bailey "Ducturns", or Dura-Dyne "VR" with 24 gauge rails and hollow vanes, or equivalent.

2.5 HIGH PRESSURE TURNING VANES

A. None required for this project.

2.6 MANUAL VOLUME DAMPERS

A. These dampers are to be other than those specified as being integral with each register, diffuser and other air outlet or inlet.

B. Provided where indicated in the complete air distribution system(s) (including ductwork, return air plenums, etc.) to allow complete balancing of the air supply, return, ventilation and exhaust system(s).

C. Opposed blade type.

D. 8" maximum blade width.

E. Made of galvanized steel, steel with acid/solvent chemical resistant coating, or steel with a sprayed or dipped aluminum rust resistant finish; flutterproof.

F. Provided so that all damper adjustment can be made from outside the completed ductwork without necessity for puncturing or otherwise penetrating the ductwork and/or its vapor barrier.

G. Fully adjustable and with locking device.

H. Manufactured by Titus, Tuttle & Bailey, Anemostat, Waterloo, Metalaire, Greenheck or equivalent.

I. Provided at a point in the ductwork which is a sufficient distance upstream from an outlet (or downstream from an inlet) to attenuate objectionable noise due to damper throttling and to preclude adverse effects on the distribution device.
J. Based upon location of the duct in which the damper is to be installed, provide the following types:

1. Dampers in ducts which are exposed or located above "lay-in" or "accessible ceilings": Young Regulator Company Model 817 or equivalent.
2. Dampers in ducts concealed above plaster ceilings or behind dry wall construction: Young Regulator Company Model 817A or equivalent.

K. Use in low pressure duct system only.

2.7 LOW PRESSURE DUCT ACCESS DOORS

A. Provided for: each manual and motorized damper; fire damper; smoke damper; electric duct heater; and where access is otherwise necessary.

B. Factory prefabricated double wall insulated type of 24 US gauge galvanized steel (of same or thicker gauge than ductwork panel in which installed, whichever is greater).

C. Minimum size shall be as large as is compatible with duct size but in no case less than the following (provide larger sizes if necessary to permit proper access operation):

<table>
<thead>
<tr>
<th>Max. Duct Dimensions</th>
<th>Access Door Size</th>
</tr>
</thead>
<tbody>
<tr>
<td>11&quot; and less</td>
<td>10&quot; x 12&quot;</td>
</tr>
<tr>
<td>12&quot; through 16&quot;</td>
<td>12&quot; x 16&quot;</td>
</tr>
<tr>
<td>17&quot; and over</td>
<td>16&quot; x 24&quot;</td>
</tr>
</tbody>
</table>

D. Doors shall be provided with and operated adjustable tension catches and shall be completely gasketed around their perimeters. Doors shall be Ventlok "Access Doors". Install in accordance with manufacturers recommendations using Ventlok #360 sealant or equivalent.

2.8 TEST OPENINGS

A. Furnish and install gasketed capped test openings for test equipment (pitot tubes, etc.) on the entering and leaving sides of air handling unit and other air handling equipment and heating coils. Test openings shall be Ventlok #699-2 or equivalent.

2.9 PREFABRICATED DUCT CONNECTIONS

A. At Contractor's option, prefabricated duct connections as manufactured by Ductmate (or approved equal system) may be used in locations and applications for which the duct connection system is recommended. Use of these connections must meet or exceed specified duct construction quality as related to structural rigidity, pressure, accessibility and other such requirements.

2.10 FIRE DAMPERS

A. Rating: 1-1/2 hours (UL approved for installation in 2 hour walls).

B. Construction: Minimum 24 gauge galvanized steel frame suitable for connection to ductwork without transition, minimum 24 gauge galvanized steel curtain type blades located out of the airstream, thickness coordinated with wall construction. Where an active smoke control system exists (refer to Section 23 09 93) the damper shall be capable of closing in an
airstream moving at a minimum of 2000 feet per minute and operating at 4" w.g. pressure (dynamic damper).

C. Sleeves: UL listed minimum gauge galvanized steel with welded construction corners. Rollformed sleeves will not be acceptable unless contractor guarantees in writing to seal voids in sleeve with UL approved sealer to limit air leakage. Length of sleeve shall be coordinated with the wall or floor.

D. Operation: Stainless steel constant force closure spring.

E. Link Setting: 160°F or 165°F.

F. Based on Ruskin Manufacturing Co. IBD2 Style B. (Static Systems).

G. Based on Ruskin Manufacturing Co., DIBD2 Style B. (Active smoke control systems only).

2.11 SMOKE DAMPERS

A. Low and Medium Pressure Ductwork:

1. UL labeled under UL 555S low leakage rated, no more than 10 CFM/SF @ 1" w.g. (UL Class II) after exposure to 1000°F for 1 hour (non-degradable). Classified for both horizontal and vertical mounting.

2. Construction:

   a. Frame 16 galvanized steel.
   b. Damper Blades: 14 gauge true airfoil design constructed of galvanized steel of low leakage non-heat degradable design with friction free silicone rubber edge type for a smoke seal to 450°F incorporated into blade and frame shapes. Blade shall be suitable for installation in systems with a maximum velocity of 4,000 FPM and 8" w.g. pressure at closure.

3. Damper operation by means of an electric actuator 120V AC, 24V AC or signal from smoke detector alarm circuit. Electric motor actuator to be UL listed with damper assembly for power open, spring closed operation with a maximum travel time of 15 seconds. Motor furnished with all connecting linkage and mounting hardware.

4. Damper and actuator shall be provided with a 60 month warranty.

5. Based on Ruskin Manufacturing Co., SD60-II.

2.12 SMOKE/FIRE DAMPERS

A. Low and Medium Pressure Ductwork:

1. UL labeled under the following standards:

   a. UL 555 - 1-1/2 hr. fire endurance.
   b. UL 555S - Low leakage rated, no more than 10 CFM/SF @ 1" w.g. (UL Class II) after exposure to 1000°F for 1 hour (non-degradable).
   c. Classified for both horizontal and vertical mounting.

2. Construction: Single damper designed and rated for combination smoke/fire duty.

   a. Frame: 16 ga. galvanized steel.
   b. Damper Blades: 14 gauge true airfoil design constructed of galvanized steel of low leakage non-heat degradable design with friction free inflatable silicone coated
fiberglass material to maintain smoke leakage rating to a minimum of 450°F and galvanized steel for flame seal to 1900°F. Blade shall be suitable for installation in systems with a maximum velocity of 2,000 FPM and 4” w.g. pressure at closure.

c. Duct sleeve provided by others.

3. Operation:

a. Smoke/fire damper operation by means of an integral resettable and re-useable UL listed electric-ambient temperature link, UL listed releasing device and mechanical lock assembly. Link activated by either electric, 120V AC or 24V AC signal from smoke detector alarm circuit or 350°F duct ambient temperature. Damper shall be capable of being reopened by remote signal when the duct temperature drops to 150°F. Electric motor actuator shall be UL listed with the damper assembly for power open/spring closed operation. Motor actuator shall be factory furnished with all connecting linkage and mounting hardware and shall be factory tested for proper operation.

b. Damper and actuator shall be provided with a 60 month warranty.


2.13 BACKDRAFT DAMPERS

A. Low Pressure Ductwork:

1. Rating: Up to 1" wg positive or negative.
2. Frame: Minimum 16 gauge (.064") galvanized steel or extruded aluminum.
3. Blades: Minimum 16 gauge (.064") galvanized steel or extruded aluminum parallel blade action, brass bearing, non-ferrous or de-iron pivot pins, gasketed blades.
4. Accessories: Counter balance and weights suitable for assisting or retarding as indicated on the drawings.
5. Based on Ruskin Manufacturing, Co. CBD4.

PART 3 - EXECUTION

3.1 GENERAL

A. Construct and install all accessories in accordance with the latest indicated editions of applicable SMACNA construction standards.

B. Provide all mitered elbows with turning vanes.

C. Install all duct system accessories in accordance with manufacturer’s recommendations.

D. All accessories installed in poly-vinyl-steel ductwork shall have acid/solvent chemical corrosion resistant coating.

E. All manual damper arms shall be tagged with fluorescent colored strip.

3.2 FIRE DAMPERS

A. Fire dampers shall be provided where indicated.

B. Review the architectural drawings to determine the wall construction rating so as to provide the proper rated damper.
C. All fire dampers shall be mounted within a UL approved thickness galvanized steel sleeve permanently affixed to the wall by means of perimeter retaining angles.

D. The fire damper shall be permanently attached to the sleeve. All voids around the sleeve and damper and sleeve and wall shall be properly sealed with fire barrier material, refer to division 07.

E. Ductwork shall be attached to the fire damper by means of a UL approved break away connection.

F. Access doors or access sections shall be provided at all fire damper locations.

3.3 SMOKE DAMPERS

A. Provided where indicated. See combination smoke/fire damper for assemblies in fire rated barriers.

B. Review the architectural drawings to determine the wall construction rating so as to provide the proper rated damper.

C. Provide access doors or access sections at all damper locations.

D. Coordinate the provision of the smoke damper actuator with the automatic temperature control and fire alarm system and ensure adequate space for the mounting of the actuator during installation of the damper and ductwork.

3.4 SMOKE/FIRE DAMPER

A. Provided where indicated. All smoke dampers in fire rated barriers to be combination type.

B. Review the architectural drawings to determine the wall construction rating so as to provide the proper rated damper.

C. All smoke/fire dampers shall be mounted within a UL approved thickness galvanized steel sleeve permanently affixed to the wall by means of perimeter retaining angles.

D. The smoke/fire damper shall be permanently attached to the sleeve. All voids around the sleeve and damper and sleeve and wall shall be properly sealed with fire barrier material, refer to division 07.

E. Ductwork shall be attached to the smoke/fire damper by means of a UL approved break away connection.

F. Access doors or access sections shall be provided at all smoke/fire damper locations.

G. Coordinate the provision of the smoke damper actuator with the Building Control System and assure adequate space for the mounting of the actuator during installation of the smoke/fire damper and ductwork.

3.5 BACKDRAFT DAMPER

A. Securely attach backdraft damper to wall with a suitable sleeve and retaining angles and seal all voids between damper and wall.
B. Adjust damper to open or close under the design conditions.

END OF SECTION 23 33 00
SECTION 23 34 29
FANS: CENTRIFUGAL, CEILING MOUNTED

PART 1 - GENERAL

1.1 SCOPE
A. Provide ceiling mounted light duty centrifugal fans with characteristics indicated.

1.2 SHOP DRAWINGS
A. Refer to requirements of Section entitled "General Mechanical Provisions".

1.3 CERTIFIED PERFORMANCE
A. Be AMCA certified as to both sound and performance ratings.

1.4 MANUFACTURER
A. Design Basis: Basis of design is similar to Acme Master-ette Model V Series and Greenheck CSP Series or as scheduled on drawings.


PART 2 - PRODUCTS

2.1 FAN HOUSING
A. Fan housing including longitudinal, traverse, and diagonal stiffeners, motor mounts, bearing and drive supports shall be constructed of steel. Entire fan housing shall be internally lined with ½-inch thick or greater, three pound per cubic foot density fiberglass acoustical duct liner with a stabilized surface. Liner shall be held in place with adhesive and mechanical fasteners. All insulation and adhesives shall meet requirements of NFPA 90A as to flame spread and smoke developed ratings. Housing, including all bracing, stiffeners and motor mounted assembly shall be factory finished with a baked on alkyd enamel finish over a corrosion resistant primer. Removable panel in bottom of housing for complete access to motor and fan.

2.2 CEILING INLET GRILLE
A. Steel or aluminum: Baked enamel finish.

2.3 FAN WHEEL
A. Shall be centrifugal type and shall be statically and dynamically balanced. Single or twin impeller as necessary to provide indicated performance.

2.4 FAN MOTOR
A. Permanently lubricated shaded pole motor mounted on resilient isolators to minimize vibration and noise.
2.5 BACK DAMPER
A. Mounted in throat of fan discharge.

2.6 DRIVE ASSEMBLY
A. Drive shall be direct drive type as indicated on drawings, and shall conform with the requirements of Section entitled "General Mechanical Provisions".

2.7 DISCONNECT SWITCH
A. Fans shall include factory mounted disconnect switches prewired to the drive motor.

2.8 SPEED CONTROL
A. Solid state speed controller for speed reduction to 40% Mounted on housing or as otherwise indicated.

PART 3 - EXECUTION

3.1 PLACEMENT AND MOUNTING
A. Fan locations shall be essentially as shown on drawings; however, actual fan placement shall be verified using field measurements and data relating to equipment approved for actual installation on this project. Mount fan in strict accordance with manufacturer's instructions.

3.2 TEST AND BALANCE
A. All fan performance shall be certified by test and balance procedures as specified in section describing test and balance procedures.

END OF SECTION 23 34 29
SECTION 23 37 13
AIR DISTRIBUTION DEVICES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS
A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division-01 Specification sections, apply to work of this section.

1.2 SCOPE
A. Provide all air distribution devices as indicated on the drawings and as specified herein for a complete and operable system.

1.3 RELATION TO OTHER WORK
A. Refer to the section, "General Mechanical Provisions", for related requirements. Refer to other sections of Division 23 and to all other applicable portions of the Drawings and Specifications.

B. Coordinate with work of the ceiling, drywall and plastering trades as required to insure an orderly progression of work and a first class finished system with respect to placement, alignment, finish, general fit and absence of conflict with lighting systems and fire protection systems.

Insulate air distribution devices to prevent condensation formation.

1.4 DESIGN CONDITIONS
A. Acoustical: Noise produced at each diffuser, register, grille or other air distribution device shall not exceed a noise criteria level of NC 35 based on sound pressure levels in db re 0.002 microbars unless otherwise indicated. Coordinate air distribution devices, sound attenuation measures and equipment actually provided to insure that this design constraint is not exceeded by the system installed.

Exceptions: Any particular rooms or areas which are normally occupied by other than maintenance staff or service staff and which may be noted on the drawings as requiring lower NC criteria.

B. Pressure Drop: Pressure drop across any air distribution device shall not exceed 0.15 in wg static pressure unless otherwise indicated.

1.5 SHOP DRAWINGS
A. Refer to the requirements of Section entitled "General Mechanical Provisions".

1.6 MANUFACTURER
A. Products listed in this Section or on the plans are based on a specific manufacturer to establish the desired style, quality and type. Equivalent products, complying with the requirements of this Section and the installation requirements of the plans, by the following manufacturers are acceptable:

1. Titus
2. Metalaire
3. Price
4. Krueger
5. Carnes

B. Manufacturers must be members of the Air Distribution Council unless otherwise indicated.

1.7 OTHER REQUIREMENTS

A. All aluminum is to be extruded unless otherwise indicated.

B. Appearance: Each air distribution device which has a portion thereof (frame, core, etc.) exposed to view in the finished area shall have a factory applied finish which matches and is compatible with the color of the surrounding surface on which the device is installed. Colors must be approved by Architect prior to device fabrication.

C. All louvers, dampers and/or shutters shall be rated by their manufacturer in accord with AMCA Standard 500-74.

D. Integral Components: All dampers, blank-off baffles and other companion devices which form an integral part of air distribution device shall be factory made items produced by the manufacturer of air distribution device.

E. Louvers: Louvers may be specified in another division but for reference may also be indicated on mechanical drawings.

F. Door Grilles: Door grilles may be specified in another division but for reference may also be indicated on mechanical drawings.

PART 2 - PRODUCTS

2.1 GENERAL

A. Provide the following air distribution devices as applicable to this project. Refer to air distribution device schedule as shown on drawings.

2.2 OTHER REQUIREMENTS


B. Provide ceiling and/or linear diffusers with border styles that are compatible with adjacent ceiling systems, and that are specifically manufactured to fit into ceiling module with accurate fit and adequate support. Refer to general construction drawings and specifications for types of ceiling systems which will contain each type of diffuser.

C. Diffusers, grilles and registers installed in fire rated ceiling, or floor/ceiling assemblies shall be constructed of steel.

D. Mounting Screws: Where grilles, diffusers or registers are specified which require mounting screws visible from the face of the device these screws shall be furnished with the air
distribution equipment and be finished at the factory to match the finish on the grille, diffuser or register in which they are to be used.

PART 3 - EXECUTION

3.1 GENERAL

A. Install neatly where indicated in accord with manufacturer's recommendations and in accord with SMACNA recommendations and as otherwise indicated.

B. Properly test, balance and adjust to produce quiet, draftless operation to best degree possible.

3.2 INSTALLATION

A. Rectangular Diffusers: Where diffusers are the lay-in type, they shall be supported by the inverted T-bar suspension system but all ducts connected thereto shall be supported independently of the ceiling as specified under Section entitled "Ductwork". Surface mounted diffusers shall be supported by the duct runouts or drops where sheet metal ducts are indicated and by separate hangers where flex runouts are indicated. All rectangular ceiling diffusers shall be installed with their lines parallel and perpendicular to the building line and properly aligned with the ceiling.

B. Sidewall Grilles and Registers: Mount securely to the duct system flanges using finish screws and in accordance with accepted good practice.

C. Ceiling mounted Exhaust and Return Registers/Grilles: Mount as specified hereinbefore for surface mounted ceiling diffusers except use finished screws provided and secure to duct and finished ceiling (or finished ceiling for nonducted returns) in accordance with the manufacturer's instructions. Where required to provide adequate support for nonducted registers or grilles, provide appropriate mounting frame for incorporation into the ceiling system.

D. Install all outlets and inlets as recommended by the manufacturer; in accordance with recognized industry practices; to insure that products serve intended functions.

E. Locate ceiling air outlets and inlets as indicated on the drawings. Unless otherwise indicated, locate units in center of acoustical ceiling modules. Install square and parallel with partitions, ceiling grid members, etc.

F. Spare Parts: Furnish to Owner, with receipt, 3 operating keys for each type of outlet and inlet that require them.

G. Do not install blank-offs under continuous linear diffuser distribution plenums. Distribution plenums shall cover only active portion of the diffuser.

3.3 PROTECTION OF WORK UNTIL FINAL ACCEPTANCE

A. Coordinate the installation of the air distribution equipment with related work and finishing of adjacent surfaces to prevent damage to the devices or adjacent finishes. Protect the finish of all air distribution equipment until final acceptance. Replace or repair to the Architect's satisfaction any damaged equipment.

END OF SECTION 23 37 13
PART 1 - GENERAL

1.1 SCOPE
A. Provide complete louver assemblies as indicated on Drawings and in Specifications.

1.2 SHOP DRAWINGS
A. Refer to the section entitled "General Mechanical Provisions".

1.3 CERTIFICATION
A. All performance shall be certified by AMCA and bear the AMCA Certified Ratings Seal for Air Performance and Water Penetration in accord with AMCA Standard 550.

PART 2 - PRODUCTS

2.1 GENERAL REQUIREMENTS
A. Stationary type; extruded aluminum construction.
B. All components factory assembled by the louver manufacturer including heads, jambs, sills, blades and mullions. Louver sizes too large for shipping shall be assembled at the site from factory assembled louver sections to provide the overall sizes required.
C. Frame:
   1. 4-inch depth.
   2. Suitable for mounting in the type of wall where indicated. Coordinate with wall construction indicated on architectural drawings.
   3. Extruded aluminum of 0.100-inches minimum thickness.
   4. Provided with caulking slots.
D. Blades:
   1. Drainable type with drain gutter in each blade and downspouts in jambs and mullions.
   2. Extruded aluminum of 0.081-inch minimum thickness.
   3. Approximately 37-1/2-degree blade angle.
   4. Blades on approximately 3-inch centers.
E. Finish:
   1. Clear anodized.
F. Operating characteristics:
   1. High free area.
   2. Low water penetration.
   3. Free area based on air velocity of not greater than 500 fpm.
   4. Air flow pressure drop in intake mode or exhaust mode of not greater than 0.025-inches w.g.s.p.
G. Design: Limit span between visible mullions to 10-feet and shall incorporate such other structural supports required to withstand a wind load of 50 lbs. per sq. ft.

H. Size: As scheduled or shown on Drawings or as required to comply with the above operating characteristic constraints.

2.2 ACCESSORIES

A. Bird screen: Aluminum, 3/4-inch mesh, typical for all louvers.

B. Insect screen: Aluminum, 18-16 mesh, where indicated on drawings.

C. Frame: Flange, 1-1/2-inch nominal width for louvers of sizes 24" wide X 12" high and smaller; non-flanged, suitable for cased opening mounting for louvers of sizes greater than 24" wide x 12" high.

2.3 ACCEPTABLE MANUFACTURERS

A. Basis of Design: Ruskin Model ELF-6375DXD. Acceptable: equivalent products of American Warming & Ventilating; Carnes; Greenheck; Krueger; Louvers & Dampers, Inc., Metal Industries; or approved equal.

PART 3 - EXECUTION

3.1 GENERAL

A. Install in accord with manufacturer's recommendations and in accord with applicable portions of current SMACNA guidelines.

B. Installation shall be watertight between complete circumference of frame and wall.

C. Coordinate complete installation with other work related to structure, wall construction, ductwork (if any) and other such interfaces.

D. For additional requirements, refer to Architectural drawings and other portions of the Contract Documents.

END OF SECTION 23 37 25
SECTION 23 41 00
AIR FILTER ASSEMBLIES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division-01 Specification sections, apply to work of this section.

1.2 SCOPE

A. Furnish and install complete air filter assemblies of the types, sizes and capacities indicated.

1.3 RELATION TO OTHER WORK

A. Refer to the section, "General Mechanical Provisions", for related requirements. Refer to other sections of Division 23 and to all other applicable portions of the Drawings and Specifications.

1.4 SHOP DRAWINGS

A. Include complete performance data at the scheduled operating conditions; dimensions; weights; performance curves; airside pressure losses; quantities; descriptions; and any other necessary information.

PART 2 - PRODUCTS

2.1 GENERAL

A. Filters shall pass applicable air quantities at velocities and pressure drops which are within manufacturer's recommended operating ranges and as specified and scheduled.

B. Filter Manufacturers: Continental; American Air Filter; Cambridge; Farr; Flanders; Purafil; or equivalent.

C. Filter Housing Apparatus Manufacturers: Same manufacturer as the applicable filters or same manufacturer as the air handling unit in which installed, whichever manufacturer is applicable.

D. Air Handling Unit Filter Sections: Shall be of adequate size to accept specified filters. Air handling unit filter sections shall be factory made by air handling unit manufacturer or by filter manufacturer to be specifically compatible with applicable air handling unit.

E. Fan Coil Unit and Fan Powered Terminal Unit Filter Box: Integral part of fan coil unit or terminal unit assembly.

1. Access: Filter sections shall be designed for side service access unless otherwise indicated.

2.2 REPLACEABLE THROWAWAY FILTERS, 1-INCH THICK

A. Dacron or fibrous glass multi-ply fiber with 3 graduated density plies. Equal to Continental Conoply Type LD 3 ply, AAF 5700. Galvanized steel or aluminum or fiberboard frame suitable for mounting in applicable filter box. Minimum efficiency: 25% NBS atmospheric
dust spot efficiency. Applicable uses: fan coil units; fan powered terminal units at heating
 coils contained therein.

2.3 INITIAL PREFILTERS FOR AIR HANDLING UNITS

A. Filter Housing: Integral part of air handling unit assembly. (If not part of AHU assembly, provide external filter housing.)

B. Filters: Extended surface, pleated panel type; disposable; double-wall chipboard frame with diagonal support members; 2-inches thick; average efficiency no less than 25-30% based on ASHRAE 52.2-99 test method; operate at an initial resistance of not more than 0.25-inches w.g.s.p. at 500 fpm face velocity. Design base: Farr 30/30.

2.4 FINAL PREFILTERS FOR AIR HANDLING UNITS

A. Filter Housing: Integral part of air handling unit assembly. (If not part of AHU assembly, provide external filter housing.)

B. Filters: Air filters shall be high performance, extended area, deep pleated, disposable type. They shall consist of a filter element, media retainer holding frame and sealer frame. The filter element shall be of the high performance, pre-formed, deep pleated, disposable type. The media shall be microfine glass fiber which is reinforced by a laminated synthetic backing. The filter shall have an average efficiency of 80-85% on ASHRAE Test Standard 52.2-99. It shall have an average arrestance of no less than 98%. The filter shall be listed by Underwriters' Laboratories as Class 1.

C. Media retainer: shall be of welded steel construction and shall be designed in such a manner that it supports the multiple pleats of the filter element against the direction of airflow. The media retainer shall be PVC coated and designed to totally eliminate the possibility of oscillation and/or sagging. Holding Frames shall be factory fabricated of 16 gauge galvanized steel and shall be equipped with gaskets and four spring type positive sealing fasteners. Fasteners shall be capable of being attached or removed without the use of tools. Sealer frames shall be fabricated of 20 gauge galvanized steel and shall be equipped with gasketing material on the rear flange of the sealer frame.

D. Design Base: Farr HP-100.

2.5 EXTERNAL FILTER HOUSING FOR AIR HANDLING UNIT FILTERS

A. Filter Housing: Holding frame of galvanized steel reinforced with bracing and gussets; constructed to provide positive air seal and retainage of filter elements; doors equipped with heavy duty latches and resilient gasketing; designed for side access. Housing shall accept both initial and final prefilters. Applicable uses: where filter housing is not an integral part of air handling unit assembly. Design base: Farr Model 3P Universal Glide/Pack.

2.6 ACTIVATED CARBON FILTERS

A. Activated carbon filters shall be the full flow high velocity type. Each filter shall contain 90 pounds of activated carbon per 2000 CFM. Filters shall be of size and quantity as indicated on the plans. The casing shall be constructed of galvanized steel. The activated carbon in each filter shall be contained in removable panels constructed of high heat, medium impact polystyrene plastic, to withstand corrosion, and so installed as to preclude the possibility of air bypass. The panels shall contain internal separators to minimize the settling of the carbon and shall be capable of being refilled by the owner. The activated carbon shall have an

2.7 HEPA FILTERS

A. Each module shall consist of an all metal corrosion resistant steel casing, steel center divider, filter pack, adjustable flow control, spun steel inlet collar, face screen and integral provisions for attachment of seismic restraints. Module shall be provided for use in lay-in type ceiling and shall be custom manufactured in size as required to fit the lay-in ceiling furnished.

B. The filter pack shall be made with pleated all-glass filter media and safe-edge corrugated aluminum separators. The filter media, separators, and casing components shall be encapsulated in a high stability compound to eliminate any possibility of leaks around the filter media or through the casing joints.

C. The flow control system shall provide each module with the capability of being adjusted to a specified discharge velocity between 25 and 110 fpm with a supply air static pressure between 0.5" and 2.0" w.g. The discharge velocity shall be uniform across the projected face of the module within a tolerance of + 20 fpm.

D. Flow control adjustments and measurements shall be made from the discharge face of the module. A single port of volumetric flow and filter resistance measurements and adjustments and measurement of upstream test aerosol concentration shall be provided in the face of the unit.

E. The module shall be protected by a diamond perforated anodized aluminum screen sealed to the face of the unit. The module shall provide a minimum of 5/8" of bearing and sealing surface when installed on a 1-1/2" T-Bar system.

F. The complete module shall be manufactured, tested and supplied by filter manufacturer. The completed unit shall be tested for efficiency and leaks and certified to have a minimum efficiency of 99.99% on 0.3 micron thermally generated particles and be leak-free per Federal Standard 209B.

G. After test and cleaning, the module face and inlet collar shall be sealed with removable shields to prevent further contamination and protect against damage.

H. Design Base: Cambridge model CAM-1.

PART 3 - EXECUTION

3.1 GENERAL

A. Arrangement and Access: Arrange, install and make provisions for easy access to and removal and replacement of filters. Provide access doors and/or panels as necessary.

B. Coordination and Matching: Coordinate assembly components and properly match sizes and quantities of filters with related air moving systems (e.g., air handling units, fan coil units, filter banks) so that filter assemblies will operate in accord with operating conditions, sizes and capacities as listed in this section or as otherwise indicated.

3.2 MANOMETER

A. Provide a filter manometer for each separate filter bank type (e.g., initial prefILTER bank, final prefILTER bank) of each air handling unit filter assembly. Do not provide for fan coil units or
terminal units. Units shall be complete with pressure fittings, tubing, vent valves, lags, fluid, and the like as required for a complete installation. Acceptable: Dwyer Series 250-AF with pressure range as applicable for filter bank. Not required for fan coil units. Manometers shall be installed in strict accordance with the manufacturer's instructions and in a manner which will not compromise filter access. Provide mounting brackets as required for proper installation. Set red and green signal flags for proper indication of status of the filters involved.

3.3 MISCELLANEOUS SUPPORT STEEL AND HARDWARE

A. Provide as required to provide for adequate support and structural integrity of each filter bank. In no case shall supplementary supports be less than those indicated or recommended by the filter manufacturer in his standard installation instructions.

3.4 FILTER ASSEMBLY LOCATIONS

A. Where scheduled and shown on the drawings.

3.5 ORIGINAL AND SPARE FILTER SETS

A. Provide an original filter set and two (2) spare filter sets for each unit having an air handling equipment filter assembly specified above. Upon initial start-up, each filter assembly shall be provided with a complete original filter set. Prior to or at the time of final test and balance, this original filter set shall be replaced with a complete new spare filter set. However, if at the time of final test and balance there is still useful operating life remaining in the initial filter set (i.e. the filters are still operating within their recommended pressure drop limits for the particular application), then the Contractor (if he is given written approval by the final test and balance agency) may give the spare filter sets to the Owner (at a place of the Owner's selection on the site) in lieu of replacing the original filters with the spare filters.

END OF SECTION 23 41 00
SECTION 23 43 24
AIR PURIFICATION SYSTEM

PART 1 - GENERAL

1.1 DESCRIPTION OF WORK
A. This section describes the design, performance and installation of an air purification system intended for use as part of another manufacturer's air handling unit or mounted on the duct as shown on the plans, details and equipment schedules.

1.2 REFERENCED CODES AND STANDARDS
A. The following codes and standards are referenced throughout. The edition to be used is that currently enforced by the authority having jurisdiction (AHJ) or in absence of such direction that referenced by the current enforceable IBC code or as indicated by the contract documents, except where specifically referenced by this section of the specifications.
1. ASHRAE Standards 62 & 52
2. National Electric Code NFPA 70
3. UL 867

1.3 RELATED WORK
A. Testing, Adjusting and Balancing
B. Facility Access and Protection
C. Ductwork
D. Filters
E. Water and Refrigerant Piping
F. Electrical Wiring
G. Control Wiring

1.4 QUALITY ASSURANCE
A. The Air Purification System shall be a product of an established manufacturer within the USA.
B. A qualified representative from the manufacturer shall be available to inspect the installation of the air purification system to ensure installation in accordance with manufacturer's recommendation.
C. Technologies that do not address gas disassociation such as UV Lights, Powered Particulate Filters and/or polarized media filters shall not be considered. Uni-polar ion generators shall not be acceptable. “Plasma” particulate filters shall not be acceptable.
D. Projects designed using ASHRAE Standard 62, IAQ Procedure shall require the manufacturer to provide Indoor Air Quality calculations using the formulas within ASHRAE Standard 62.1-2007 to validate acceptable indoor air quality at the quantity of outside air scheduled with the technology submitted. The manufacturer shall provide independent test data on a previous
installation in a similar application, that proves compliance to ASHRAE 62 and the accuracy of the calculations.

1.5 SUBMITTALS

A. Product Data: Submit manufacturer's technical product data for ion generators including:

1. Schedule of plasma generators indicating unit designation, number of each type required for each unit/application.
2. Data sheet for each type of plasma generator, and accessory furnished; indicating construction, sizes, and mounting details.
3. Performance data for each type of plasma device furnished.
4. Indoor Air Quality calculations using the formulas within ASHRAE Standard 62.1-2007 to validate acceptable indoor air quality at the quantity of outside air scheduled (when projects are designed with outside air reduction).
5. Product drawings detailing all physical, electrical and control requirements.

B. Operating & Maintenance Data: Submit O&M data and recommended spare parts lists.

1.6 PRODUCT DELIVERY, STORAGE AND HANDLING

A. Deliver in factory fabricated shipping containers. Identify on outside of container type of product and location to be installed. Avoid crushing or bending.

B. Store in original cartons and protect from weather and construction work traffic.

C. Store indoors and in accordance with the manufacturers’ recommendation for storage.

1.7 WARRANTY

A. Equipment shall be warrantied by the manufacturer against defects in material and workmanship. This guarantee shall be by the Contractor to the Owner to replace for the Owner any defective workmanship, equipment, or material which has been furnished under this Contract at no cost to the Owner for a period of one year from the date of acceptance of the System at Substantial Completion.

PART 2 - PRODUCTS

2.1 GENERAL

A. The air purification system(s) shall be of the size, type, arrangement and capacity indicated and required by the unit furnished and shall be of the manufacturers specified.

B. Acceptable Manufacturers: Plasma Air, Global Plasma Solutions, Bioclimatic.

C. All other Suppliers of comparable products requesting prior approval shall:

1. Submit for prior approval in accordance with the requirements of Section 230100.
2. In addition, manufacturers submitting for prior approval for Bi-Polar Ionization must as part of the prior approval request provide their ASHRAE 62.1-2007 calculations that prove conformance to the ASHRAE Standard with the reduction of outside air to the scheduled values. A letter on the manufacturer's letterhead requesting prior approval must accompany the request for prior approval stating their calculations are ASHRAE compliant. A third party validation study performed on a previous installation of the same application shall also be included.
2.2 BI-POLAR IONIZATION DESIGN AND PERFORMANCE CRITERIA

A. Each piece of air handling equipment, so designated on the plans, details, equipment schedules and/or specifications shall contain a Plasma Generator with Bi-polar Ionization output as described here within.

B. The Bi-polar Ionization system shall be capable of:
   1. Effectively killing microorganisms downstream of the bi-polar ionization equipment (mold, bacteria, virus, etc.).
   2. Controlling gas phase contaminants generated from human occupants, building structure, furnishings and outside air contaminants.
   3. Capable of reducing static space charges.
   4. Effectively reducing space particle counts.

C. The bi-polar ionization system shall operate in a manner such that equal amounts of positive and negative ions are produced. Uni-polar ion devices shall not be acceptable.
   1. Air exchange rates may vary through the full operating range of a constant volume or VAV system. The quantity of air exchange shall not be increased due to requirements of the air purification system.
   2. Velocity Profile: The air purification device shall not have maximum velocity profile.

D. Humidity: Plasma Generators shall not require preheat protection when the relative humidity of the entering air exceeds 85%. Relative humidity from 0 - 100%, condensing, shall not cause damage, deterioration or dangerous conditions within the air purification system.

E. Equipment Requirements:
   1. Electrode Specifications (Bi-polar Ionization):
      a. Each Plasma Generator with Bi-polar Ionization output shall include the required number of electrodes and power generators sized to the air handling equipment capacity. Bi-polar ionization tubes manufactured of glass and steel mesh shall not be acceptable due to replacement requirements, maintenance, performance output reduction over time, ozone production and corrosion.
      b. Electrodes shall be energized when the main unit disconnect is turned on and the fan is operating.
      c. Manufacture shall demonstrate that no voltage potential exists due to exposed electrical components.

F. Air Handler Mounted Units:
   1. Where so indicated on the plans and/or schedules Plasma Generator(s) shall be supplied and installed. The mechanical contractor shall mount the Plasma Generator and associated power supplies. All interconnecting wiring shall be UL and NEC NFPA 70 approved. Electrical contractor shall provide a [<120Volt>, <230 Volt>] circuit to the ion generators.

G. Ionization Requirements:
   1. Plasma Generators with Bi-polar ionization output shall be capable of controlling gas phase contaminants and shall be provided for all equipment listed above.
      a. The Bi-polar ionization system shall consist of Bi-Polar Plasma Generator and power supply. The Bi-polar system shall be installed where indicated on the plans or specified...
to be installed. The device shall be capable of being powered by 110VAC to 208VAC to 240VAC without the use of an external transformer. Ionization systems requiring isolation transformers shall not be acceptable.

b. Ionization Output: The ionization output shall be controlled such that an equal number of positive and negative ions are produced. Imbalanced levels shall not be acceptable.

c. Ionization output from each electrode shall be a minimum of 15 million ions/cc when tested at 2" from the ionization generator.

2. Ozone Generation:

a. The operation of the electrodes or Bi-polar ionization units shall conform to UL 867-2007 with respect to ozone generation.

H. Electrical Requirements:

1. Wiring, conduit and junction boxes shall be installed within housing plenums in accordance with NEC NFPA 70. Plasma Generator shall accept an electrical service of 115 VAC to 240VAC, 1 phase, 50/60 Hz.

I. Control Requirements:

1. All Plasma Generators shall have internal short circuit protection, overload protection, and automatic fault reset.

2. The installing contractor shall mount and wire the Plasma device within the air handling unit specified or as shown or the plans. The contractor shall follow all manufacturer IOM instructions during installation.

PART 3 - EXECUTION

3.1 GENERAL

A. The Contractor shall be responsible for maintaining all air systems until the owner accepts the building (Owner Acceptance).

3.2 ASSEMBLY AND ERECTION: PLASMA GENERATOR WITH BI-POLAR IONIZATION

A. All equipment shall be assembled and installed in a workman like manner to the satisfaction of the owner, architect, and engineer.

B. Any material damaged by handling, water or moisture shall be replaced, by the mechanical contractor, at no cost to the owner.

C. All equipment shall be protected from dust and damage on a daily basis throughout construction.

3.3 TESTING

A. Provide the manufacturers recommended electrical tests.

3.4 COMMISSIONING AND TRAINING

A. A manufacturer’s authorized representative shall provide start-up supervision and training of owner’s personnel in the proper operation and maintenance of all equipment.

END OF SECTION 23 43 24
PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division-01 Specification sections, apply to work of this section.

1.2 SCOPE

A. Provide factory assembled and prewired electric duct heaters where indicated. Heater capacities, sizes and operating characteristics shall be as scheduled on drawings or as indicated in other sections.

1.3 RELATION TO OTHER WORK

A. Refer to the section, "General Mechanical Provisions", for related requirements. Refer to other sections of Division 23 and to all other applicable portions of the Drawings and Specifications.

1.4 SHOP DRAWINGS

A. Refer to requirements of Section entitled "General Mechanical Provisions". Include complete data on heater sizes; required clearances; direction of air flow; control box construction and dimensions; power and control wiring (both factory and field); operating and safety controls; and capacities and operating characteristics.

1.5 MANUFACTURERS

A. Equipment items listed in the schedule on the drawings are based on a specific manufacturer to establish the desired style, quality, performance, and type of equipment. Equal products, complying with the required installation shown on the plans and with these specifications, by the following manufacturers are acceptable:

1. Brasch
2. Tennessee Plastics
3. Indeeco
4. Electric Heaters Division of I.T.E.
5. Valley Industries
6. Dell
7. Greenheck

PART 2 - PRODUCTS

2.1 GENERAL

A. Each heater shall be UL listed for zero clearance, open coil slip-in type for duct mounting. Sizes, direction of air flow, mounting position, electrical characteristics, and heating capacities shall be as indicated.

1. Meet all applicable requirements of current NEC.
2. UL listed including all built-in components.
3. Be entirely suitable for installation in the indicated locations (ductwork or air handling unit(s) as applicable).
4. Coordinated with the specified requirements of the mechanical system control system.

2.2 MATERIALS AND CONSTRUCTION

A. Galvanized or aluminized steel frame and terminal box with hinged cover.
B. Maximum watt density of 35 watts per square inch of resistance wire surface area (unless otherwise specified).
C. Terminals recessed into air stream 1-1/4 inches minimum.
D. Stainless steel resistance coil terminals and nuts.
E. Iron free resistance wire of 80% nickel and 20% chromium.
F. Reinforced resistance wire bracket supports spaced no greater than four inches apart with stiffening ribs and gussets.
G. Securely positioned terminal insulators and bracket bushings of high quality ceramic.
H. Dielectrically tested for 1000 volts plus twice the rated voltage of 2000 volts, whichever is greater.
I. Heat limiter in each energized heating element power line.
J. Balanced three phase delta connected load if three phase heaters are specified.
K. Insulated terminal box to prevent condensation.
L. Full fine break mercury contactors which will break all ungrounded conductors (note horizontal, vertical or oblique position of each heater assembly as shown on drawings).
M. Transformer with primary fusing if control voltage is different from supply voltage.
N. Overcurrent protection consisting of automatic circuit breaker(s) each installed in accord with NEC requirements.
O. Manual reset thermal cutout in series with a disc type, automatic reset thermal cutout for primary protection, and heat limiters in the heating element power lines to de-energize the elements if the primary cutout fails. Devices shall be serviceable through the terminal box without having to remove heater from duct.
P. Control terminals and power terminals.
Q. Pneumatic-electric switches (one per heater step) when control signal is pneumatic.
R. Built-in or remote pressure type air flow switch. Install in series with automatic reset thermal cutout.
S. Factory mounted integral disconnect switch.
PART 3 - EXECUTION

3.1 GENERAL

A. Arrange and install heater to provide uniform heating of air stream.

B. Properly and firmly support in each location.

3.2 PLACEMENT

A. Heater locations shall be essentially as shown on drawings; however, actual placement shall be verified using field measurements and data relating to the equipment actually approved for installation on this project. Heaters and all controls shall be arranged for horizontal or vertical, top, side or bottom mounting as indicated on drawings. Heater installation shall conform to all governing codes as to clearances, disconnect means, wiring, and like items.

B. Support: Provide duct hangers, and specified in section entitled "Ductwork", immediately adjacent to both sides of heater at both sides of the duct.

C. Duct Openings: Shall be accurately cut, properly reinforced, and gasketed as required for an air tight installation. Insulation shall be finished up to the control box in such a manner as not to compromise service access to heater and provide a proper vapor seal at the edge of the insulation.

3.3 CONTROL COORDINATION

A. Coordinate and provide all items necessary for each heater to operate in accord with the control system sequences and methodology described in other sections of this division.

3.4 TEST AND BALANCE

A. All heater performance shall be certified by test and balance procedures as specified in section covering testing and balancing.

3.5 CLEANING AND PROTECTION

A. Contractor shall protect the heaters from damage from the time of their receipt until final acceptance and shall thoroughly clean the complete heater (including interior of control box) of all dirt and construction debris prior to requesting final inspection. Control box, access door, elements, control and like items which become damaged during the course of construction shall be required to "as new" condition or shall be replaced with new material or equipment components.

3.6 WIRING DIAGRAMS

A. Provide complete wiring diagram furnished by the heating coil system manufacturer to the mechanical systems control manufacturer and the electrical contractor. This wiring diagram shall completely indicate in full detail all electrical and control wiring requirements, terminals, etc., necessary to allow the control manufacturer and electrical contractor to completely coordinate their respective wiring portions of the heating coil system installation.

END OF SECTION 23 54 17
SECTION 23 81 44
AIR CONDITIONING UNITS, PACKAGED ROOFTOP

PART 1 - GENERAL

1.1 SCOPE

A. Provide packaged rooftop air conditioners where indicated on the drawings. Unit capacities and operating conditions shall be as scheduled on the drawings.

1.2 RELATION TO OTHER WORK

A. Coordinate shop drawings; equipment ordering, delivery and placement; structural framing; roof construction; roofing; utility connections. Refer to the Section entitled "General Provisions".

1.3 SHOP DRAWINGS

A. Refer to the Section entitled "General Provisions". Include complete data on roof curbs; duct opening requirements; equipment weights; power and control wiring (both factory and field); operating and safety controls; capacities and rating conditions; and equipment sound power levels in each octave band.

1.4 WARRANTY

A. Include the cost of one year's warranty on entire system plus an additional four years warranty on refrigerant system and all components thereof. The first year's warranty shall comply with the standard warranty (guaranty) provisions of these specifications. The additional four year warranty shall include parts, refrigerant and oil, exclusive of labor.

1.5 MANUFACTURER

A. Design Basis: Units used as a design basis are Weatherking Series DFC.

B. Acceptable Manufacturers: Trane, Carrier, Lennox, Bryant, Command Aire or equal.

PART 2 - PRODUCTS

2.1 FRAME

A. Unit shall be completely factory assembled with all components mounted on a one piece unitized frame. Frame shall be constructed of extruded aluminum or welded steel. Frame shall incorporate lifting lugs for purposes of rigging and setting the unit in place.

2.2 CASING

A. Unit casing shall be not less than 14 gauge zinc coated steel, phosphatized, epoxy primed, and finished with enamel. Casing roof shall utilize one piece construction with all seams filled with sealant. Access shall be provided by means of access panels furnished in sufficient number and size to enable ready access to all controls, fans, coils, filters, compressors, refrigerant system accessories, and service valves. Access panels shall be gasketed neoprene seals.
2.3 REFRIGERANT COILS
   A. Refrigerant coils shall be constructed of seamless copper tubes with aluminum heat transfer fins mechanically bonded thereto. Condenser coils shall be tested at not less than 400 psig and proved tight. Evaporator coils shall be tested at not less than 300 psig and proved tight.
   B. Units scheduled as having two compressors must be provided with two compressors; single compressor units are not acceptable unless scheduled as such.

2.4 ELECTRIC HEATER
   A. Provide electric resistance heating coils, of the capacities scheduled, as integral factory mounted and wired equipment. Heating coils shall be of heavy duty nickel chromium wire and incorporated manual and auto reset high limit protection devices and air flow interlock devices. Heaters shall be UL labeled.

2.5 FANS
   A. Supply Air Fans: Supply air fans shall be double width, double inlet forward curved blade type and shall be both statically and dynamically balanced. Fans shall be of the belt type. Drives shall conform with the Section entitled "General Provisions".
   B. Condenser Fans: Shall be propeller type, direct drive, statically and dynamically balanced and protected with metal guards on discharge side.

2.6 FILTERS
   A. Two inch (2") thick throwaway filters which shall filter both return and outside air handled by unit. Filter media shall be non-organic long fiber mineral glass type with viscous coating and shall be UL Class 2. Filter average dust spot efficiency atmospheric shall be not less than twenty-five percent (25%). Filter face velocity shall not exceed 500 fpm.

2.7 COMPRESSORS
   A. Unit compressor(s) may be of the hermetic or semi-hermetic type.

2.8 REFRIGERANT CIRCUIT ACCESSORIES
   A. The following refrigerant accessories shall be included: Suction accumulator; backseating compressor suction and discharge valves with gauge ports on serviceable hermetics; high and low pressure service gauge ports and valves; filter drier; sight glass and moisture indicator; thermostatic expansion valves; and crankcase heater. Where units have multiple compressors, the above shall apply to each compressor refrigerant circuit.

2.9 INSULATION
   A. All casing panels and all interior surfaces of exterior casing members in contact with airstream shall be insulated with not less than one inch (1") expanded foam or glass fiber insulation. All unit insulation and adhesives shall comply with the requirements of NFPA 90A as to flame spread and smoke developed ratings.
2.10 ROOF CURB

A. Unit shall be furnished complete with National Roofing Contractor’s Association approved roof curb constructed of not less than 14 gauge zinc coated steel with gasketed supply and return air openings. Curb height shall be a minimum of twelve inches (12”).

2.11 UTILITY CONNECTIONS

A. Utility connection openings may be provided within the roof curb enclosure, or on the exterior of the unit provided a good water seal is provided to prevent leakage within the unit.

2.12 CONTROLS

A. General: Units shall be furnished and installed complete with all system operating and safety controls specified herein and as otherwise required for a complete and operable system. Controls shall be of the electric and electronic type. Unit controls shall operate at 115V AC and all remote controls shall be low voltage (less than 50V AC).

B. Refrigerant Controls: Refrigerant controls shall include short cycle protection; high pressure cutout; low pressure cutout; and oil pressure failure protection switch (on serviceable hermetics).

C. Room Controls: Each unit shall be provided with an individual space control capable of matching system heat input on heat removal to space heat loss or heat gain sufficiently close to maintain a space temperature within plus or minus two (2) degrees of thermostat setpoint.

D. Thermostat: Provide for each unit a remote thermostat located in the space served by the unit. Thermostat shall have the following minimum control features:
   2. Fan on-auto switch.
   3. Power and filter status indicated lights.

E. Automatic Time Switch: Furnish and install an electric time switch with electrically would synchronous carryover feature to start and stop the unit with system selector switch in the "auto" position. Clock shall be capable of starting and stopping unit at different times on different days and of skipping days. Provide time clock override switch for each unit.

PART 3 - EXECUTION

3.1 PLACEMENT AND MOUNTING

A. Unit location shall be essentially as shown on drawings. However, actual placement of the roof curb shall be verified using field measurements and data relating to the equipment approved for actual installation on this project. The roof decking, roof slab, and roof insulation shall be continuous throughout the area enclosed by the curb with the exception of the actual supply and return duct penetrations. Duct penetrations shall be continuously sealed using a non-hardening sealant.

3.2 WIRING

A. All control, and interlock wiring shall be run in conduit and shall be performed as work of Division 23.
3.3 DUCT CONNECTIONS

A. Supply and return ducts shall be connected to their respective unit duct collars using flexible connectors. These connectors shall be installed properly so that they are not in tension and are aligned with their respective ducts.

3.4 MANUFACTURER’S FIELD SUPERVISION

A. Provide the services of an authorized representative of the equipment manufacturer who shall personally supervise the following: check out of all field wiring; unit start up; and unit test and balance including control calibration.

3.5 TESTING AND BALANCING

A. Refer to Section describing test and balance.

END OF SECTION 23 81 44
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 work of this Section.
   B. Coordination of work between mechanical and electrical trades is covered in Division-23 Section "GENERAL MECHANICAL PROVISIONS".

1.2 SUMMARY
   A. This Section specifies the basic requirements for electrical installations and includes requirements common to all sections of Division-26. It expands and supplements the requirements specified in sections of Division-01.

1.3 CODES AND STANDARDS
   A. Install all work in accordance with the applicable requirements of the latest edition of the following:
      1. National Electric Code (NEC)
      2. Local, State, County and City Codes
      3. National Fire Protection Association (NFPA)
      4. American National Standards Institute (ANSI)
      5. NEMA Standards
   B. It is the intent of the Contract Documents to comply with the applicable codes, ordinances, regulations, and standards. Where discrepancies occur, notify the Architect in writing, and ask for interpretation. Correct any installation that fails to comply with the applicable codes and standards at no additional cost to the Owner.
   C. All materials shall be new and free of defects, and shall be U.L. listed, bear the U.L. label or be labeled or listed with an approved, nationally recognized Electrical Testing Agency. Where no labeling or listing service is available for certain types of equipment, test data shall be submitted to prove to the Engineer that equipment meets or exceeds available standards.

1.4 PERMITS AND INSPECTIONS
   A. Obtain and make all payments for permits and inspections required. At the completion of the project and before final acceptance of the electrical work, provide evidence of final inspection and approval by the authorities having jurisdiction.

1.5 QUALITY ASSURANCE
   A. Manufacturers: Firms regularly engaged in manufacture of electrical products specified, whose products have been in satisfactory use in similar service for not less than 5 years.
   B. Installer's Qualifications: Firm with at least 5 years of successful installation experience on projects with electrical work similar to that required for this project.
1.6 IDENTIFICATION

A. The following items shall be equipped with nameplates: All motors, motor starters, motor-control centers, pushbutton stations, control panels, time switches, disconnect switches, panelboards, circuit breakers, contactors.

B. Nameplates shall adequately describe the function of the particular equipment involved. Nameplates for panelboards and switchboards shall include the panel designation, branch (normal or emergency), voltage and phase of the supply. For example, "Panel A, Emergency Branch, 480Y/277V, 3-phase, 4-wire."

C. Nameplates shall be laminated phenolic plastic, black front and back with white core, with 3/8 inch high lettering etched through the outer covering. White engraved letters on black background. Attach with plated self-tapping screws or brass bolts.

D. Provide nameplates on all existing equipment that a circuit under this contract is fed from.

E. All junction box covers shall be hand marked with a 1/8 inch wide permanent black marking pen, indicating panel and circuit numbers contained, or system contained, i.e., fire alarm, telephone, etc.

1.7 ROUGH-IN

A. Verify final locations for rough-ins with field measurements and with the requirements of the actual equipment to be connected, and architectural room elevations.

1.8 ELECTRICAL INSTALLATIONS

A. Coordinate electrical equipment and materials installation with other building components.

B. Verify all dimensions by field measurements.

C. Arrange for chases, slots, and openings in other building components to allow for electrical installations.

D. Coordinate the installation of required supporting devices and sleeves to be set in poured in place concrete and other structural components, as they are constructed.

E. Sequence, coordinate, and integrate installations of electrical materials and equipment for efficient flow of the Work. Give particular attention to large equipment requiring positioning prior to closing-in the building.

F. Coordinate the cutting and patching of building components to accommodate the installation of electrical equipment and materials.

G. Coordinate connection of electrical systems with local utility services. Comply with requirements of governing regulations, franchised service companies, and controlling agencies. Provide required connections for each service.

1.9 CUTTING AND PATCHING

A. This Article specifies the cutting and patching of electrical equipment, components, and materials to include removal and legal disposal of selected materials, components, and equipment.
B. Do not endanger or damage installed Work through procedures and processes of cutting and patching.

C. Arrange for repairs required to restore other work, because of damage caused as a result of electrical installations.

D. No additional compensation will be authorized for cutting and patching Work that is necessitated by ill-timed, defective, or non-conforming installations.

E. Perform cutting, fitting, and patching of electrical equipment and materials required to:
   1. Uncover Work to provide for installation of ill-timed work;
   2. Remove and replace defective Work;
   3. Remove and replace Work not conforming to requirements of the Contract Documents;
   4. Remove samples of installed Work as specified for testing;
   5. Upon written instructions from the Architect/Engineer, uncover and restore Work to provide for Architect/Engineer observation of concealed Work.
   6. Install electrical work in existing facilities.

1.10 ELECTRICAL SUBMITTALS

A. Refer to the Conditions of the Contract (General and Supplementary) and Division-01 Section: SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES for submittal definitions, requirements, and procedures.

B. Submittal of shop drawings, product data, and samples will be accepted only when submitted by the Contractor. Data submitted from subcontractors and material suppliers directly to the Architect/Engineer will not be processed.

1.11 PRODUCT OPTIONS AND SUBSTITUTIONS

A. Refer to the Instructions to Bidders and the Division-01 for requirements in selecting products and requesting substitutions. Where a listing of acceptable manufacturers has been given, use one of those manufacturers given only.

1.12 PRODUCT LISTING

A. Prepare listing of major electrical equipment and materials for the project.

B. Provide all information requested.

C. Submit this listing as a part of the submittal requirement specified in Division-01.

D. When two or more items of the same material or equipment are required they shall be of the same manufacturer, i.e., panelboards, motor starters, transformers, etc. Product manufacturer uniformity does not apply to raw materials, bulk materials, wire, conduit, fittings, sheet metal, steel bar stock, welding rods, solder, fasteners, motors for dissimilar equipment units, and similar items used in Work, except as otherwise indicated.

E. Provide products which are compatible within systems and other connected items.
1.13 DELIVERY, STORAGE, AND HANDLING
A. Deliver products to project properly identified with names, model numbers, types, grades, compliance labels, and similar information needed for distinct identifications; adequately packaged and protected to prevent damage during shipment, storage, and handling.
B. Store equipment and materials at the site, unless off-site storage is authorized in writing. Protect stored equipment and materials from damage.
C. Coordinate deliveries of electrical materials and equipment to minimize construction site congestion. Limit each shipment of materials and equipment to the items and quantities needed for the smooth and efficient flow of installations.

1.14 RECORD DOCUMENTS
A. Refer to the Division-01 Section: PROJECT CLOSEOUT or PROJECT RECORD DOCUMENTS for requirements. The following paragraphs supplement the requirements of Division-01.
B. Mark Drawings to indicate revisions to conduit size and location both exterior and interior; actual equipment locations, distribution and branch electrical circuitry; fuse and circuit breaker size and arrangements; support and hanger details.
C. Mark Specifications to indicate approved substitutions; Change Orders; actual equipment and materials used.

1.15 OPERATION AND MAINTENANCE DATA
A. Refer to the Division-01 Section; PROJECT CLOSEOUT or OPERATION AND MAINTENANCE DATA for procedures and requirements for preparation and submittal of maintenance manuals.

1.16 WARRANTIES
A. Refer to individual equipment specifications for warranty requirements.
B. Compile and assemble the warranties specified in Divisions-26, 27 & 28, into a separate set of vinyl covered, three ring binders, tabulated and indexed for easy reference.
C. Provide complete warranty information for each item to include product or equipment, date of beginning of warranty or bond; duration of warranty or bond; and names, addresses, and telephone numbers and procedures for filing a claim and obtaining warranty services.

1.17 CLEANING
A. Refer to the Division-01 Section; PROJECT CLOSEOUT or FINAL CLEANING for general requirements for final cleaning.
B. Clean all light fixtures, lamps and lenses prior to final acceptance. Replace all inoperative lamps.

1.18 TEMPORARY POWER
A. Provide and pay for all temporary electrical service as required for construction.
B. Provide all temporary lighting and power distribution as required for construction. Temporary power design & installation shall be performed by the electrical contractor in coordination with the utility company.

1.19 ELECTRONIC FILES

A. CADD files will be available on a limited basis to qualified firms at the Architects prerogative. Recipients are cautioned that these files may not accurately show actual conditions as constructed. Users are responsible to verify actual field conditions. These files are not intended to be used as shop drawings.

1.20 EXISTING CONDITIONS

A. Prior to bid, the Contractor shall visit the existing facility and become familiar with existing conditions. Contractor shall include in his bid price, allowances for work to be performed in the existing operational areas of the facility. All work in existing operational areas shall be coordinated and scheduled with the facility, and may have to be performed during non-normal working hours.

B. All existing ceilings and finishes removed for installation of work under this Contract shall be replaced or returned to "like new" condition.

C. Existing piping, conduit and ductwork are located in areas of construction under this Contract. Contractor shall relocate or modify any existing piping, conduit or ductwork. Shutdown of existing systems for relocation shall be coordinated with the facility.

D. Before any construction begins, it shall be the responsibility of the Contractor to investigate and coordinate proposed new ceiling heights with existing conditions and ceiling space requirements for new lighting fixtures, ductwork, sprinkler, plumbing, piping and conduit systems.

E. It shall be the Contractor's responsibility to adjust existing and new ductwork, sprinkler, plumbing, piping and conduit systems to accommodate the work in the ceiling height provided. Architect shall be notified before construction begins if any ceiling space is not adequate for the work shown.

END OF SECTION 26 01 00
SECTION 26 05 19
LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes the following:

1. Building wires and cables rated 600 V and less.
2. Connectors, splices, and terminations rated 600 V and less.

1.2 QUALITY ASSURANCE

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

B. Comply with NFPA 70.

PART 2 - PRODUCTS

2.1 CONDUCTORS AND CABLES

A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. Alcan Products Corporation; Alcan Cable Division.
3. General Cable Corporation.
4. Senator Wire & Cable Company.
5. Southwire Company.

B. Copper Conductors: Comply with NEMA WC 70.

C. Conductor Insulation: Comply with NEMA WC 70 for Types THHN-THWN and XHHW.

D. Multiconductor Cable: Comply with NEMA WC 70 for metal-clad cable, Type MC with ground wire.

2.2 CONNECTORS AND SPLICES

A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. AFC Cable Systems, Inc.
3. O-Z/Gedney; EGS Electrical Group LLC.
4. 3M; Electrical Products Division.
5. Tyco Electronics Corp.

B. Description: Factory-fabricated connectors and splices of size, ampacity rating, material, type, and class for application and service indicated.
PART 3 - EXECUTION

3.1 CONDUCTOR MATERIAL APPLICATIONS

A. Feeders: Copper. Solid for No. 10 AWG and smaller; stranded for No. 8 AWG and larger.

B. Branch Circuits: Copper. Solid for No. 10 AWG and smaller; stranded for No. 8 AWG and larger.

3.2 CONDUCTOR INSULATION AND MULTICONDUCTOR CABLE APPLICATIONS AND WIRING METHODS

A. Service Entrance: Type THHN-THWN, single conductors in raceway.

B. Feeders: Type THHN-THWN, single conductors in raceway.

C. Branch Circuits: Type THHN-THWN, single conductors in raceway.

D. Class 1 Control Circuits: Type THHN-THWN, in raceway.

E. Class 2 Control Circuits: Type THHN-THWN, in raceway, unless specified otherwise.

3.3 INSTALLATION OF CONDUCTORS AND CABLES

A. Conceal cables in finished walls, ceilings, and floors, unless otherwise indicated.

B. Use manufacturer-approved pulling compound or lubricant where necessary; compound used must not deteriorate conductor or insulation. Do not exceed manufacturer's recommended maximum pulling tensions and sidewall pressure values.

C. Use pulling means, including fish tape, cable, rope, and basket-weave wire/cable grips, that will not damage cables or raceway.

D. Install exposed cables parallel and perpendicular to surfaces of exposed structural members, and follow surface contours where possible.

E. Conductor sizes indicated on circuit homeruns or in schedules shall be installed over the entire length of the circuit, unless noted otherwise on the Drawings or in these Specifications.

F. Before installing raceways and pulling wire to any mechanical equipment, verify electrical characteristics with final submittal on equipment to assure proper number and AWG of conductors. (As for multiple speed motors, different motor starter arrangements, etc.).

G. Coordinate all wire sizes with lug sizes on equipment, devices, etc. Provide/install lugs as required to match wire size.

H. Where oversized conductors are called for (due to voltage drop, etc.) provide/install lugs as required to match conductors, or provide/install splice box, and splice to reduce conductor size to match lug size.
3.4 CONNECTIONS

A. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A and UL 486B.

B. Make splices and taps that are compatible with conductor material and that possess equivalent or better mechanical strength and insulation ratings than unspliced conductors.
   
   1. Use oxide inhibitor in each splice and tap conductor for aluminum conductors.

C. Where aluminum conductors are terminated, spliced or tapped, the connectors shall be color-coded, tool applied compression type made of aluminum with wire barrels factory prefilled with oxide inhibiting compound.

D. Connectors must pass UL Standard 486A-486B, bear markings AL7CU (75 degrees C) or AL97C (90 degrees C) for application, and have UL label.

E. Wiring at Outlets: Install conductor at each outlet, with at least 12 inches of slack.

3.5 SLEEVE AND SLEEVE-SEAL INSTALLATION FOR ELECTRICAL PENETRATIONS

A. Install sleeves and sleeve seals at penetrations of exterior floor and wall assemblies. Comply with requirements in Division 26 Section "Sleeves and Sleeve Seals for Electrical Raceways and Cabling."

3.6 FIRESTOPPING

A. Apply firestopping to electrical penetrations of fire-rated floor and wall assemblies to restore original fire-resistance rating of assembly.

3.7 FIELD QUALITY CONTROL

A. Perform tests and inspections and prepare test reports.

B. Tests and Inspections:

   1. After installing conductors and cables and before electrical circuitry has been energized, test service entrance and feeder conductors for compliance with requirements.


   3. Infrared Scanning: After Substantial Completion, but not more than 60 days after Final Acceptance, perform an infrared scan of each splice in cables and conductors No. 3 AWG and larger. Remove box and equipment covers so splices are accessible to portable scanner.

      a. Instrument: Use an infrared scanning device designed to measure temperature or to detect significant deviations from normal values.

C. Remove and replace malfunctioning units and retest as specified above.

END OF SECTION 26 05 19
SECTION 26 05 26
GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes: Grounding systems and equipment.

1.2 QUALITY ASSURANCE

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

B. Comply with UL 467 for grounding and bonding materials and equipment.

PART 2 - PRODUCTS

2.1 CONDUCTORS

A. Insulated Conductors: Copper wire or cable insulated for 600 V unless otherwise required by applicable Code or authorities having jurisdiction.

B. Bare Copper Conductors:
   2. Tinned Conductors: ASTM B 33.
   3. Bonding Conductor: Stranded conductor, minimum size per NEC.
   4. Bonding Jumper: Copper tape, braided conductors terminated with copper ferrules; 1-5/8 inches wide and 1/16 inch thick.

C. Grounding Bus: Predrilled rectangular bars of annealed copper, 1/4 by 4 inches.

2.2 CONNECTORS

A. Listed and labeled by an NRTL acceptable to authorities having jurisdiction for applications in which used and for specific types, sizes, and combinations of conductors and other items connected.

B. Bolted Connectors for Conductors and Pipes: Copper or copper alloy, pressure type with at least two bolts.
   1. Pipe Connectors: Clamp type, sized for pipe.

C. Welded Connectors: Exothermic-welding kits of types recommended by kit manufacturer for materials being joined and installation conditions.

D. Bus-bar Connectors: Mechanical type, cast silicon bronze, solderless compression-type wire terminals, and long-barrel, two-bolt connection to ground bus bar.

2.3 GROUNDING ELECTRODES

A. Ground Rods: Copper-clad steel, sectional type; 3/4 inch by 10 feet in length minimum, 20 feet in length where indicated.
PART 3 - EXECUTION

3.1 APPLICATIONS

A. Conductors: Install stranded conductors unless otherwise indicated.

B. Underground Grounding Conductors: Install bare copper conductor, No. 2/0 AWG minimum. Bury at least 24 inches below grade.

C. Grounding Bus: Install in electrical and telephone equipment rooms, in rooms housing service equipment, and elsewhere as indicated.
1. Install bus on insulated spacers 2 inches minimum from wall, 6 inches above finished floor unless otherwise indicated.
2. Where indicated on both sides of doorways, route bus up to top of door frame, across top of doorway, and down to specified height above floor; connect to horizontal bus.

D. Conductor Terminations and Connections:
1. Pipe and Equipment Grounding Conductor Terminations: Bolted connectors.
2. Underground Connections: Welded connectors except at test wells and as otherwise indicated.
3. Connections to Ground Rods at Test Wells: Bolted connectors.

3.2 GROUNDING UNDERGROUND DISTRIBUTION SYSTEM COMPONENTS

A. Comply with IEEE C2 grounding requirements.

B. Grounding Manholes and Handholes: Install a driven ground rod through manhole or handhole floor, close to wall, and set rod depth so 4 inches will extend above finished floor. If necessary, install ground rod before manhole is placed and provide No. 1/0 AWG bare, tinned-copper conductor from ground rod into manhole through a waterproof sleeve in manhole wall. Protect ground rods passing through concrete floor with a double wrapping of pressure-sensitive insulating tape or heat-shrunk insulating sleeve from 2 inches above to 6 inches below concrete. Seal floor opening with waterproof, nonshrink grout.

C. Grounding Connections to Manhole Components: Bond exposed-metal parts such as inserts, cable racks, pulling irons, ladders, and cable shields within each manhole or handhole, to ground rod or grounding conductor. Make connections with No. 4 AWG minimum, stranded, hard-drawn copper bonding conductor. Train conductors level or plumb around corners and fasten to manhole walls. Connect to cable armor and cable shields according to written instructions by manufacturer of splicing and termination kits.

D. Pad-Mounted Transformers and Switches: Install two ground rods and ground ring around the pad. Ground pad-mounted equipment and noncurrent-carrying metal items associated with substations by connecting them to underground cable and grounding electrodes. Install tinned-copper conductor not less than No. 2 AWG for ground ring and for taps to equipment grounding terminals. Bury ground ring not less than 6 inches from the foundation.

3.3 EQUIPMENT GROUNDING

A. Install insulated equipment grounding conductors with all feeders and branch circuits.
B. Install insulated equipment grounding conductors with the following items, in addition to those required by NFPA 70:

1. Feeders and branch circuits.
2. Lighting circuits.
3. Receptacle circuits.
5. Three-phase motor and appliance branch circuits.
6. Armored and metal-clad cable runs.
7. Busway Supply Circuits: Install insulated equipment grounding conductor from grounding bus in the switchgear, switchboard, or distribution panel to equipment grounding bar terminal on busway.

C. Air-Duct Equipment Circuits: Install insulated equipment grounding conductor to duct-mounted electrical devices operating at 120 V and more, including air cleaners, heaters, dampers, humidifiers, and other duct electrical equipment. Bond conductor to each unit and to air duct and connected metallic piping.

D. Water Heater, Heat-Tracing, and Antifrost Heating Cables: Install a separate insulated equipment grounding conductor to each electric water heater and heat-tracing cable. Bond conductor to heater units, piping, connected equipment, and components.

E. Isolated Equipment Enclosure Circuits: For designated equipment supplied by a branch circuit or feeder, isolate equipment enclosure from supply circuit raceway with a nonmetallic raceway fitting listed for the purpose. Install fitting where raceway enters enclosure, and install a separate insulated equipment grounding conductor. Isolate conductor from raceway and from panelboard grounding terminals. Terminate at equipment grounding conductor terminal of the applicable derived system or service unless otherwise indicated.

F. Signal and Communication Equipment: In addition to grounding and bonding required by NFPA 70, provide a separate grounding system complying with requirements in TIA/ATIS J-STD-607-A.

1. For telephone, alarm, voice and data, and other communication equipment, provide No. 6 AWG minimum insulated grounding conductor in raceway from grounding electrode system to each service location, terminal cabinet, wiring closet, and central equipment location.
2. Service and Central Equipment Locations and Wiring Closets: Terminate grounding conductor on a 1/4-by-4-by-12-inch grounding bus.
3. Terminal Cabinets: Terminate grounding conductor on cabinet grounding terminal.

G. Metal Poles Supporting Outdoor Lighting Fixtures: Install grounding electrode and a separate insulated equipment grounding conductor in addition to grounding conductor installed with branch-circuit conductors.

3.4 INSTALLATION

A. Grounding Conductors: Route along shortest and straightest paths possible unless otherwise indicated or required by Code. Avoid obstructing access or placing conductors where they may be subjected to strain, impact, or damage.
B. Ground Rods: Drive rods until tops are 2 inches below finished floor or final grade unless otherwise indicated.

   1. Interconnect ground rods with grounding electrode conductor below grade and as otherwise indicated. Make connections without exposing steel or damaging coating if any.
   2. For grounding electrode system, install at least three rods spaced at least one-rod length from each other and located at least the same distance from other grounding electrodes, and connect to the service grounding electrode conductor.

C. Test Wells: Ground rod driven through drilled hole in bottom of handhole. Handholes shall be at least 12 inches deep, with cover.

   1. Test Wells: Install at least one test well for each service unless otherwise indicated. Install at the ground rod electrically closest to service entrance. Set top of test well flush with finished grade or floor.

D. Bonding Straps and Jumpers: Install in locations accessible for inspection and maintenance except where routed through short lengths of conduit.

   1. Bonding to Structure: Bond straps directly to basic structure, taking care not to penetrate any adjacent parts.
   2. Bonding to Equipment Mounted on Vibration Isolation Hangers and Supports: Install bonding so vibration is not transmitted to rigidly mounted equipment.
   3. Use exothermic-welded connectors for outdoor locations; if a disconnect-type connection is required, use a bolted clamp.

E. Grounding and Bonding for Piping:

   1. Metal Water Service Pipe: Install insulated copper grounding conductors, in conduit, from building's main service equipment, or grounding bus, to main metal water service entrances to building. Connect grounding conductors to main metal water service pipes; use a bolted clamp connector or bolt a lug-type connector to a pipe flange by using one of the lug bolts of the flange. Where a dielectric main water fitting is installed, connect grounding conductor on street side of fitting. Bond metal grounding conductor conduit or sleeve to conductor at each end.
   2. Water Meter Piping: Use braided-type bonding jumpers to electrically bypass water meters. Connect to pipe with a bolted connector.
   3. Bond each aboveground portion of gas piping system downstream from equipment shutoff valve.

F. Bonding Interior Metal Ducts: Bond metal air ducts to equipment grounding conductors of associated fans, blowers, electric heaters, and air cleaners. Install tinned bonding jumper to bond across flexible duct connections to achieve continuity.

G. Grounding for Steel Building Structure: Install a driven ground rod at base of each corner column and at intermediate exterior columns at distances not more than 60 feet apart.

H. Ground Ring: Install a grounding conductor, electrically connected to each building structure ground rod and to each steel column, extending around the perimeter of building.

   1. Install tinned-copper conductor not less than No. 4/0 AWG for ground ring and for taps to building steel.
   2. Bury ground ring not less than 24 inches from building's foundation.

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I. Ufer Ground (Concrete-Encased Grounding Electrode): Fabricate according to NFPA 70; use a minimum of 20 feet of bare copper conductor not smaller than No. 4 AWG.

1. Bond grounding conductor to reinforcing steel in at least four locations and to anchor bolts. Extend grounding conductor below grade and connect to building’s grounding grid or to grounding electrode external to concrete.

3.5 FIELD QUALITY CONTROL

A. Perform the following tests and inspections and prepare test reports:

1. After installing grounding system but before permanent electrical circuits have been energized, test for compliance with requirements.
2. Test completed grounding system at each location where a maximum ground-resistance level is specified, at service disconnect enclosure grounding terminal, at ground test wells, and at individual ground rods. Make tests at ground rods before any conductors are connected.

   a. Measure ground resistance no fewer than two full days after last trace of precipitation and without soil being moistened by any means other than natural drainage or seepage and without chemical treatment or other artificial means of reducing natural ground resistance.
   b. Perform tests by fall-of-potential method according to IEEE 81.

B. Grounding system will be considered defective if it does not pass tests and inspections.

C. Prepare test and inspection reports.

D. Report measured ground resistances that exceeds 5 ohms.

END OF SECTION 26 05 26
SECTION 26 05 29
HANGERS AND SUPPORTS FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes the following:
   1. Hangers and supports for electrical equipment and systems.
   2. Construction requirements for concrete bases.

1.2 DEFINITIONS

A. EMT: Electrical metallic tubing.
B. IMC: Intermediate metal conduit.
C. RMC: Rigid metal conduit.

1.3 PERFORMANCE REQUIREMENTS

A. Design supports for multiple raceways capable of supporting combined weight of supported systems and its contents.
B. Design equipment supports capable of supporting combined operating weight of supported equipment and connected systems and components.
C. Rated Strength: Adequate in tension, shear, and pullout force to resist maximum loads calculated or imposed for this Project, with a minimum structural safety factor of five times the applied force.

1.4 QUALITY ASSURANCE

A. Welding: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."
B. Comply with NFPA 70.

1.5 COORDINATION

A. Coordinate size and location of concrete bases. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork requirements are specified together with concrete Specifications.
B. Coordinate installation of roof curbs, equipment supports, and roof penetrations.

PART 2 - PRODUCTS

2.1 SUPPORT, ANCHORAGE, AND ATTACHMENT COMPONENTS

A. Steel Slotted Support Systems: Comply with MFMA-4, factory-fabricated components for field assembly.
1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
   a. Allied Tube & Conduit.
   b. Cooper B-Line, Inc.; a division of Cooper Industries.
   c. ERICO International Corporation.
   d. GS Metals Corp.
   e. Thomas & Betts Corporation.
   f. Unistrut; Tyco International, Ltd.
   g. Wesanco, Inc.

2. Metallic Coatings: Hot-dip galvanized after fabrication and applied according to MFMA-4.
3. Nonmetallic Coatings: Manufacturer's standard PVC, polyurethane, or polyester coating applied according to MFMA-4.
4. Painted Coatings: Manufacturer's standard painted coating applied according to MFMA-4.
5. Channel Dimensions: Selected for applicable load criteria.

B. Raceway and Cable Supports: As described in NECA 1 and NECA 101.

C. Conduit and Cable Support Devices: Steel and malleable-iron hangers, clamps, and associated fittings, designed for types and sizes of raceway or cable to be supported.

D. Support for Conductors in Vertical Conduit: Factory-fabricated assembly consisting of threaded body and insulating wedging plug or plugs for non-armored electrical conductors or cables in riser conduits. Plugs shall have number, size, and shape of conductor gripping pieces as required to suit individual conductors or cables supported. Body shall be malleable iron.

E. Structural Steel for Fabricated Supports and Restraints: ASTM A 36/A 36M, steel plates, shapes, and bars; black and galvanized.

F. Mounting, Anchoring, and Attachment Components: Items for fastening electrical items or their supports to building surfaces include the following:

1. Mechanical-Expansion Anchors: Insert-wedge-type, stainless steel, for use in hardened portland cement concrete with tension, shear, and pullout capacities appropriate for supported loads and building materials in which used.
   a. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
      1) Cooper B-Line, Inc.; a division of Cooper Industries.
      2) Empire Tool and Manufacturing Co., Inc.
      3) Hilti Inc.
      4) ITW Ramset/Red Head; a division of Illinois Tool Works, Inc.
      5) MKT Fastening, LLC.

2. Concrete Inserts: Steel or malleable-iron, slotted support system units similar to MSS Type 18; complying with MFMA-4 or MSS SP-58.
3. Clamps for Attachment to Steel Structural Elements: MSS SP-58, type suitable for attached structural element.
4. Through Bolts: Structural type, hex head, and high strength. Comply with ASTM A 325.
5. Toggle Bolts: All-steel springhead type.

2.2 FABRICATED METAL EQUIPMENT SUPPORT ASSEMBLIES

A. Description: Welded or bolted, structural-steel shapes, shop or field fabricated to fit dimensions of supported equipment.

PART 3 - EXECUTION

3.1 APPLICATION

A. Comply with NECA 1 and NECA 101 for application of hangers and supports for electrical equipment and systems except if requirements in this Section are stricter.

B. Maximum Support Spacing and Minimum Hanger Rod Size for Raceway: Space supports for EMT, IMC, and RMC as required by NFPA 70. Minimum rod size shall be 1/4 inch in diameter.

C. Multiple Raceways or Cables: Install trapeze-type supports fabricated with steel slotted support system, sized so capacity can be increased by at least 25 percent in future without exceeding specified design load limits.

   1. Secure raceways and cables to these supports with single-bolt conduit clamps using spring friction action for retention in support channel.

D. Spring-steel clamps designed for supporting single conduits without bolts may be used for 1-1/2-inch and smaller raceways serving branch circuits and communication systems above suspended ceilings and for fastening raceways to trapeze supports.

3.2 SUPPORT INSTALLATION

A. Comply with NECA 1 and NECA 101 for installation requirements except as specified in this Article.

B. Raceway Support Methods: In addition to methods described in NECA 1, EMT, IMC, and RMC may be supported by openings through structure members, as permitted in NFPA 70.

C. Strength of Support Assemblies: Where not indicated, select sizes of components so strength will be adequate to carry present and future static loads within specified loading limits. Minimum static design load used for strength determination shall be weight of supported components plus 200 lb.

D. Mounting and Anchorage of Surface-Mounted Equipment and Components: Anchor and fasten electrical items and their supports to building structural elements by the following methods unless otherwise indicated by code:

   1. To Wood: Fasten with lag screws or through bolts.
   2. To New Concrete: Bolt to concrete inserts.
   3. To Masonry: Approved toggle-type bolts on hollow masonry units and expansion anchor fasteners on solid masonry units.
   4. To Existing Concrete: Expansion anchor fasteners.
   5. Instead of expansion anchors, powder-actuated driven threaded studs provided with lock washers and nuts may be used in existing standard-weight concrete 4 inches thick or greater. Do not use for anchorage to lightweight-aggregate concrete or for slabs less than 4 inches thick.
6. To Steel: Welded threaded studs complying with AWS D1.1/D1.1M, with lock washers and nuts, beam clamps (MSS Type 19, 21, 23, 25, or 27) complying with MSS SP-69, spring-tension clamps.

7. To Light Steel: Sheet metal screws.

8. Items Mounted on Hollow Walls and Nonstructural Building Surfaces: Mount cabinets, panelboards, disconnect switches, control enclosures, pull and junction boxes, transformers, and other devices on slotted-channel racks attached to substrate by means that meet seismic-restraint strength and anchorage requirements.

E. Drill holes for expansion anchors in concrete at locations and to depths that avoid reinforcing bars.

3.3 INSTALLATION OF FABRICATED METAL SUPPORTS

A. Cut, fit, and place miscellaneous metal supports accurately in location, alignment, and elevation to support and anchor electrical materials and equipment.

B. Field Welding: Comply with AWS D1.1/D1.1M.

3.4 CONCRETE BASES

A. Construct concrete bases of dimensions indicated but not less than 4 inches larger in both directions than supported unit, and so anchors will be a minimum of 10 bolt diameters from edge of the base.

B. Use 3000-psi 28-day compressive-strength concrete.

C. Anchor equipment to concrete base.

1. Place and secure anchorage devices. Use supported equipment manufacturer’s setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.

2. Install anchor bolts to elevations required for proper attachment to supported equipment.

3. Install anchor bolts according to anchor-bolt manufacturer’s written instructions.

3.5 PAINTING

A. Touchup: Clean field welds and abraded areas of shop paint. Paint exposed areas immediately after erecting hangers and supports. Use same materials as used for shop painting. Comply with SSPC-PA 1 requirements for touching up field-painted surfaces.

1. Apply paint by brush or spray to provide minimum dry film thickness of 2.0 mils.

B. Galvanized Surfaces: Clean welds, bolted connections, and abraded areas and apply galvanizing-repair paint to comply with ASTM A 780.

END OF SECTION 26 05 29
SECTION 26 05 33
RACEWAYS AND BOXES FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Metal conduits, tubing, and fittings.
2. Nonmetal conduits, tubing, and fittings.
3. Surface raceways.
5. Handholes and boxes for exterior underground cabling.

1.2 DEFINITIONS

A. EMT: Electrical Metallic Tubing.
B. ENT: Electrical Nonmetallic Tubing.
C. FMC: Flexible Metal Conduit.
D. GRC: Galvanized Rigid (steel) Conduit.
E. IMC: Intermediate Metal Conduit.
F. LFMC: Liquidtight Flexible Metal Conduit.
G. RNC: Rigid Nonmetallic Conduit.

1.3 QUALITY ASSURANCE

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

B. Comply with NFPA 70.

PART 2 - PRODUCTS

2.1 METAL CONDUITS, TUBING, AND FITTINGS

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. AFC Cable Systems, Inc.
3. Anamet Electrical, Inc.
4. Electri-Flex Company.
5. O-Z/Gedney; a brand of EGS Electrical Group.
7. Thomas & Betts Corporation.
8. Wheatland Tube Company.
B. Listing and Labeling: Metal conduits, tubing, and fittings shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

C. GRC: Comply with ANSI C80.1 and UL 6.

D. IMC: Comply with ANSI C80.6 and UL 1242.

E. PVC-Coated Steel Conduit: PVC-coated rigid steel conduit.
   1. Comply with NEMA RN 1.
   2. Coating Thickness: 0.040 inch, minimum.

F. EMT: Comply with ANSI C80.3 and UL 797.

G. FMC: Comply with UL 1; zinc-coated steel.

H. LFMC: Flexible steel conduit with PVC jacket and complying with UL 360.

I. Fittings for Metal Conduit: Comply with NEMA FB 1 and UL 514B.
   1. Fittings for EMT:
      a. Material: Steel.
      b. Type: Set-screw or compression.
   2. Expansion Fittings: PVC or steel to match conduit type, complying with UL 651, rated for environmental conditions where installed, and including flexible external bonding jumper.
   3. Coating for Fittings for PVC-Coated Conduit: Minimum thickness of 0.040 inch, with overlapping sleeves protecting threaded joints.
   4. All metallic fittings shall be furnished with zinc-coating, or other approved application.

J. Joint Compound for IMC or GRC: Approved, as defined in NFPA 70, by authorities having jurisdiction for use in conduit assemblies, and compounded for use to lubricate and protect threaded conduit joints from corrosion and to enhance their conductivity.

2.2 NONMETALLIC CONDUITS, TUBING, AND FITTINGS

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. AFC Cable Systems, Inc.
   2. Anamet Electrical, Inc.
   3. Arnco Corporation.
   4. CANTEX Inc.
   5. Carlon Corp.
   7. Electri-Flex Company.
   8. Lamson & Sessions; Carlon Electrical Products.
   9. RACO; a Hubbell company.
   10. Thomas & Betts Corporation.

B. Listing and Labeling: Nonmetallic conduits, tubing, and fittings shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
C. ENT: Comply with NEMA TC 13 and UL 1653.

D. RNC: Type EPC-40-PVC, complying with NEMA TC 2 and UL 651 unless otherwise indicated.

E. LFNC: Comply with UL 1660.

F. Fittings for ENT and RNC: Comply with NEMA TC 3; match to conduit or tubing type and material.

G. Fittings for LFNC: Comply with UL 514B.

### 2.3 BOXES, ENCLOSURES, AND CABINETS

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. Cooper Technologies Company; Cooper Crouse-Hinds.
2. Hoffman; a Pentair company.
3. Hubbell Incorporated; Killark Division.
5. RACO; a Hubbell Company.
6. Robroy Industries.
7. Thomas & Betts Corporation.
8. Wiremold / Legrand.

B. General Requirements for Boxes, Enclosures, and Cabinets: Boxes, enclosures, and cabinets installed in wet locations shall be listed for use in wet locations. Stamped steel boxes shall not be used in exposed areas.

C. Sheet Metal Outlet and Device Boxes: Comply with NEMA OS 1 and UL 514A.

D. Cast-Metal Outlet and Device Boxes: Comply with NEMA FB 1, ferrous alloy, Type FD, with gasketed cover.

E. Nonmetallic Outlet and Device Boxes: Comply with NEMA OS 2 and UL 514C.

F. Metal Floor Boxes:

   1. Material: Cast metal or sheet metal.
   2. Type: Fully adjustable.
   3. Shape: Rectangular.
   4. Listing and Labeling: Metal floor boxes shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

G. Small Sheet Metal Pull and Junction Boxes: NEMA OS 1.

H. Cast-Metal Access, Pull, and Junction Boxes: Comply with NEMA FB 1 and UL 1773, cast aluminum with gasketed cover.

I. Hinged-Cover Enclosures: Comply with UL 50 and NEMA 250, Type 1 with continuous-hinge cover with flush latch unless otherwise indicated.

   1. Metal Enclosures: Steel, finished inside and out with manufacturer's standard enamel.
J. Cabinets:

1. NEMA 250, Type 1 galvanized-steel box with removable interior panel and removable front, finished inside and out with manufacturer's standard enamel.
2. Hinged door in front cover with flush latch and concealed hinge.
3. Key latch to match panelboards.
4. Metal barriers to separate wiring of different systems and voltage.
5. Accessory feet where required for freestanding equipment.

2.4 HANDHOLES AND BOXES FOR EXTERIOR UNDERGROUND WIRING

A. General Requirements for Handholes and Boxes:

1. Boxes and handholes for use in underground systems shall be designed and identified as defined in NFPA 70, for intended location and application.
2. Boxes installed in wet areas shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

B. Polymer-Concrete Handholes and Boxes with Polymer-Concrete Cover: Molded of sand and aggregate, bound together with polymer resin, and reinforced with steel, fiberglass, or a combination of the two.

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. Quazite.
   b. Armorcast Products Company.
   c. Carson Industries LLC.
   e. NewBasis.
   f. Oldcastle Precast, Inc.; Christy Concrete Products.

2. Cover: Weatherproof, secured by tamper-resistant locking devices and having structural load rating consistent with enclosure and handhole location.
3. Cover Finish: Nonskid finish shall have a minimum coefficient of friction of 0.50.
4. Cover Legend: Molded lettering, "ELECTRIC."

PART 3 - EXECUTION

3.1 RACEWAY APPLICATION

A. Outdoors: Apply raceway products as specified below unless otherwise indicated:

1. Exposed Conduit: EMT.
2. Concealed Conduit, Aboveground: Rigid steel conduit, GRC, IMC.
3. Underground Conduit: RNC, Type EPC-40-PVC.
4. Connection to Vibrating Equipment (Including Transformers and Hydraulic, Pneumatic, Electric Solenoid, or Motor-Driven Equipment): LFMC.
5. Boxes and Enclosures, Aboveground: NEMA 250, Type 3R.
6. Application of Handholes and Boxes for Underground Wiring:
   a. Handholes and Pull Boxes in Driveway, Parking Lot, and Off-Roadway Locations, Subject to Occasional, Nondeliberate Loading by Heavy Vehicles: Polymer
concrete or Fiberglass-reinforced polyester resin, SCTE 77, Tier 15 structural load rating.

b. Handholes and Pull Boxes in Sidewalk and Similar Applications with a Safety Factor for Nondeliberate Loading by Vehicles: Polymer-concrete units, SCTE 77, Tier 8 structural load rating.

c. Handholes and Pull Boxes Subject to Light-Duty Pedestrian Traffic Only: Fiberglass-reinforced polyester resin, structurally tested according to SCTE 77 with 3000-lbf vertical loading.

B. Indoors: Apply raceway products as specified below unless otherwise indicated:

1. Exposed, Not Subject to Physical Damage: EMT.
2. Exposed and Subject to Severe Physical Damage: Rigid steel conduit. Raceway locations include the following:
   a. Loading dock.
   b. Corridors used for traffic of mechanized carts, forklifts, and pallet-handling units.
   c. Mechanical rooms.

3. Concealed in Ceilings and Interior Walls and Partitions: EMT.
4. Connection to Vibrating Equipment (Including Transformers and Hydraulic, Pneumatic, Electric Solenoid, or Motor-Driven Equipment): FMC, except use LFMC in damp or wet locations.
5. Damp or Wet Locations: Rigid steel conduit
6. Raceways for Optical-Fiber or Communications Cable in Spaces Used for Environmental Air: EMT.
7. Raceways for Optical-Fiber or Communications-Cable Risers in Vertical Shafts: EMT.
8. Raceways for Concealed General-Purpose Distribution of Optical-Fiber or Communications Cable: General-use, optical-fiber/communications-cable raceway or EMT.
9. Boxes and Enclosures: NEMA 250, Type 1, except use NEMA 250, Type 3R stainless steel in damp or wet locations.

C. Minimum Raceway Size: 3/4 inch trade size.

D. Raceway Fittings: Compatible with raceways and suitable for use and location.

1. Rigid and Intermediate Steel Conduit: Use threaded rigid steel conduit fittings unless otherwise indicated. Comply with NEMA FB 2.10.
2. PVC Externally Coated, Rigid Steel Conduits: Use only fittings listed for use with this type of conduit. Patch and seal all joints, nicks, and scrapes in PVC coating after installing conduits and fittings. Use sealant recommended by fitting manufacturer and apply in thickness and number of coats recommended by manufacturer.
3. EMT: Use setscrew or compression, steel fittings. Comply with NEMA FB 2.10.
4. Flexible Conduit: Use only fittings listed for use with flexible conduit. Comply with NEMA FB 2.20.

3.2 INSTALLATION

A. Comply with NECA 1 and NECA 101 for installation requirements except where requirements on Drawings or in this article are stricter.

B. Keep raceways at least 6 inches away from parallel runs of flues and steam or hot-water pipes. Install horizontal raceway runs above water and steam piping.
C. Complete raceway installation before starting conductor installation.

D. Arrange stub-ups so curved portions of bends are not visible above finished slab.

E. Install no more than the equivalent of three 90-degree bends in any conduit run except for control wiring conduits, for which fewer bends are allowed. Support within 12 inches of changes in direction.

F. Conceal conduit and EMT within finished walls, ceilings, and floors unless otherwise indicated. Install conduits parallel or perpendicular to building lines.

G. Support conduit within 12 inches of enclosures to which attached.

H. Raceways Embedded in Slabs:
   1. Run conduit larger than 1-inch trade size, parallel or at right angles to main reinforcement. Where at right angles to reinforcement, place conduit close to slab support. Secure raceways to reinforcement at maximum 10-foot intervals.
   2. Arrange raceways to cross building expansion joints at right angles with expansion fittings.
   3. Change from EMT to GRC before rising above floor. Conduit shall be GRC for a minimum of 6 inches above penetration.
   4. Protect conduit from corrosion at penetration through slab with PVC coating, bituminous mastic, or taping (2 inch wide minimum Scotchwrap No. 50 with 50% overlay.)

I. Stub-ups to Above Recessed Ceilings:
   1. Use EMT, IMC, or RMC for raceways.
   2. Use a conduit bushing or insulated fitting to terminate stub-ups not terminated in hubs or in an enclosure.

J. Threaded Conduit Joints, Exposed to Wet, Damp, Corrosive, or Outdoor Conditions: Apply listed compound to threads of raceway and fittings before making up joints. Follow compound manufacturer's written instructions.

K. Raceway Terminations at Locations Subject to Moisture or Vibration: Use insulating bushings to protect conductors including conductors smaller than No. 4 AWG.

L. Terminate threaded conduits into threaded hubs or with locknuts on inside and outside of boxes or cabinets. Install bushings on conduits up to 1-1/4-inch trade size and insulated throat metal bushings on 1-1/2-inch trade size and larger conduits terminated with locknuts. Install insulated throat metal grounding bushings on service conduits.

M. Install raceways square to the enclosure and terminate at enclosures with locknuts. Install locknuts hand tight plus 1/4 turn more.

N. Install pull wires in empty raceways. Use polypropylene or monofilament plastic line with not less than 200-lb tensile strength. Leave at least 12 inches of slack at each end of pull wire. Cap underground raceways designated as spare above grade alongside raceways in use.

O. Pathways for Optical-Fiber and Communications Cable: Install pathways, metal and nonmetallic, rigid and flexible, as follows:
   1. 3/4-Inch Trade Size and Smaller: Install pathways in maximum lengths of 50 feet.
2. 1-Inch Trade Size and Larger: Install pathways in maximum lengths of 75 feet.
3. Install with a maximum of two 90-degree bends or equivalent for each length of pathway unless Drawings show stricter requirements. Separate lengths with pull or junction boxes or terminations at distribution frames or cabinets where necessary to comply with these requirements.

P. Install raceway sealing fittings at accessible locations according to NFPA 70 and fill them with listed sealing compound. For concealed raceways, install each fitting in a flush steel box with a blank cover plate having a finish similar to that of adjacent plates or surfaces. Install raceway sealing fittings according to NFPA 70.

Q. Install devices to seal raceway interiors at accessible locations. Locate seals so no fittings or boxes are between the seal and the following changes of environments. Seal the interior of all raceways at the following points:

1. Where conduits pass from warm to cold locations, such as boundaries of refrigerated spaces.
2. Where an underground service raceway enters a building or structure.
3. Where otherwise required by NFPA 70.

R. Comply with manufacturer's written instructions for solvent welding RNC and fittings.

S. Expansion-Joint Fittings:

1. Install in each run of aboveground conduit that is located where environmental temperature change may exceed 30 deg F and that has straight-run length that exceeds 25 feet.
2. Install type and quantity of fittings that accommodate temperature change listed for each of the following locations:
   a. Outdoor Locations Not Exposed to Direct Sunlight: 125 deg F temperature change.
   b. Outdoor Locations Exposed to Direct Sunlight: 155 deg F temperature change.
   c. Indoor Spaces Connected with Outdoors without Physical Separation: 125 deg F temperature change.
   d. Attics: 135 deg F temperature change.

3. Install fitting(s) that provide expansion and contraction for at least 0.00041 inch per foot of length of straight run per deg F of temperature change.
4. Install expansion fittings at all locations where conduits cross building or structure expansion joints.
5. Install each expansion-joint fitting with position, mounting, and piston setting selected according to manufacturer's written instructions for conditions at specific location at time of installation.

T. Flexible Conduit Connections: Use a maximum of 72 inches of flexible conduit for recessed and semirecessed luminaires, equipment subject to vibration, noise transmission, or movement; and for transformers and motors.

1. Use LFMC in damp or wet locations.

U. Recessed Boxes in Masonry Walls: Saw-cut opening for box in center of cell of masonry block, and install box flush with surface of wall.
V. Fasten junction and pull boxes to or support from building structure. Do not support boxes by conduits.

W. Set metal floor boxes level and flush with finished floor surface.

3.3 INSTALLATION OF UNDERGROUND CONDUIT

A. Direct-Buried Conduit:

1. Excavate trench bottom to provide firm and uniform support for conduit.
2. Install backfill.
3. After installing conduit, backfill and compact. Start at tie-in point, and work toward end of conduit run, leaving conduit at end of run free to move with expansion and contraction as temperature changes during this process. Firmly hand tamp backfill around conduit to provide maximum supporting strength. After placing controlled backfill to within 12 inches of finished grade, make final conduit connection at end of run and complete backfilling with normal compaction.
4. Install manufactured duct elbows for stub-ups at poles and equipment and at building entrances through floor unless otherwise indicated. Encase elbows for stub-up ducts throughout length of elbow.
5. Install manufactured rigid steel conduit elbows for stub-ups at poles and equipment and at building entrances through floor.

a. Couple steel conduits to ducts with adapters designed for this purpose, and encase coupling with 3 inches of concrete for a minimum of 12 inches on each side of the coupling.
   b. For stub-ups at equipment mounted on outdoor concrete bases and where conduits penetrate building foundations, extend steel conduit horizontally a minimum of 60 inches from edge of foundation or equipment base. Install insulated grounding bushings on terminations at equipment.

6. Warning Planks: Bury warning planks approximately 12 inches above direct-buried conduits but a minimum of 6 inches below grade. Align planks along centerline of conduit.
7. Underground Warning Tape: Comply with requirements in Section 26 05 53 “Identification for Electrical Systems.”

3.4 INSTALLATION OF UNDERGROUND HANDHOLES AND BOXES

A. Install handholes and boxes level and plumb and with orientation and depth coordinated with connecting conduits to minimize bends and deflections required for proper entrances.

B. Unless otherwise indicated, support units on a level bed of crushed stone or gravel, graded from 1/2-inch sieve to No. 4 sieve and compacted to same density as adjacent undisturbed earth.

C. Elevation: In paved areas, set so cover surface will be flush with finished grade. Set covers of other enclosures 1 inch above finished grade.

D. Install removable hardware, including pulling eyes, cable stanchions, cable arms, and insulators, as required for installation and support of cables and conductors and as indicated. Select arm lengths to be long enough to provide spare space for future cables but short enough to preserve adequate working clearances in enclosure.
E. Field-cut openings for conduits according to enclosure manufacturer’s written instructions. Cut wall of enclosure with a tool designed for material to be cut. Size holes for terminating fittings to be used, and seal around penetrations after fittings are installed.

3.5 FIRESTOPPING

A. Install firestopping at penetrations of fire-rated floor and wall assemblies.

3.6 PROTECTION

A. Protect coatings, finishes, and cabinets from damage and deterioration.

1. Repair damage to galvanized finishes with zinc-rich paint recommended by manufacturer.
2. Repair damage to PVC coatings or paint finishes with matching touchup coating recommended by manufacturer.

END OF SECTION 26 05 33
SECTION 26 05 44
SLEEVES AND SLEEVE SEALS FOR ELECTRICAL RACEWAYS AND CABLEING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Sleeves for raceway and cable penetration of non-fire-rated construction walls and floors.
   2. Sleeve-seal systems.
   5. Silicone sealants.

PART 2 - PRODUCTS

2.1 SLEEVES

A. Wall Sleeves:
   2. Cast-Iron Pipe Sleeves: Cast or fabricated "wall pipe," equivalent to ductile-iron pressure pipe, with plain ends and integral waterstop unless otherwise indicated.

B. Sleeves for Conduits Penetrating Non-Fire-Rated Gypsum Board Assemblies: Galvanized-steel sheet; 0.0239-inch minimum thickness; round tube closed with welded longitudinal joint, with tabs for screw-fastening the sleeve to the board.

C. PVC-Pipe Sleeves: ASTM D 1785, Schedule 40.

D. Molded-PVC Sleeves: With nailing flange for attaching to wooden forms.

E. Molded-PE or -PP Sleeves: Removable, tapered-cup shaped, and smooth outer surface with nailing flange for attaching to wooden forms.

F. Sleeves for Rectangular Openings:
   2. Minimum Metal Thickness:
      a. For sleeve cross-section rectangle perimeter less than 50 inches and with no side larger than 16 inches, thickness shall be 0.052 inch.
      b. For sleeve cross-section rectangle perimeter 50 inches or more and one or more sides larger than 16 inches, thickness shall be 0.138 inch.

2.2 SLEEVE-SEAL SYSTEMS

A. Description: Modular sealing device, designed for field assembly, to fill annular space between sleeve and raceway or cable.
1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
   a. Advance Products & Systems, Inc.
   b. CALPICO, Inc.
   c. Metraflex Company (The).
   d. Pipeline Seal and Insulator, Inc.
   e. Proco Products, Inc.

2. Sealing Elements: EPDM rubber interlocking links shaped to fit surface of pipe. Include type and number required for pipe material and size of pipe.
3. Pressure Plates: Carbon steel.
4. Connecting Bolts and Nuts: Carbon steel, with corrosion-resistant coating of length required to secure pressure plates to sealing elements.

2.3 GROUT
   A. Description: Nonshrink; recommended for interior and exterior sealing openings in non-fire-rated walls or floors.
   C. Design Mix: 5000-psi, 28-day compressive strength.
   D. Packaging: Premixed and factory packaged.

2.4 SILICONE SEALANTS
   A. Silicone Sealants: Single-component, silicone-based, neutral-curing elastomeric sealants of grade indicated below.
      1. Grade: Pourable (self-leveling) formulation for openings in floors and other horizontal surfaces that are not fire rated.
   B. Silicone Foams: Multicomponent, silicone-based liquid elastomers that, when mixed, expand and cure in place to produce a flexible, nonshrinking foam.

2.5 FIRE RATED RACEWAY AND CABLE PenetRATION
   A. System used for penetrations shall be NRTL listed as suitable for the purpose and shall maintain the original fire rating of the penetrated floor, wall, etc.

PART 3 - EXECUTION

3.1 SLEEVE INSTALLATION FOR NON-FIRE-RATED ELECTRICAL PENETRATIONS
   A. Comply with NECA 1.
   B. Comply with NEMA VE 2 for cable tray and cable penetrations.
   C. Sleeves for Conduits Penetrating Above-Grade Non-Fire-Rated Concrete and Masonry-Unit Floors and Walls:
1. Interior Penetrations of Non-Fire-Rated Walls and Floors:
   a. Seal annular space between sleeve and raceway or cable, using joint sealant appropriate for size, depth, and location of joint. Comply with requirements in Section 07 92 00 “Joint Sealants.”
   b. Seal space outside of sleeves with mortar or grout. Pack sealing material solidly between sleeve and wall so no voids remain. Tool exposed surfaces smooth; protect material while curing.

2. Use pipe sleeves unless penetration arrangement requires rectangular sleeved opening.
3. Size pipe sleeves to provide 1/4-inch annular clear space between sleeve and raceway or cable unless sleeve seal is to be installed.
4. Install sleeves for wall penetrations unless core-drilled holes or formed openings are used. Install sleeves during erection of walls. Cut sleeves to length for mounting flush with both surfaces of walls. Deburr after cutting.

D. Sleeves for Conduits Penetrating Non-Fire-Rated Gypsum Board Assemblies:
   1. Use circular metal sleeves unless penetration arrangement requires rectangular sleeved opening.
   2. Seal space outside of sleeves with approved joint compound for gypsum board assemblies.

E. Roof-Penetration Sleeves: Seal penetration of individual raceways and cables with flexible boot-type flashing units applied in coordination with roofing work. Roof penetrations shall be avoided if at all possible.

F. Aboveground, Exterior-Wall Penetrations: Seal penetrations using steel pipe sleeves and mechanical sleeve seals. Select sleeve size to allow for 1-inch annular clear space between pipe and sleeve for installing mechanical sleeve seals.

G. Underground, Exterior-Wall and Floor Penetrations: Install cast-iron pipe sleeves. Size sleeves to allow for 1-inch annular clear space between raceway or cable and sleeve for installing sleeve-seal system.

3.2 SLEEVE-SEAL-SYSTEM INSTALLATION

A. Install sleeve-seal systems in sleeves in exterior concrete walls and slabs-on-grade at raceway entries into building.

B. Install type and number of sealing elements recommended by manufacturer for raceway or cable material and size. Position raceway or cable in center of sleeve. Assemble mechanical sleeve seals and install in annular space between raceway or cable and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.

3.3 SLEEVE-SEAL-FITTING INSTALLATION

A. Install sleeve-seal fittings in new walls and slabs as they are constructed.

B. Assemble fitting components of length to be flush with both surfaces of concrete slabs and walls. Position waterstop flange to be centered in concrete slab or wall.

C. Secure nailing flanges to concrete forms.
D. Using grout, seal the space around outside of sleeve-seal fittings.

END OF SECTION 26 05 44
PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Identification for raceways.
2. Identification of power and control cables.
3. Identification for conductors.
5. Warning labels and signs.
6. Instruction signs.
7. Equipment identification labels.
8. Miscellaneous identification products.

1.2 QUALITY ASSURANCE

A. Comply with ANSI A13.1
B. Comply with NFPA 70.
D. Comply with ANSI Z535.4 for safety signs and labels.
E. Adhesive-attached labeling materials, including label stocks, laminating adhesives, and inks used by label printers, shall comply with UL 969.

1.3 COORDINATION

A. Coordinate identification names, abbreviations, colors, and other features with requirements in other Sections requiring identification applications, Drawings, Shop Drawings, manufacturer’s wiring diagrams, and the Operation and Maintenance Manual; and with those required by codes, standards, and 29 CFR 1910.145. Use consistent designations throughout Project.
B. Coordinate installation of identifying devices with completion of covering and painting of surfaces where devices are to be applied.
C. Coordinate installation of identifying devices with location of access panels and doors.
D. Install identifying devices before installing acoustical ceilings and similar concealment.

PART 2 - PRODUCTS

2.1 POWER RACEWAY IDENTIFICATION MATERIALS

A. Comply with ANSI A13.1 for minimum size of letters for legend and for minimum length of color field for each raceway size.
B. Colors for Raceways Carrying Circuits at 600 V or Less:
1. Black letters on an orange field
2. Legend: Indicate voltage.

C. Self-Adhesive Vinyl Labels for Raceways Carrying Circuits at 600 V or Less: Preprinted, flexible label laminated with a clear, weather- and chemical-resistant coating and matching wraparound adhesive tape for securing ends of legend label.

D. Snap-Around, Color-Coding Bands for Raceways Carrying Circuits at 600 V or Less: Slit, pretensioned, flexible, solid-colored acrylic sleeve, 2 inches long, with diameter sized to suit diameter of raceway or cable it identifies and to stay in place by gripping action.

2.2 ARMORED AND METAL-CLAD CABLE IDENTIFICATION MATERIALS

A. Comply with ANSI A13.1 for minimum size of letters for legend and for minimum length of color field for each raceway and cable size.

B. Colors for Raceways Carrying Circuits at 600 V and Less:
   1. Black letters on an orange field.
   2. Legend: Indicate voltage.

C. Self-Adhesive Vinyl Labels: Preprinted, flexible label laminated with a clear, weather- and chemical-resistant coating and matching wraparound adhesive tape for securing ends of legend label.

2.3 POWER AND CONTROL CABLE IDENTIFICATION MATERIALS

A. Comply with ANSI A13.1 for minimum size of letters for legend and for minimum length of color field for each raceway and cable size.

B. Self-Adhesive Vinyl Labels: Preprinted, flexible label laminated with a clear, weather- and chemical-resistant coating and matching wraparound adhesive tape for securing ends of legend label.

C. Snap-Around Labels: Slit, pretensioned, flexible, preprinted, color-coded acrylic sleeve, with diameter sized to suit diameter of raceway or cable it identifies and to stay in place by gripping action.

2.4 CONDUCTOR IDENTIFICATION MATERIALS

A. Color-Coding Conductor Tape: Colored, self-adhesive vinyl tape not less than 3 mils thick by 1 to 2 inches wide.

B. Marker Tapes: Vinyl or vinyl-cloth, self-adhesive wraparound type, with circuit identification legend machine printed by thermal transfer or equivalent process.

C. Single Conductor Control Wires: Identify with pre-printed sleeve type heat-shrink marker, with wire number, at each termination.

2.5 UNDERGROUND-LINE WARNING TAPE

A. Tape:
1. Recommended by manufacturer for the method of installation and suitable to identify and locate underground electrical and communications utility lines.
2. Printing on tape shall be permanent and shall not be damaged by burial operations.
3. Tape material and ink shall be chemically inert, and not subject to degrading when exposed to acids, alkalis, and other destructive substances commonly found in soils.

B. Color and Printing:

1. Comply with ANSI Z535.1 through ANSI Z535.5.
2. Inscriptions for Red-Colored Tapes: ELECTRIC LINE, HIGH VOLTAGE.
3. Inscriptions for Orange-Colored Tapes: TELEPHONE CABLE, CATV CABLE, COMMUNICATIONS CABLE, OPTICAL FIBER CABLE.

2.6 WARNING LABELS AND SIGNS


B. Self-Adhesive Warning Labels: Factory-printed, multicolor, pressure-sensitive adhesive labels, configured for display on front cover, door, or other access to equipment unless otherwise indicated.

C. Baked-Enamel Warning Signs:

1. Preprinted aluminum signs, punched or drilled for fasteners, with colors, legend, and size required for application.
2. 1/4-inch grommets in corners for mounting.
3. Nominal size, 7 by 10 inches.

D. Metal-Backed, Butyrate Warning Signs:

1. Weather-resistant, nonfading, preprinted, cellulose-acetate butyrate signs with 0.0396-inch galvanized-steel backing; and with colors, legend, and size required for application.
2. 1/4-inch grommets in corners for mounting.
3. Nominal size, 10 by 14 inches.

E. Warning label and sign shall include, but are not limited to, the following example legends:

1. Multiple Power Source Warning: "DANGER - ELECTRICAL SHOCK HAZARD - EQUIPMENT HAS MULTIPLE POWER SOURCES."
2. Workspace Clearance Warning: "WARNING - OSHA REGULATION - AREA IN FRONT OF ELECTRICAL EQUIPMENT MUST BE KEPT CLEAR FOR 36 INCHES."

2.7 INSTRUCTION SIGNS

A. Engraved, laminated acrylic or melamine plastic, minimum 1/16 inch thick for signs up to 20 sq. inches and 1/8 inch thick for larger sizes.

1. Engraved legend with black letters on white face
2. Punched or drilled for mechanical fasteners.
3. Framed with mitered acrylic molding and arranged for attachment at applicable equipment.
B. Adhesive Film Label with Clear Protective Overlay: Machine printed, in black, by thermal transfer or equivalent process. Minimum letter height shall be 3/8 inch. Overlay shall provide a weatherproof and UV-resistant seal for label.

2.8 EQUIPMENT IDENTIFICATION LABELS


2.9 MISCELLANEOUS IDENTIFICATION PRODUCTS

A. Paint: Comply with requirements in painting Sections for paint materials and application requirements. Select paint system applicable for surface material and location (exterior or interior).

B. Fasteners for Labels and Signs: Self-tapping, stainless-steel screws or stainless-steel machine screws with nuts and flat and lock washers.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Verify identity of each item before installing identification products.

B. Location: Install identification materials and devices at locations for most convenient viewing without interference with operation and maintenance of equipment.

C. Apply identification devices to surfaces that require finish after completing finish work.

D. Self-Adhesive Identification Products: Clean surfaces before application, using materials and methods recommended by manufacturer of identification device.

E. Attach signs and plastic labels that are not self-adhesive type with mechanical fasteners appropriate to the location and substrate.

F. System Identification Color-Coding Bands for Raceways and Cables: Each color-coding band shall completely encircle cable or conduit. Place adjacent bands of two-color markings in contact, side by side. Locate bands at changes in direction, at penetrations of walls and floors, at 50-foot maximum intervals in straight runs, and at 25-foot maximum intervals in congested areas.

G. Panelboard engraved labels shall be mechanically fastened using rivets or screws.

H. Underground-Line Warning Tape: During backfilling of trenches install continuous underground-line warning tape directly above line at 6 to 8 inches below finished grade. Use multiple tapes where width of multiple lines installed in a common trench or concrete envelope exceeds 16 inches overall.

3.2 IDENTIFICATION SCHEDULE

A. Accessible Raceways, 600 V or Less, for Service, Feeder, and Branch Circuits More Than 30 A, and 120 V to ground: Identify with self-adhesive vinyl label. Install labels at 30-foot maximum intervals.
B. Accessible Raceways and Cables within Buildings: Identify the covers of each junction and pull box of the following systems with self-adhesive vinyl labels with the wiring system legend and system voltage. System legends shall be as follows:

2. Power.
3. UPS.

C. Power-Circuit Conductor Identification, 600 V or Less: For conductors in vaults, pull and junction boxes, manholes, and handholes, use color-coding conductor tape to identify the phase.

1. Color-Coding for Phase and Voltage Level Identification, 600 V or Less: Use colors listed below for ungrounded service, feeder, and branch-circuit conductors.

   a. Color shall be factory applied or field applied for sizes larger than No. 8 AWG, if authorities having jurisdiction permit.
   b. Colors for 208/120-V Circuits:

      1) Phase A: Black.
      2) Phase B: Red.
      3) Phase C: Blue.

   c. Colors for 480/277-V Circuits:

      1) Phase A: Brown.
      2) Phase B: Orange.
      3) Phase C: Yellow.

   d. Field-Applied, Color-Coding Conductor Tape: Apply in half-lapped turns for a minimum distance of 6 inches from terminal points and in boxes where splices or taps are made. Apply last two turns of tape with no tension to prevent possible unwinding. Locate bands to avoid obscuring factory cable markings.

D. Install instructional sign including the color-code for grounded and ungrounded conductors using adhesive-film-type labels.

E. Conductors to Be Extended in the Future: Attach marker tape to conductors and list source.

F. Auxiliary Electrical Systems Conductor Identification: Identify field-installed alarm, control, and signal connections.

1. Identify conductors, cables, and terminals in enclosures and at junctions, terminals, and pull points. Identify by system and circuit designation.
2. Use system of marker tape designations that is uniform and consistent with system used by manufacturer for factory-installed connections.

G. Locations of Underground Lines: Identify with underground-line warning tape for power, lighting, communication, and control wiring and optical fiber cable.

1. Limit use of underground-line warning tape to direct-buried cables.
2. Install underground-line warning tape for both direct-buried cables and cables in raceway.
H. Workspace Indication: Install floor marking tape to show working clearances in the direction of access to live parts. Workspace shall be as required by NFPA 70 and 29 CFR 1926.403 unless otherwise indicated. Do not install at flush-mounted panelboards and similar equipment in finished spaces.

I. Warning Labels for Indoor Cabinets, Boxes, and Enclosures for Power and Lighting: Self-adhesive warning labels.

2. Identify system voltage with black letters on an orange background.
3. Apply to exterior of door, cover, or other access.
4. For equipment with multiple power or control sources, apply to door or cover of equipment including, but not limited to, the following:
   a. Power transfer switches.
   b. Controls with external control power connections.

J. Operating Instruction Signs: Install instruction signs to facilitate proper operation and maintenance of electrical systems and items to which they connect. Install instruction signs with approved legend where instructions are needed for system or equipment operation.

K. Emergency Operating Instruction Signs: Install instruction signs with white legend on a red background with minimum 3/8-inch-high letters for emergency instructions at equipment used for power transfer.

L. Equipment Identification Labels: On each unit of equipment, install unique designation label that is consistent with wiring diagrams, schedules, and the Operation and Maintenance Manual. Apply labels to disconnect switches and protection equipment, central or master units, control panels, control stations, terminal cabinets, and racks of each system. Systems include power, lighting, control, communication, signal, monitoring, and alarm systems unless equipment is provided with its own identification.

1. Labeling Instructions:
   a. Indoor Equipment: Self-adhesive, engraved, laminated acrylic or melamine label. Unless otherwise indicated, provide a single line of text with 1/2-inch-high letters on 1-1/2-inch-high label; where two lines of text are required, use labels 2 inches high. Follow the Gulfstream panelboard labeling scheme.
   b. Outdoor Equipment: Engraved, laminated acrylic or melamine label.
   c. Elevated Components: Increase sizes of labels and letters to those appropriate for viewing from the floor.
   d. Unless provided with self-adhesive means of attachment, fasten labels with appropriate mechanical fasteners that do not change the NEMA or NRTL rating of the enclosure.

2. Equipment to Be Labeled:
   a. Panelboards: Typewritten directory of circuits in the location provided by panelboard manufacturer. Panelboard identification shall be engraved, laminated acrylic or melamine label.
   b. Enclosures and electrical cabinets.
   c. Access doors and panels for concealed electrical items.
   d. Switchboards.
   e. Transformers: Label that includes tag designation shown on Drawings for the transformer, feeder, and panelboards or equipment supplied by the secondary.
f. Emergency system boxes and enclosures.
g. Enclosed switches.
h. Enclosed circuit breakers.
i. Enclosed controllers.
j. Variable-speed controllers.
k. Power transfer equipment.
l. Power-generating units.
m. Monitoring and control equipment.

END OF SECTION 26 05 53
SECTION 26 09 23
LIGHTING CONTROL DEVICES

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes the following lighting control devices:

1. Photoelectric switches.
2. Indoor occupancy sensors.

1.2 SUBMITTALS

A. Product Data: For each type of product indicated.
B. Field quality-control test reports.
C. Operation and maintenance data.

1.3 QUALITY ASSURANCE

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

PART 2 - PRODUCTS

2.1 OUTDOOR PHOTOELECTRIC SWITCHES

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. Cooper Industries, Inc.
2. Intermatic, Inc.
3. NSi Industries LLC; TORK Products.
4. Tyco Electronics; ALR Brand.

B. Description: Solid state, with SPST dry contacts rated for 1800-VA tungsten or 1000-VA inductive, to operate connected relay, contactor coils, or microprocessor input; complying with UL 773A.

1. Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
2. Light-Level Monitoring Range: 1.5 to 10 fc, with an adjustment for turn-on and turn-off levels within that range.
3. Time Delay: Fifteen second minimum, to prevent false operation.
5. Mounting: Twist lock complies with NEMA C136.10, with base-and-stem mounting or stem-and-swivel mounting accessories as required to direct sensor to the north sky exposure.
2.2 INDOOR OCCUPANCY SENSORS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   1. Hubbell Lighting.
   3. Lithonia Lighting; Acuity Lighting Group, Inc.
   4. Sensor Switch, Inc.
   5. TORK.
   6. Watt Stopper (The).
   7. N-Light

B. General Description: Wall- or ceiling-mounting, solid-state units with a separate relay unit.
   1. Operation: Unless otherwise indicated, turn lights on when covered area is occupied and off when unoccupied; with a time delay for turning lights off, adjustable over a minimum range of 1 to 15 minutes.
   2. Sensor Output: Contacts rated to operate the connected relay, complying with UL 773A. Sensor shall be powered from the relay unit.
   3. Relay Unit: Dry contacts rated for 20-A ballast load at 120- and 277-V ac, for 13-A tungsten at 120-V ac, and for 1 hp at 120-V ac. Power supply to sensor shall be 24-V dc, 150-mA,
   4. Class 2 power source as defined by NFPA 70.
   5. Mounting:
      a. Sensor: Suitable for mounting in any position on a standard outlet box.
      b. Relay: Externally mounted through a 1/2-inch knockout in a standard electrical enclosure.
      c. Time-Delay and Sensitivity Adjustments: Recessed and concealed behind hinged door.
   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. Automatic Light-Level Sensor: Adjustable from 2 to 200 fc; keep lighting off when selected lighting level is present.

C. Dual-Technology Type: Ceiling mounted; detect occupants in coverage area using PIR and ultrasonic detection methods. The particular technology or combination of technologies that control on-off functions is selectable in the field by operating controls on unit.
   1. Sensitivity Adjustment: Separate for each sensing technology.
   2. Detector Sensitivity: Detect occurrences of 6-inch-minimum movement of any portion of a human body that presents a target of not less than 36 sq. in., and detect a person of average size and weight moving not less than 12 inches in either a horizontal or a vertical manner at an approximate speed of 12 inches/s.
   3. Detection Coverage (Standard Room): Detect occupancy anywhere within a circular area of 1000 sq. ft. when mounted on a 96-inch-high ceiling.

2.3 SWITCHBOX-MOUNTED OCCUPANCY SENSORS

A. General Requirements for Sensors: Automatic-wall-switch occupancy sensor, suitable for mounting in a single gang switchbox.
1. Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
2. Operating Ambient Conditions: Dry interior conditions, 32 to 120 deg F.
3. Switch Rating: Not less than 800-VA fluorescent at 120 V, 1200-VA fluorescent at 277 V, and 800-W incandescent.

B. Wall-Switch Sensor:

1. Standard Range: 180-degree field of view, field adjustable from 180 to 40 degrees; with a minimum coverage area of 2100 sq. ft.
2. Sensing Technology: Dual technology - PIR and ultrasonic.
3. Switch Type: SP, field selectable automatic "on," or manual "on" automatic "off."
4. Voltage: Dual voltage, 120 and 277 V; dual-technology type.
5. Ambient-Light Override: Concealed, field-adjustable, light-level sensor from 10 to 150 fc. The switch prevents the lights from turning on when the light level is higher than the set point of the sensor.
6. Concealed, field-adjustable, "off" time-delay selector at up to 30 minutes.
7. Concealed "off" time-delay selector at 30 seconds, and 5, 10, and 20 minutes.
8. Adaptive Technology: Self-adjusting circuitry detects and memorizes usage patterns of the space and helps eliminate false "off" switching.

2.4 CONDUCTORS AND CABLES

A. Power Wiring to Supply Side of Remote-Control Power Sources: Not smaller than No. 12 AWG. Comply with requirements in Division 26 Section "Conductors and Cables."

B. Classes 2 and 3 Control Cable: Multiconductor cable with stranded-copper conductors not smaller than No. 18 AWG. Comply with requirements in Division 26 Section "Conductors and Cables."

C. Class 1 Control Cable: Multiconductor cable with stranded-copper conductors not smaller than No. 16 AWG. Comply with requirements in Division 26 Section "Conductors and Cables."

PART 3 - EXECUTION

3.1 SENSOR INSTALLATION

A. Install and aim sensors in locations to achieve not less than 90 percent coverage of areas indicated. Do not exceed coverage limits specified in manufacturer’s written instructions.

B. When requested within 12 months of date of Substantial Completion, provide on-site assistance in adjusting sensors to suit actual occupied conditions. Provide up to two visits to Project during other than normal occupancy hours for this purpose.

3.2 CONTACTOR INSTALLATION

A. Mount electrically held lighting contactors with elastomeric isolator pads, to eliminate structure borne vibration, unless contactors are installed in an enclosure with factory-installed vibration isolators.

3.3 WIRING INSTALLATION

A. Wiring Method: Comply with Division 26 Section "Conductors and Cables." Minimum conduit size shall be 1/2 inch.
B. Wiring within Enclosures: Comply with NECA 1. Separate power-limited and nonpower-limited conductors according to conductor manufacturer's written instructions.

C. Size conductors according to lighting control device manufacturer's written instructions, unless otherwise indicated.

D. Splices, Taps, and Terminations: Make connections only on numbered terminal strips in junction, pull, and outlet boxes; terminal cabinets; and equipment enclosures.

3.4 IDENTIFICATION

A. Identify components and power and control wiring according to Division 26 Section "Electrical Identification."

   1. Identify controlled circuits in lighting contactors.
   2. Identify circuits or luminaries controlled by photoelectric and occupancy sensors at each sensor.

B. Label time switches and contactors with a unique designation.

3.5 FIELD QUALITY CONTROL

A. Perform the following field tests and inspections and prepare test reports:

   1. After installing time switches and sensors, and after electrical circuitry has been energized, adjust and test for compliance with requirements.
   2. Operational Test: Verify operation of each lighting control device, and adjust time delays.

B. Lighting control devices that fail tests and inspections are defective work.

END OF SECTION 26 09 23
SECTION 26 24 16
PANELBOARDS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Distribution panelboards.
   2. General-use and lighting branch-circuit panelboards.

1.2 SUBMITTALS

A. Product Data: For each type of panelboard, switching and overcurrent protective device, transient voltage suppression device, accessory, and component indicated. Include dimensions and manufacturers' technical data on features, performance, electrical characteristics, ratings, and finishes.

B. Panelboard Schedules: For installation in panelboards.

C. Operation and Maintenance Data: For panelboards and components to include in emergency, operation, and maintenance manuals.
   1. Manufacturer's written instructions for testing and adjusting overcurrent protective devices.

1.3 QUALITY ASSURANCE

A. Source Limitations: Obtain panelboards, overcurrent protective devices, components, and accessories from single source from single manufacturer.

B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

C. Comply with NEMA PB 1.

D. Comply with NFPA 70.

1.4 DELIVERY, STORAGE, AND HANDLING

A. Remove loose packing and flammable materials from inside panelboards; install temporary electric heating (250 W per panelboard) to prevent condensation.

B. Handle and prepare panelboards for installation according to NEMA PB 1.

1.5 PROJECT CONDITIONS

A. Environmental Limitations:
   1. Do not deliver or install panelboards until spaces are enclosed and weathertight, wet work in spaces is complete and dry, work above panelboards is complete, and temporary HVAC system is operating and maintaining ambient temperature and humidity conditions at occupancy levels during the remainder of the construction period.
B. Service Conditions: NEMA PB 1, usual service conditions, as follows:

1. Ambient temperatures within limits specified.
2. Altitude not exceeding 6600 feet.

1.6 COORDINATION

A. Coordinate layout and installation of panelboards and components with other construction that penetrates walls or is supported by them, including electrical and other types of equipment, raceways, piping, encumbrances to workspace clearance requirements, and adjacent surfaces. Maintain required workspace clearances and required clearances for equipment access doors and panels.

1.7 WARRANTY

A. Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace transient voltage suppression devices that fail in materials or workmanship within specified warranty period.

1. Warranty Period: One year with extended warranties provided by manufacturers.

PART 2 - PRODUCTS

2.1 GENERAL REQUIREMENTS FOR PANELBOARDS

A. Enclosures: Flush- and surface-mounted cabinets.

1. Rated for environmental conditions at installed location.

a. Indoor Dry and Clean Locations: NEMA 250, Type 1.
   b. Outdoor Locations: NEMA 250, Type 3R.
   c. Indoor Locations Subject to Dust, Falling Dirt, and Dripping Noncorrosive Liquids: NEMA 250, Type 12.

2. Front: Secured to box with concealed trim clamps. For surface-mounted fronts, match box dimensions; for flush-mounted fronts, overlap box.

3. Skirt for Surface-Mounted Panelboards: Same gage and finish as panelboard front with flanges for attachment to panelboard, wall, and ceiling or floor.

4. Gutter Extension and Barrier: Same gage and finish as panelboard enclosure; integral with enclosure body. Arrange to isolate individual panel sections.

5. Finishes:

   a. Panels and Trim: Steel, factory finished immediately after cleaning and pretreating with manufacturer's standard two-coat, baked-on finish consisting of prime coat and thermosetting topcoat.
   b. Back Boxes: Same finish as panels and trim.
   c. Fungus Proofing: Permanent fungicidal treatment for overcurrent protective devices and other components.


B. Incoming Mains Location: Top and bottom.
C. Phase, Neutral, and Ground Buses:
   1. Material: Copper.
   2. Equipment Ground Bus: Adequate for feeder and branch-circuit equipment grounding conductors; bonded to box.

D. Conductor Connectors: Suitable for use with conductor material and sizes.

   1. Material: Copper.
   2. Main and Neutral Lugs: Mechanical type.
   3. Ground Lugs and Bus-Configured Terminators: Mechanical type.
   4. Feed-Through Lugs: Mechanical type, suitable for use with conductor material. Locate at opposite end of bus from incoming lugs or main device.
   5. Subfeed (Double) Lugs: Mechanical type suitable for use with conductor material. Locate at same end of bus as incoming lugs or main device.

E. Service Equipment Label: NRTL labeled for use as service equipment for panelboards or load centers with one or more main service disconnecting and overcurrent protective devices.

F. Future Devices: Mounting brackets, bus connections, filler plates, and necessary appurtenances required for future installation of devices.


2.2 DISTRIBUTION PANELBOARDS

A. Basis-of-Design Product: Subject to compliance with requirements, provide

   1. Square D; a brand of Schneider Electric.
   2. Eaton Electrical Inc.; Cutler-Hammer.
   3. General Electric Company

B. Panelboards: NEMA PB 1, power and feeder distribution type.

C. Doors: Secured with vault-type latch with tumbler lock; keyed alike.

D. Mains: As indicated on Drawings.


F. Branch Overcurrent Protective Devices for Circuit-Breaker Frame Sizes Larger Than 125 A: Bolt-on circuit breakers.

2.3 GENERAL-USE AND LIGHTING BRANCH-CIRCUIT PANELBOARDS

A. Basis-of-Design Product: Subject to compliance with requirements, provide

   1. Square D; a brand of Schneider Electric.
   2. Eaton Electrical Inc.; Cutler-Hammer.
   3. General Electric Company
B. Panelboards: NEMA PB 1, branch-circuit type.

C. Mains: As indicated on Drawings.

D. Branch Overcurrent Protective Devices: Bolt-on circuit breakers, replaceable without disturbing adjacent units.

E. Doors: Concealed hinges; secured with flush latch with tumbler lock; keyed alike.

2.4 DISCONNECTING AND OVERCURRENT PROTECTIVE DEVICES

A. Basis-of-Design Product: Subject to compliance with requirements, provide

1. Square D; a brand of Schneider Electric.
2. Eaton Electrical Inc.; Cutler-Hammer.
3. General Electric Company

B. Molded-Case Circuit Breaker (MCCB): Comply with UL 489, with interrupting capacity to meet available fault currents.

3. Electronic trip, 100 percent rated circuit breakers shall be provided for circuit breaker frame sizes 400A and larger. Provide with rms sensing; field-replaceable rating plug or field-replicable electronic trip; and the following field-adjustable settings:
   a. Instantaneous trip.
   b. Long- and short-time pickup levels.
   c. Long- and short-time time adjustments.
   d. Ground-fault pickup level, time delay, and \( I^2t \) response.


5. Molded-Case Circuit-Breaker (MCCB) Features and Accessories:
   a. Standard frame sizes, trip ratings, and number of poles.
   b. Lugs: Mechanical style, suitable for number, size, trip ratings, and conductor materials.
   c. Application Listing: Appropriate for application; Type SWD for switching fluorescent lighting loads; Type HID for feeding fluorescent and high-intensity discharge (HID) lighting circuits.
   d. Ground-Fault Protection: Integrally mounted relay and trip unit with adjustable pickup and time-delay settings, push-to-test feature, and ground-fault indicator.
   e. Handle Padlocking Device: Fixed attachment, for locking circuit-breaker handle in on or off position.
   f. Handle Clamp: Loose attachment, for holding circuit-breaker handle in on position.
PART 3 - EXECUTION

3.1 EXAMINATION

A. Receive, inspect, handle, and store panelboards according to NEMA PB 1.1.

B. Examine panelboards before installation. Reject panelboards that are damaged or rusted or have been subjected to water saturation.

C. Examine elements and surfaces to receive panelboards for compliance with installation tolerances and other conditions affecting performance of the Work.

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

3.2 INSTALLATION

A. Install panelboards and accessories according to NEMA PB 1.1.

B. Temporary Lifting Provisions: Remove temporary lifting eyes, channels, and brackets and temporary blocking of moving parts from panelboards.

C. Mount top of trim 90 inches above finished floor unless otherwise indicated.

D. Mount panelboard cabinet plumb and rigid without distortion of box. Mount recessed panelboards with fronts uniformly flush with wall finish and mating with back box.

E. Install overcurrent protective devices and controllers not already factory installed.

1. Set field-adjustable, circuit-breaker trip ranges per the coordination study.

F. Install filler plates in unused spaces.

G. Stub four 1-inch empty conduits from panelboard into accessible ceiling space or space designated to be ceiling space in the future. Stub four 1-inch empty conduits into raised floor space or below slab not on grade.

H. Arrange conductors in gutters into groups and bundle and wrap with wire ties after completing load balancing.

I. Comply with NECA 1.

3.3 IDENTIFICATION

A. Identify field-installed conductors, interconnecting wiring, and components; provide warning signs.

B. Create a directory to indicate installed circuit loads after balancing panelboard loads; incorporate Owner’s final room designations. Obtain approval before installing. Use a computer or typewriter to create directory; handwritten directories are not acceptable.

C. Panelboard Nameplates: Label each panelboard with a nameplate.

D. Device Nameplates: Label each branch circuit device in distribution panelboards with a nameplate.
3.4 FIELD QUALITY CONTROL

A. Acceptance Testing Preparation:
   1. Test insulation resistance for each panelboard bus, component, connecting supply, feeder, and control circuit.
   2. Test continuity of each circuit.

B. Tests and Inspections:
   1. Perform each visual and mechanical inspection and electrical test stated in NETA Acceptance Testing Specification. Certify compliance with test parameters.
   2. Correct malfunctioning units on-site, where possible, and retest to demonstrate compliance; otherwise, replace with new units and retest.
   3. Perform the following infrared scan tests and inspections and prepare reports:
      a. Initial Infrared Scanning: After Substantial Completion, but not more than 60 days after Final Acceptance, perform an infrared scan of each panelboard. Remove front panels so joints and connections are accessible to portable scanner.
      b. Instruments and Equipment:
         1) Use an infrared scanning device designed to measure temperature or to detect significant deviations from normal values.

C. Panelboards will be considered defective if they do not pass tests and inspections.

D. Prepare test and inspection reports, including a certified report that identifies panelboards included and that describes scanning results. Include notation of deficiencies detected, remedial action taken, and observations after remedial action.

3.5 ADJUSTING

A. Adjust moving parts and operable component to function smoothly, and lubricate as recommended by manufacturer.

END OF SECTION 26 24 16
SECTION 26 27 13
ELECTRICITY METERING

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes electricity metering.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Shop Drawings: For electricity-metering equipment.
   1. Include elevation views of front panels of control and indicating devices and control stations.
   2. Include diagrams for power, signal, and control wiring.
   3. Wire Termination Diagrams and Schedules: Include diagrams for power, signal, and control wiring. Identify terminals and wiring designations and color-codes to facilitate installation, operation, and maintenance. Indicate recommended types, wire sizes, and circuiting arrangements for field-installed wiring, and show circuit protection features. Differentiate between manufacturer-installed and field-installed wiring.
   4. Include series-combination rating data for modular meter centers with main disconnect device.

1.3 INFORMATIONAL SUBMITTALS

A. Field quality-control reports.

B. Sample warranty.

1.4 CLOSEOUT SUBMITTALS

A. Operation and maintenance data.

1.5 QUALITY ASSURANCE

A. Testing Agency Qualifications: An NRTL.

1.6 WARRANTY

A. Special Warranty: Manufacturer agrees to repair or replace components of metering equipment that fail in materials or workmanship within specified warranty period.
   1. Warranty Period: Cost to repair or replace any parts for two years from date of Substantial Completion.

1.7 COORDINATION

A. Electrical Service Connections: Coordinate with utility companies and utility-furnished components.
PART 2 - PRODUCTS

2.1 SYSTEM DESCRIPTION

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

B. Comply with UL 916.

2.2 UTILITY METERING INFRASTRUCTURE

A. Install metering accessories furnished by the utility company, complying with its requirements.

B. Utility-Furnished Meters: Connect data transmission facility of metering equipment installed by the Utility.

1. Data Transmission: Transmit pulse data over control-circuit conductors, classified as Class 1 per NFPA 70, Article 725. Comply with Section 26 05 23 "Control-Voltage Electrical Power Cables."

C. Current-Transformer Cabinets: Comply with requirements of electrical-power utility company.

D. Meter Sockets:

1. Comply with requirements of electrical-power utility company.


E. Arc-Flash Warning Labels:

1. Labels: Comply with requirements for "Arc-Flash Warning Labels" in Section 26 05 73.19 "Arc-Flash Hazard Analysis." Apply a properly sized self-adhesive label at each work location included in the analysis.

2. Labels: Comply with requirements for "Self-Adhesive Equipment Labels" and "Signs" in Section 26 05 53 "Identification for Electrical Systems." Apply a properly sized self-adhesive label for each work location included in the analysis. Labels shall be machine printed, with no field-applied markings.

a. The label shall have an orange header with the wording, "WARNING, ARC-FLASH HAZARD," and shall include the following information taken directly from the arc-flash hazard analysis:

1) Location designation.
2) Nominal voltage.
3) Flash protection boundary.
4) Hazard risk category.
5) Incident energy.
6) Working distance.
7) Engineering report number, revision number, and issue date.

2.3 ELECTRICITY METERS

A. System Description: Able to meter designated activity loads, with or without external alarm, control, and communication capabilities, or other optional features.
B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. ABB, Electrification Products Division.
2. Davidge Controls.
3. Eaton.
4. E-Mon.
5. GE Power; General Electric Company.
10. Square D; Schneider Electric USA.

C. Standard: Comply with ANSI C12.1 and ANSI C12.20, 0.5 accuracy class.

1. Ambient Temperature: Minus 22 deg F to plus 158 deg F.
2. Humidity: Zero to 95 percent, noncondensing.
3. Capacities and Characteristics:
   a. Circuit: 120/240-V ac, 100 A.
   b. Measure: kWh, onboard LED display.
   c. Remote-Reading Options: None.

D. General Requirements for Meters:

1. Certify that meters comply with ANSI C12.20 requirements by a laboratory accredited by the National Voluntary Laboratory Accreditation Program (NVLAP) of the National Institute of Standards and Technology (NIST). The laboratory shall use test equipment that is certified annually and is traceable to NIST standards.
2. Enclosure: Supplied by meter manufacturer, NEMA 250, Type 1 minimum, with provisions for locking or sealing.
3. Identification: Comply with requirements in Section 26 05 53 "Identification for Electrical Systems."
4. Onboard Nonvolatile Data Storage: kWh, until reset.
5. Sensors: Current-sensing type, supplied by electronic meter manufacturer, with current or voltage output, selected for optimum range and accuracy for meters indicated for this application.
   a. Type: Split and solid core, complying with recommendation of meter manufacturer.

E. Current-Transformer Cabinet: Size and configuration as recommended by metering equipment manufacturer for use with indicated connected feeder and sensors.

F. Data Transmission Cable: Comply with requirements in Section 26 05 23 "Control-Voltage Electrical Power Cables."

PART 3 - EXECUTION

3.1 INSTALLATION

A. Comply with equipment installation requirements in NECA 1.
B. Install meters furnished by utility company. Install raceways and equipment according to utility company's written instructions. Provide empty conduits for metering leads and extend grounding connections as required by utility company.

C. Install modular meter center according to switchboard installation requirements in NECA 400.

D. Install arc-flash labels as required by NFPA 70.

E. Wiring Method:
   1. Comply with requirements in Section 26 05 19 "Low-Voltage Electrical Power Conductors and Cables."
   2. Install unshielded, twisted-pair cable for control and signal transmission conductors, complying with Section 27 15 13 "Communications Copper Horizontal Cabling."
   3. Minimum conduit size shall be 1/2 inch.

F. Comply with requirements for identification specified in Section 26 05 53 "Identification for Electrical Systems."

3.2 FIELD QUALITY CONTROL

A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.

B. Perform tests and inspections with the assistance of a factory-authorized service representative.

C. Tests and Inspections:
   1. Equipment and Software Setup:
      a. Set meter date and time clock.
      b. Test, calibrate, and connect pulse metering system.
      c. Set and verify billing demand interval for demand meters.
      d. Report settings and calibration results.
      e. Set up reporting and billing software, insert billing location names and initial constant values and variable needed for billing computations.
   2. Connect a load of known kilowatt rating, 1.5 kW minimum, to a circuit supplied by metered feeder.
   3. Turn off circuits supplied by metered feeder and secure them in off condition.
   4. Run test load continuously for eight hours minimum, or longer, to obtain a measurable meter indication. Use test-load placement and setting that ensures continuous, safe operation.
   5. Check and record meter reading at end of test period and compare with actual electricity used, based on test-load rating, duration of test, and sample measurements of supply voltage at test-load connection. Record test results.
   6. Generate test report and billing for each tenant or activity from the meter reading tests.

D. Electricity metering will be considered defective if it does not pass tests and inspections.

E. Prepare test and inspection reports.

END OF SECTION 26 27 13
PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Standard-grade receptacles, 125 V, 20 A.
2. USB receptacles.
3. GFCI receptacles, 125 V, 20 A.
4. Twist-locking receptacles.
5. Pendant cord-connector devices.
6. Cord and plug sets.
7. Toggle switches, 120/277 V, 20 A.
8. Wall-box dimmers.
9. Wall plates.
10. Floor service fittings.
11. Prefabricated multioutlet assemblies.
12. Service poles.

1.2 DEFINITIONS

A. AFCI: Arc-fault circuit interrupter.
B. BAS: Building automation system.
C. GFCI: Ground-fault circuit interrupter.
D. Pigtail: Short lead used to connect a device to a branch-circuit conductor.
E. RFI: Radio-frequency interference.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.
B. Shop Drawings: List of legends and description of materials and process used for premarking wall plates.
C. Samples: One for each type of device and wall plate specified, in each color specified.

1.4 INFORMATIONAL SUBMITTALS

A. Field quality-control reports.

1.5 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For wiring devices to include in all manufacturers’ packing-label warnings and instruction manuals that include labeling conditions.
PART 2 - PRODUCTS

2.1 GENERAL WIRING-DEVICE REQUIREMENTS

A. Wiring Devices, Components, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and use.

B. Comply with NFPA 70.

C. RoHS compliant.

D. Comply with NEMA WD 1.

E. Devices that are manufactured for use with modular plug-in connectors may be substituted under the following conditions:
   1. Connectors shall comply with UL 2459 and shall be made with stranding building wire.
   2. Devices shall comply with requirements in this Section.

F. Devices for Owner-Furnished Equipment:
   1. Receptacles: Match plug configurations.
   2. Cord and Plug Sets: Match equipment requirements.

G. Device Color:
   1. Wiring Devices Connected to Normal Power System: As selected by Architect unless otherwise indicated or required by NFPA 70 or device listing.
   2. Wiring Devices Connected to Essential Electrical System: Red.

H. Wall Plate Color: For plastic covers, match device color.

I. Source Limitations: Obtain each type of wiring device and associated wall plate from single source from single manufacturer.

2.2 STANDARD-GRADE RECEPTACLES, 125 V, 20 A

A. Duplex Receptacles, 125 V, 20 A:
   1. Description: Two pole, three wire, and self-grounding.
   2. Configuration: NEMA WD 6, Configuration 5-20R.
   3. Standards: Comply with UL 498 and FS W-C-596.

B. Weather-Resistant Duplex Receptacle, 125 V, 20 A:
   1. Description: Two pole, three wire, and self-grounding. Integral shutters that operate only when a plug is inserted in the receptacle. Square face.
   2. Configuration: NEMA WD 6, Configuration 5-20R.
   4. Marking: Listed and labeled as complying with NFPA 70, "Receptacles in Damp or Wet Locations" Article.
2.3 USB RECEPTACLES

A. USB Charging Receptacles:
   2. USB Receptacles: Dual and quad, USB Type A, 5 V dc, and 2.1 A per receptacle (minimum).

2.4 GFCI RECEPTACLES, 125 V, 20 A

A. Duplex GFCI Receptacles, 125 V, 20 A:
   1. Description: Integral GFCI with "Test" and "Reset" buttons and LED indicator light. Two pole, three wire, and self-grounding.
   2. Configuration: NEMA WD 6, Configuration 5-20R.
   3. Type: Feed through.
   4. Standards: Comply with UL 498, UL 943 Class A, and FS W-C-596.

2.5 TWIST-LOCKING RECEPTACLES

A. Twist-Lock, Single Receptacles, 120 V, 20 A:
   1. Configuration: NEMA WD 6, Configuration L5-20R.
   2. Standards: Comply with UL 498.

B. Twist-Lock, Single Receptacles, 250 V, 20 A:
   1. Configuration: NEMA WD 6, Configuration L6-20R.
   2. Standards: Comply with UL 498.

2.6 PENDANT CORD-CONNECTOR DEVICES

A. Description: Matching, locking-type plug and receptacle body connector, heavy-duty grade.

B. Configuration: NEMA WD 6, Configurations as shown on drawings.

C. Body: Nylon, with screw-open, cable-gripping jaws and provision for attaching external cable grip.

D. External Cable Grip: Woven wire-mesh type made of high-strength, galvanized-steel wire strand, matched to cable diameter, and with attachment provision designed for corresponding connector.

E. Standards: Comply with FS W-C-596.

2.7 CORD AND PLUG SETS

A. Match voltage and current ratings and number of conductors to requirements of equipment being connected.

B. Cord: Rubber-insulated, stranded-copper conductors, with Type SOW-A jacket; with green-insulated grounding conductor and ampacity of at least 130 percent of the equipment rating.
C. Plug: Nylon body and integral cable-clamping jaws. Match cord and receptacle type for connection.

2.8 TOGGLE SWITCHES, 120/277 V, 20 A

A. Single-Pole Switches, 120/277 V, 20 A:

B. Two-Pole Switches, 120/277 V, 20 A:
   1. Comply with UL 20 and FS W-S-896.

C. Three-Way Switches, 120/277 V, 20 A:
   1. Comply with UL 20 and FS W-S-896.

2.9 DIMMERS

A. Wall-Box Dimmers:
   1. Description: Modular, full-wave, solid-state dimmer switch with integral, quiet on-off switches, with audible frequency and EMI/RFI suppression filters.
   2. Control: Continuously adjustable slider; with single-pole or three-way switching.
   4. Incandescent Lamp Dimmers: 120 V; control shall follow square-law dimming curve. On-off switch positions shall bypass dimmer module.
      a. 600 W; dimmers shall require no derating when ganged with other devices.

   5. Fluorescent Lamp Dimmer Switches: Modular; compatible with dimmer ballasts; trim potentiometer to adjust low-end dimming; dimmer-ballast combination capable of consistent dimming with low end not greater than 20 percent of full brightness.

   6. LED Lamp Dimmer Switches: Modular; compatible with LED lamps; trim potentiometer to adjust low-end dimming; capable of consistent dimming with low end not greater than 20 percent of full brightness.

2.10 WALL PLATES

A. Single Source: Obtain wall plates from same manufacturer of wiring devices.

B. Single and combination types shall match corresponding wiring devices.
   1. Plate-Securing Screws: Metal with head color to match plate finish.
   4. Material for Damp Locations: Thermoplastic with spring-loaded lift cover, and listed and labeled for use in wet and damp locations.

C. Wet-Location, Weatherproof Cover Plates: NEMA 250, complying with Type 3R, weather-resistant thermoplastic with lockable cover.
2.11 FLOOR SERVICE FITTINGS

A. Flush-Type Floor Service Fittings:
   1. Description: Type: Modular, flush-type, dual-service units suitable for wiring method used, with cover flush with finished floor.
   2. Compartments: Barrier separates power from voice and data communication cabling.
   3. Service Plate and Cover: Rectangular, solid brass with satin finish.
   5. Data Communication Outlet: Two modular, keyed, color-coded, RJ-45 jacks for twisted pair cable.

2.12 PREFABRICATED MULTIOUTLET ASSEMBLIES

A. Description: Two-piece surface metal raceway, with factory-wired multioutlet harness.

B. Components shall be products from single manufacturer designed for use as a complete, matching assembly of raceways and receptacles.

C. Raceway Material: Metal, with manufacturer's standard finish.

D. Multioutlet Harness:
   1. Receptacles: 15-A, 125-V, NEMA WD 6 Configuration 5-15R receptacles complying with NEMA WD 1, UL 498, and FS W-C-596.
   2. Receptacle Spacing: as indicated on drawings.
   3. Wiring: No. 12 AWG solid, Type THHN copper, single circuit.

2.13 SERVICE POLES

A. Dual-Channel Service Poles:
   1. Description: Factory-assembled and -wired units to extend power and voice and data communication from distribution wiring concealed in ceiling to devices or outlets in pole near floor.
   2. Poles: Nominal 2.5-inch- square cross-section, with height adequate to extend from floor to at least 6 inches above ceiling, and with separate channels for power wiring and voice and data communication cabling.
   3. Mounting: Ceiling trim flange with concealed bracing arranged for positive connection to ceiling supports; with pole foot and carpet pad attachment.
   5. Finishes: Manufacturer's standard painted finish and trim combination.
   6. Wiring: Sized for minimum of five No. 12 AWG power and ground conductors and a minimum of four, balanced twisted pair data communication cables.
   7. Power Receptacles: Two duplex, 20-A, straight-blade receptacles complying with requirements in this Section.
PART 3 - EXECUTION

3.1 INSTALLATION

A. Comply with NECA 1, including mounting heights listed in that standard, unless otherwise indicated.

B. Coordination with Other Trades:

1. Protect installed devices and their boxes. Do not place wall finish materials over device boxes, and do not cut holes for boxes with routers that are guided by riding against outside of boxes.
2. Keep outlet boxes free of plaster, drywall joint compound, mortar, cement, concrete, dust, paint, and other material that may contaminate the raceway system, conductors, and cables.
3. Install device boxes in brick or block walls so that the cover plate does not cross a joint unless the joint is troweled flush with the face of the wall.
4. Install wiring devices after all wall preparation, including painting, is complete.

C. Conductors:

1. Do not strip insulation from conductors until right before they are spliced or terminated on devices.
2. Strip insulation evenly around the conductor using tools designed for the purpose. Avoid scoring or nicking of solid wire or cutting strands from stranded wire.
3. The length of free conductors at outlets for devices shall comply with NFPA 70, Article 300, without pigtails.
4. Existing Conductors:
   a. Cut back and pigtail, or replace all damaged conductors.
   b. Straighten conductors that remain and remove corrosion and foreign matter.
   c. Pigtailing existing conductors is permitted, provided the outlet box is large enough.

D. Device Installation:

1. Replace devices that have been in temporary use during construction and that were installed before building finishing operations were complete.
2. Keep each wiring device in its package or otherwise protected until it is time to connect conductors.
3. Do not remove surface protection, such as plastic film and smudge covers, until the last possible moment.
4. Connect devices to branch circuits using pigtails that are not less than 6 inches in length.
5. When there is a choice, use side wiring with binding-head screw terminals. Wrap solid conductor tightly clockwise, two-thirds to three-fourths of the way around terminal screw.
6. Use a torque screwdriver when a torque is recommended or required by manufacturer.
7. When conductors larger than No. 12 AWG are installed on 15- or 20-A circuits, splice No. 12 AWG pigtails for device connections.
8. Tighten unused terminal screws on the device.
9. When mounting into metal boxes, remove the fiber or plastic washers used to hold device-mounting screws in yokes, allowing metal-to-metal contact.

E. Receptacle Orientation:

1. Install ground pin of vertically mounted receptacles down, and on horizontally mounted receptacles to the right.
F. Device Plates: Do not use oversized or extra-deep plates. Repair wall finishes and remount outlet boxes when standard device plates do not fit flush or do not cover rough wall opening.

G. Dimmers:
   1. Install dimmers within terms of their listing.
   2. Verify that dimmers used for fan-speed control are listed for that application.
   3. Install unshared neutral conductors on line and load side of dimmers according to manufacturers' device, listing conditions in the written instructions.

H. Arrangement of Devices: Unless otherwise indicated, mount flush, with long dimension vertical and with grounding terminal of receptacles on top. Group adjacent switches under single, multigang wall plates.

I. Adjust locations of floor service outlets and service poles to suit arrangement of partitions and furnishings.

3.2 GFCI RECEPTACLES

A. Install non-feed-through GFCI receptacles where protection of downstream receptacles is not required.

3.3 IDENTIFICATION

A. Comply with Section 26 05 53 "Identification for Electrical Systems."

B. Essential Electrical System: Mark receptacles supplied from the essential electrical system to allow easy identification using a self-adhesive label.

3.4 FIELD QUALITY CONTROL

A. Test Instruments: Use instruments that comply with UL 1436.

B. Test Instrument for Receptacles: Digital wiring analyzer with digital readout or illuminated digital-display indicators of measurement.

C. Perform the following tests and inspections:
   1. Test Instruments: Use instruments that comply with UL 1436.
   2. Test Instrument for Receptacles: Digital wiring analyzer with digital readout or illuminated digital-display indicators of measurement.

D. Tests for Receptacles:
   1. Line Voltage: Acceptable range is 105 to 132 V.
   2. Percent Voltage Drop under 15-A Load: A value of 6 percent or higher is unacceptable.
   3. Ground Impedance: Values of up to 2 ohms are acceptable.
   4. GFCI Trip: Test for tripping values specified in UL 1436 and UL 943.
   5. Using the test plug, verify that the device and its outlet box are securely mounted.
   6. Tests shall be diagnostic, indicating damaged conductors, high resistance at the circuit breaker, poor connections, inadequate fault-current path, defective devices, or similar problems. Correct circuit conditions, remove malfunctioning units and replace with new ones, and retest as specified above.
E. Wiring device will be considered defective if it does not pass tests and inspections.

END OF SECTION 26 27 26
PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Cartridge fuses rated 600-V ac and less for use in enclosed switches.

1.2 QUALITY ASSURANCE

A. Source Limitations: Obtain fuses, for use within a specific product or circuit, from single source from single manufacturer.

B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

C. Comply with NEMA FU 1 for cartridge fuses.

D. Comply with NFPA 70.

1.3 PROJECT CONDITIONS

A. Where ambient temperature to which fuses are directly exposed is less than 40 deg F or more than 100 deg F, apply manufacturer's ambient temperature adjustment factors to fuse ratings.

1.4 COORDINATION

A. Coordinate fuse ratings with utilization equipment nameplate limitations of maximum fuse size and with system short-circuit current levels.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   1. Cooper Bussmann, Inc.
   2. Ferraz Shawmut, Inc.
   3. Littelfuse, Inc.

2.2 CARTRIDGE FUSES

A. Characteristics: NEMA FU 1, nonrenewable cartridge fuses with voltage ratings consistent with circuit voltages.
PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine fuses before installation. Reject fuses that are moisture damaged or physically damaged.

B. Examine holders to receive fuses for compliance with installation tolerances and other conditions affecting performance, such as rejection features.

C. Examine utilization equipment nameplates and installation instructions. Install fuses of sizes and with characteristics appropriate for each piece of equipment.

D. Evaluate ambient temperatures to determine if fuse rating adjustment factors must be applied to fuse ratings.

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

3.2 FUSE APPLICATIONS

A. Motor Branch Circuits: Class RK5, time delay.

B. Other Branch Circuits: Class RK5, time delay.

C. Control Circuits: Class CC, time delay.

3.3 INSTALLATION

A. Install fuses in fusible devices. Arrange fuses so rating information is readable without removing fuse.

3.4 IDENTIFICATION

A. Install labels complying with requirements for identification specified in Division 26 Section "Identification for Electrical Systems" and indicating fuse replacement information on inside door of each fused switch and adjacent to each fuse block, socket, and holder.

END OF SECTION 26 28 13
PART 1 - GENERAL

1.1 SUMMARY

A. Section includes lightning protection system for ordinary structures.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Shop Drawings:
   1. Include layouts of the lightning protection system, with details of the components to be used in the installation.
   2. Include raceway locations needed for the installation of conductors.
   3. Details of air terminals, ground rods, ground rings, conductor supports, splices, and terminations, including concealment requirements.
   4. Include roof attachment details, coordinated with roof installation.
   5. Calculations required by NFPA 780 for bonding of metal bodies.

1.3 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Lightning protection system Shop Drawings, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of the items involved:
   1. Lightning protection cabling attachments to roofing systems and accessories.
   2. Lightning protection strike termination device attachment to roofing systems, coordinated with the roofing system manufacturer.
   3. Lightning protection system components penetrating roofing and moisture protection systems and system components, coordinated with the roofing system manufacturer.

B. Qualification Data: For Installer.

C. Product Certificates: For each type of roof adhesive for attaching the roof-mounted air terminal assemblies, approved by the roofing-material manufacturer.

D. Field quality-control reports.

1.4 CLOSEOUT SUBMITTALS

A. Maintenance Data: For lightning protection system to include in maintenance manuals.
   1. In addition to items specified in Section 01 78 23 "Operation and Maintenance Data," include the following:
      a. Dimensioned site plan showing dimensioned route of the ground rod locations. Comply with requirements of Section 01 78 39 "Project Record Documents."
      b. A system testing and inspection record, listing the results of inspections and ground resistance tests, as recommended by NFPA 780, Annex D.
B. Completion Certificate:
   1. UL Master Label Certificate.

1.5 QUALITY ASSURANCE

A. Installer Qualifications: LPI Master Installer.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

   1. Advanced Lightning Technology, Ltd.
   2. East Coast Lightning Equipment Inc.
   3. ERICO International Corporation.
   4. Harger Lightning & Grounding.
   8. Preferred Lightning Protection.
   9. Robbins Lightning, Inc.
   10. Thompson Lightning Protection, Inc.

2.2 PERFORMANCE REQUIREMENTS

A. NFPA Lightning Protection Standard: Comply with NFPA 780 requirements for Class I buildings.

B. Lightning Protection Components, Devices, and Accessories: Listed and labeled by a qualified testing agency as complying with UL 96, and marked for intended location and application.

2.3 MATERIALS

A. Air Terminals:

   1. Aluminum unless otherwise indicated.

B. Air Terminal Bracing:

   1. Aluminum.

C. Class 1 Main Conductors:

   1. Aluminum.

D. Ground Rods:

   1. Material: Copper-clad steel.
   3. Rods shall be not less than 120 inches long.
E. Conductor Splices and Connectors: Compression fittings that are installed with hydraulically operated tools, or exothermic welds, approved for use with the class type.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install lightning protection components and systems according to UL 96A and NFPA 780.

B. Install conductors with direct paths from air terminals to ground connections. Avoid bends less than 90 degrees and 8 inches in radius and narrow loops.

C. Conceal conductors within normal view from exterior locations at grade within 200 feet of building. Comply with requirements for concealed systems in NFPA 780.
   1. Roof penetrations required for down conductors and connections to structural-steel framework shall be made using listed through-roof fitting and connector assemblies with solid rods and appropriate roof flashings. Use materials approved by the roofing manufacturer for the purpose. Conform to the methods and materials required at roofing penetrations of the lightning protection components to ensure compatibility with the roofing specifications and warranty.
   2. Install conduit where necessary to comply with conductor concealment requirements.
   3. Air Terminals on Single-Ply Membrane Roofing: Comply with adhesive manufacturer's written instructions.

3.2 CONNECTIONS

A. Aboveground concealed connections, and connections in earth or concrete, shall be done by exothermic welds or by high-compression fittings listed for the purpose.

B. Bonding Straps and Jumpers: Install in locations accessible for inspection and maintenance, except where routed through short lengths of conduit.
   1. Bonding to Structure: Bond straps directly to basic structure, taking care not to penetrate any adjacent parts.
   2. Bonding to Equipment Mounted on Vibration Isolation Hangers and Supports: Install bonding so vibration is not transmitted to rigidly mounted equipment.

3.3 CORROSION PROTECTION

A. Do not combine materials that can form an electrolytic couple that will accelerate corrosion in the presence of moisture unless moisture is permanently excluded from junction of such materials.

B. Use conductors with protective coatings where conditions would cause deterioration or corrosion of conductors.

3.4 FIELD QUALITY CONTROL

A. Special Inspections: Engage a qualified special inspector to perform the following special inspections:
   1. Perform inspections as required to obtain a UL Master Label for system.
B. Prepare test and inspection reports and certificates.

END OF SECTION 26 41 13
SECTION 26 43 13
SURGE PROTECTION FOR LOW-VOLTAGE ELECTRICAL POWER CIRCUITS

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes field-mounted SPDS for low-voltage (120 to 600 V) power distribution and control equipment.

1.2 DEFINITIONS

A. Inominal: Nominal discharge current.
B. MCOV: Maximum continuous operating voltage.
C. Mode(s), also Modes of Protection: The pair of electrical connections where the VPR applies.
D. MOV: Metal-oxide varistor; an electronic component with a significant non-ohmic current-voltage characteristic.
E. OCPD: Overcurrent protective device.
F. SCCR: Short-circuit current rating.
G. SPD: Surge protective device.
H. VPR: Voltage protection rating.

1.3 SUBMITTALS

A. Product Data: For each type of product.

1. Include rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories.
2. Copy of UL Category Code VZCA certification, as a minimum, listing the tested values for VPRs, Inominal ratings, MCOVs, type designations, OCPD requirements, model numbers, system voltages, and modes of protection.

B. Field quality-control reports.

C. SPD manufacturer shall provide UL 4th Edition documentations as part of the submittal.

D. Sample Warranty: Manufacturer's warranty statement.

E. Maintenance Data: For SPDs to include in maintenance manuals.

1.4 PROJECT CONDITIONS

A. Service Conditions: Rate SPD devices for continuous operation under the following conditions unless otherwise indicated:

1. Maximum Continuous Operating Voltage: Not less than 115 percent of nominal system operating voltage.
2. Operating Temperature: 30 to 120 deg F.
3. Humidity: 0 to 85 percent, noncondensing.
4. Altitude: Less than 20,000 feet above sea level.

1.5 COORDINATION

A. Coordinate location of field-mounted SPD devices to allow adequate clearances for maintenance.

1.6 WARRANTY

A. Manufacturer's Warranty: Manufacturer agrees to replace or replace SPDs that fail in materials or workmanship within specified warranty period. Warranty shall cover unlimited replacement of SPD modules during the warranty period.

1. Warranty Period: 10 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 GENERAL SPD REQUIREMENTS

A. SPD with Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

B. Comply with NFPA 70.


D. Comply with NFPA 780 & UL96A Lighting Protection System Master Label.

E. MCOV of the SPD shall be the nominal system voltage.

2.2 SERVICE ENTRANCE OR TRANSFER SWITCH SUPPRESSOR

A. Basis-of-Design Product: Subject to compliance with requirements, provide products by one of the following:

1. LEA International.
2. PQ Protection.
3. Advanced Protection Technologies Inc (APT).

B. SPDs: Comply with UL 1449, Type 1.

1. SPDs shall have the following features and accessories:

   a. Integral disconnect switch.
   b. Modular design (with field replaceable modules redundant per phase and redundant per mode).
   c. SPD’s shall be mounted external to the panel; internally mounted SPD’s are not acceptable.
   d. Internal thermal protection that disconnects the SPD before damaging internal suppressor components.
   e. Indicator light display for protection status.
f. Form-C contacts rated at 5 A and 250-V ac, one normally open and one normally closed, for remote monitoring of protection status.
g. Surge counter.
h. Audible alarm, with silencing switch to indicate when protection has failed.

C. Comply with UL 1283.

D. **Peak Surge Current Rating:** The minimum single-pulse surge current withstand rating per phase shall not be less than 300 kA. The peak surge current rating shall be the arithmetic sum of the ratings of the individual MOVs in a given mode.

E. **Protection modes and UL 1449 VPR (clamping voltage) for grounded wye circuits with 480Y/277 V or 208Y/120 V, three-phase, four-wire circuits shall not exceed the following:**
   1. Line to Neutral: 1200 V for 480Y/277 V or 800 V for 208Y/120 V.
   2. Line to Ground: 1200 V for 480Y/277 V or 1200 V for 208Y/120 V.
   3. Line to Line: 2000 V for 480Y/277 V or 1000 V for 208Y/120 V.

F. **Protection modes and UL 1449 VPR for 240/120 V, single-phase, three-wire circuits shall not exceed the following:**
   1. Line to Neutral: 700 V.
   2. Line to Ground: 1000 V.
   3. Line to Line: 1000 V.

G. SCCR: Equal or exceed 200 kA.

H. Inominal Rating: 20 kA.

### 2.3 PANEL SUPPRESSORS

A. **Basis-of-Design Product:** Subject to compliance with requirements, provide products by one of the following:
   1. LEA International.
   2. PQ Protection.
   3. Advanced Protection Technologies Inc (APT).

B. **SPDs:** Comply with UL 1449, Type 2.
   1. SPDs shall have the following features and accessories:
      a. Compact, non-modular design.
      b. SPD’s shall be mounted external to the panel; internally mounted SPD’s are not acceptable.
      c. Internal thermal protection that disconnects the SPD before damaging internal suppressor components.
      d. Indicator light display for protection status.
      e. Form-C contacts rated at 5 A and 250-V ac, one normally open and one normally closed, for remote monitoring of protection status.
      f. Audible alarm, with silencing switch to indicate when protection has failed.

C. **Peak Surge Current Rating:** The minimum single-pulse surge current withstand rating per phase shall not be less than the following:
1. 100A – 400A branch panelboards: 100kA.
2. 600A – 1200A distribution panelboards: 200kA.
3. The peak surge current rating shall be the arithmetic sum of the ratings of the individual MOVs in a given mode.

D. Protection modes and UL 1449 VPR for grounded wye circuits with 480Y/277 V or 208Y/120 V, three-phase, four-wire circuits shall not exceed the following:

1. Line to Neutral: 1200 V for 480Y/277 V or 800 V for 208Y/120 V.
2. Line to Ground: 1200 V for 480Y/277 V or 700 V for 208Y/120 V.
3. Neutral to Ground: 1200 V for 480Y/277 V or 700 V for 208Y/120 V.
4. Line to Line: 2000 V for 480Y/277 V or 1200 V for 208Y/120 V.

E. Protection modes and UL 1449 VPR for 240/120-V, single-phase, three-wire circuits shall not exceed the following:

1. Line to Neutral: 700 V.
2. Line to Ground: 700 V.
3. Neutral to Ground: 700 V.
4. Line to Line: 1200 V.

F. SCCR: Equal or exceed 200 kA.

G. Innominal Rating: 20 kA.

2.4 ENCLOSURES

A. Indoor Enclosures: NEMA 250, Type 1.

B. Outdoor Enclosures: NEMA 250, Type 4.

2.5 CONDUCTORS AND CABLES

A. Power Wiring: Same size as SPD leads, complying with Section 26 05 19 "Low-Voltage Electrical Power Conductors and Cables."

B. Class 2 Control Cables: Multiconductor cable with copper conductors not smaller than No. 18 AWG, complying with Section 26 05 19 "Low-Voltage Electrical Power Conductors and Cables."

C. Class 1 Control Cables: Multiconductor cable with copper conductors not smaller than No. 14 AWG, complying with Section 26 05 19 "Low-Voltage Electrical Power Conductors and Cables."

PART 3 - EXECUTION

3.1 INSTALLATION

A. Comply with NECA 1.

B. Install an OCPD (sized per manufacturer’s recommendation) as required to comply with the UL listing of the SPD.

C. Verify all voltages before connecting to avoid injury and damage to equipment.

D. The SPDs shall be installed external to switchboard, distribution panel, or branch panel.
E. Install SPDs with conductors between suppressor and points of attachment as short and straight as possible, and adjust circuit-breaker positions to achieve shortest and straightest leads. Do not splice and extend SPD leads unless specifically permitted by manufacturer. Do not exceed manufacturer's recommended lead length. Do not bond neutral and ground.

F. Refer to manufacturer's installation manual for further details.

G. Use crimped connectors and splices only. Wire nuts are unacceptable.

H. Wiring:
   1. Power Wiring: Comply with wiring methods in Section 26 05 19 "Low-Voltage Electrical Power Conductors and Cables."
   2. Controls: Comply with wiring methods in Section 26 05 19 "Low-Voltage Electrical Power Conductors and Cables."

3.2 FIELD QUALITY CONTROL

A. Perform the following tests and inspections:
   1. Compare equipment nameplate data for compliance with Drawings and Specifications.
   2. Inspect anchorage, alignment, grounding, and clearances.
   3. Verify that electrical wiring installation complies with manufacturer's written installation requirements.

B. An SPD will be considered defective if it does not pass tests and inspections.

3.3 STARTUP SERVICE

A. Complete startup checks according to manufacturer's written instructions.

B. Do not perform insulation-resistance tests of the distribution wiring equipment with SPDs installed. Disconnect SPDs before conducting insulation-resistance tests, and reconnect them immediately after the testing is over.

C. Energize SPDs after power system has been energized, stabilized, and tested.

3.4 DEMONSTRATION

A. Train owner's maintenance personnel to operate and maintain SPDs.

END OF SECTION 26 43 13
SECTION 26 51 00
INTERIOR LIGHTING

PART 1 - GENERAL

1.1 SUMMARY
A. Section Includes:
   1. Interior lighting fixtures, lamps, ballasts, LEDs, and drivers.
   2. Emergency lighting units.
   3. Exit signs.
   4. Lighting fixture supports.

1.2 DEFINITIONS
A. BF: Ballast factor.
B. CCT: Correlated color temperature.
C. CRI: Color-rendering index.
D. HID: High-intensity discharge.
E. LER: Luminaire efficacy rating.
F. Lumen: Measured output of lamp and luminaire, or both.
G. Luminaire: Complete lighting fixture, including ballast housing if provided.

1.3 SUBMITTALS
A. Product Data: For each type of lighting fixture, arranged in order of fixture designation. Include data on features, accessories, finishes, and the following:
   1. Physical description of lighting fixture including dimensions.
   2. Ballast, including BF.
   4. Photometric data and adjustment factors based on laboratory tests, complying with IESNA Lighting Measurements Testing & Calculation Guides, of each lighting fixture type. The adjustment factors shall be for lamps, ballasts, and accessories identical to those indicated for the lighting fixture as applied in this Project.
B. Installation instructions.
C. Operation and Maintenance Data: For lighting equipment and fixtures to include in emergency, operation, and maintenance manuals.
   1. Provide a list of all lamp types used on Project; use ANSI and manufacturers’ codes.
1.4 QUALITY ASSURANCE
A. Luminaire Photometric Data Testing Laboratory Qualifications: Provided by manufacturers’ laboratories that are accredited under the National Volunteer Laboratory Accreditation Program for Energy Efficient Lighting Products.
B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
C. Comply with NFPA 70.

1.5 COORDINATION
A. Coordinate layout and installation of lighting fixtures and suspension system with other construction that penetrates ceilings or is supported by them, including HVAC equipment, fire-suppression system, and partition assemblies.

PART 2 - PRODUCTS
2.1 MANUFACTURERS
A. Products: Subject to compliance with requirements, provide product indicated on Drawings

2.2 GENERAL REQUIREMENTS FOR LIGHTING FIXTURES AND COMPONENTS
A. Recessed Fixtures: Comply with NEMA LE 4 for ceiling compatibility for recessed fixtures.
B. Incandescent Fixtures: Comply with UL 1598. Where LER is specified, test according to NEMA LE 5A.
C. Fluorescent Fixtures: Comply with UL 1598. Where LER is specified, test according to NEMA LE 5 and NEMA LE 5A as applicable.
D. Metal Parts: Free of burrs and sharp corners and edges.
E. Sheet Metal Components: Steel unless otherwise indicated. Form and support to prevent warping and sagging.
F. Doors, Frames, and Other Internal Access: Smooth operating, free of light leakage under operating conditions, and designed to permit relamping without use of tools. Designed to prevent doors, frames, lenses, diffusers, and other components from falling accidentally during relamping and when secured in operating position.
G. Diffusers and Globes:
   1. Acrylic Lighting Diffusers: 100 percent virgin acrylic plastic. High resistance to yellowing and other changes due to aging, exposure to heat, and UV radiation.
      a. Lens Thickness: At least 0.125 inch minimum unless otherwise indicated.
      b. UV stabilized.
   2. Additional specifications for diffusers and globes...
H. Factory-Applied Labels: Comply with UL 1598. Include recommended lamps and ballasts. Labels shall be located where they will be readily visible to service personnel, but not seen from normal viewing angles when lamps are in place.

1. Label shall include the following lamp and ballast characteristics:
   a. "USE ONLY" and include specific lamp type.
   b. Lamp diameter code (T-4, T-5, T-8, T-12, etc.), tube configuration (twin, quad, triple, etc.), base type, and nominal wattage for fluorescent and compact fluorescent luminaires.
   c. Lamp type, wattage, bulb type (ED17, BD56, etc.) and coating (clear or coated) for HID luminaires.
   d. Start type (preheat, rapid start, instant start, etc.) for fluorescent and compact fluorescent luminaires.
   e. ANSI ballast type (M98, M57, etc.) for HID luminaires.
   f. CCT and CRI for all luminaires.

2.3 BALLASTS FOR LINEAR FLUORESCENT LAMPS

A. General Requirements for Electronic Ballasts:

1. Comply with UL 935 and with ANSI C82.11.
2. Designed for type and quantity of lamps served.
3. Ballasts shall be designed for full light output unless another BF, dimmer, or bi-level control is indicated.
4. Sound Rating: Class A.
5. Total Harmonic Distortion Rating: Less than 10 percent.
6. Transient Voltage Protection: IEEE C62.41.1 and IEEE C62.41.2, Category A or better.
7. Operating Frequency: 42 kHz or higher.
8. Lamp Current Crest Factor: 1.7 or less.
9. BF: 0.88 or higher.
10. Power Factor: 0.95 or higher.

B. Luminaires controlled by occupancy sensors shall have programmed-start ballasts.

C. Ballasts for Dimmer-Controlled Lighting Fixtures: Electronic type.

1. Dimming Range: 100 to 5 percent of rated lamp lumens.
2. Ballast Input Watts: Can be reduced to 20 percent of normal.
3. Compatibility: Certified by manufacturer for use with specific dimming control system and lamp type indicated.
4. Control: Coordinate wiring from ballast to control device to ensure that the ballast, controller, and connecting wiring are compatible.

2.4 BALLASTS FOR COMPACT FLUORESCENT LAMPS

A. Description: Electronic-programmed rapid-start type, complying with UL 935 and with ANSI C 82.11, designed for type and quantity of lamps indicated. Ballast shall be designed for full light output unless dimmer or bi-level control is indicated:

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 Rating: Less than 20 percent.
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. BF: 0.95 or higher unless otherwise indicated.
9. Power Factor: 0.95 or higher.
10. Interference: Comply with 47 CFR 18, Ch. 1, Subpart C, for limitations on electromagnetic and radio-frequency interference for nonconsumer equipment.

2.5 DRIVERS FOR LED FIXTURES

A. Electronic Driver for LED Fixtures: Comply with UL 1310 Class 2 requirements for dry and damp locations. Include the following features unless otherwise indicated:
   1. Rated for 50,000 hours of life, unless otherwise noted.
   2. Sound Rating: Class A.
   3. Total Harmonic Distortion Rating: 20 percent or less.
   4. Current Crest Factor: 1.5 or less.
   5. 0-10V Dimming Standard (Step Dimming does not qualify).

2.6 EMERGENCY POWER UNIT

A. Internal Type: Self-contained, modular, battery-inverter unit, factory mounted within lighting fixture body and compatible with ballast. Comply with UL 924.
   1. Emergency Connection: Operate fluorescent lamp(s) or LEDs continuously at an output of 1400 lumens each. Connect unswitched circuit to battery-inverter unit and switched circuit to fixture ballast.
   2. Nightlight Connection: Operate lamp or LEDs continuously.
   3. 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.
   5. Charger: Fully automatic, solid-state, constant-current type with sealed power transfer relay.
   6. Integral Self-Test: Factory-installed electronic device automatically initiates code-required test of unit emergency operation at required intervals. Test failure is annunciated by an integral audible alarm and a flashing red LED.

2.7 EXIT SIGNS

A. General Requirements for Exit Signs: Comply with UL 924; for sign colors, visibility, luminance, and lettering size, comply with authorities having jurisdiction.

B. Internally Lighted Signs:
   1. Operating at nominal voltage of 120 V ac or 277 V ac.
   2. Lamps for AC Operation: LEDs; 50,000 hours minimum rated lamp life.
   3. Self-Powered Exit Signs (Battery Type): Internal emergency power unit.
2.8 FLUORESCENT LAMPS

A. T8 rapid-start lamps, rated 32 W maximum, nominal length of 48 inches, 2800 initial lumens (minimum), CRI 75 (minimum), color temperature 4100 K, and average rated life 20,000 hours unless otherwise indicated.

B. Compact Fluorescent Lamps: 4-Pin, CRI 80 (minimum), color temperature 4100 K, average rated life of 10,000 hours at three hours operation per start unless otherwise indicated.
   1. 26 W: T4, double or triple tube, rated 1800 initial lumens (minimum).
   2. 32 W: T4, triple tube, rated 2400 initial lumens (minimum).
   3. 42 W: T4, triple tube, rated 3200 initial lumens (minimum).

2.9 LED FIXTURES

A. Except as otherwise indicated, provide LED luminaires, of types and sizes indicated on fixture schedules.

B. Include the following features unless otherwise indicated:
   1. Each Luminaire shall consist of an assembly that utilizes edge-lit LEDs as the light source. In addition, a complete luminaire shall consist of a housing, LED array, and electronic driver (power supply).
   2. Luminaire optics shall consist of precision formed optical assembly with positively retained high grade acrylic lenses using laser precise micro-prism patterns to provide directional distribution.
   3. Each luminaire shall be rated for a minimum operational life of 60,000 hours utilizing a minimum ambient temperature of (25°C).
   4. Light Emitting Diodes tested under LM-80 Standards for a minimum of 12,000 hours.
   5. Color Rendering Index (CRI) of 82 at a minimum (85 Typical).
   6. Color temperature 3500 K, unless otherwise indicated.
   7. Rated lumen maintenance at 84% lumen output for 60,000 hours, unless otherwise indicated.
   9. Fixture depth shall be no greater than 4.75 inches.
   10. 5 year luminaire warranty, minimum.
   11. Photometry must comply with IESNA LM-79.
   12. Luminaires shall be Design Lights Consortium Qualified.
   13. The individual LEDs shall be constructed such that a catastrophic loss of the failure of one LED will not result in the loss of the entire luminaire.
   14. Luminaire shall be constructed such that driver may be replaced or repaired without the replacement of the whole fixture.
   15. Luminaires shall be UL 1598 and UL 2043 listed.

C. Technical Requirements
   1. The luminaire shall not consume power in the off state.
   2. Operation Voltage: The luminaire shall operate from a 50 HZ to 60 HZ AC line over a voltage ranging from 120 VAC to 277 VAC. The fluctuations of line voltage shall have no visible effect on the luminous output.
   3. Power Factor: The luminaire shall have a power factor of 0.9 or greater.
   4. THD: Total harmonic distortion (current and voltage) induced into an AC power line by a luminaire shall not exceed 20 percent.
   5. Operational Performance: The LED circuitry shall prevent visible flicker to the unaided eye over the voltage range specified above.
D. Thermal Management

1. The thermal management (of the heat generated by the LEDs) shall be of sufficient capacity to assure proper operation of the luminaire over the expected useful life.
2. The LED manufacturer’s maximum thermal pad temperature for the expected life shall not be exceeded.
3. Thermal management shall be passive by design. The use of fans or other mechanical devices shall not be allowed.
4. The luminaire shall have a minimum heat sink surface such that LED manufacturer’s maximum junction temperature is not exceeded at maximum rated ambient temperature.

2.10 LIGHTING FIXTURE SUPPORT COMPONENTS

A. Single-Stem Hangers: 1/2-inch steel tubing with swivel ball fittings and ceiling canopy. Finish same as fixture.

B. Twin-Stem Hangers: Two, 1/2-inch steel tubes with single canopy designed to mount a single fixture. Finish same as fixture.


D. Wires for Humid Spaces: ASTM A 580/A 580M, Composition 302 or 304, annealed stainless steel, 12 gage.

E. Rod Hangers: 3/16-inch minimum diameter, cadmium-plated, threaded steel rod.

F. Hook Hangers: Integrated assembly matched to fixture and line voltage and equipped with threaded attachment, cord, and locking-type plug.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Lighting fixtures:

1. Set level, plumb, and square with ceilings and walls unless otherwise indicated.
2. Install lamps in each luminaire.

B. Temporary Lighting: If it is necessary, and approved by Architect, to use permanent luminaires for temporary lighting, install and energize the minimum number of luminaires necessary. When construction is sufficiently complete, remove the temporary luminaires, disassemble, clean thoroughly, install new lamps, and reinstall.

C. Lay-in Ceiling Lighting Fixtures Supports: Use grid as a support element.

1. Install ceiling support system rods or wires, independent of the ceiling suspension devices, for each fixture. Locate not more than 6 inches from lighting fixture corners.
2. Support Clips: Fasten to lighting fixtures and to ceiling grid members at or near each fixture corner with clips that are UL listed for the application.
3. Fixtures of Sizes Less Than Ceiling Grid: Install as indicated on reflected ceiling plans or center in acoustical panel, and support fixtures independently with at least two 3/4-inch metal channels spanning and secured to ceiling tees.
4. Install at least one independent support rod or wire from structure to a tab on lighting fixture. Wire or rod shall have breaking strength of the weight of fixture at a safety factor of 3.

D. Suspended Lighting Fixture Support:

1. Pendants and Rods: Where longer than 48 inches, brace to limit swinging.
3. Continuous Rows: Use tubing or stem for wiring at one point and tubing or rod for suspension for each unit length of fixture chassis, including one at each end.
4. Do not use grid as support for pendant luminaires. Connect support wires or rods to building structure.

3.2 IDENTIFICATION

A. Install labels with panel and circuit numbers on concealed junction and outlet boxes. Identify light fixtures that are fed by an emergency generator with a label stating “EMERGENCY SERVICE”. Place label on the ballast near the wire terminations.

3.3 FIELD QUALITY CONTROL

A. Test for Emergency Lighting: Interrupt power supply to demonstrate proper operation. Verify transfer from normal power to emergency power and retransfer to normal.

3.4 STARTUP SERVICE

A. Burn-in all lamps that require specific aging period to operate properly, prior to occupancy by Owner. Burn-in fluorescent and compact fluorescent lamps intended to be dimmed, for at least 100 hours at full voltage.

END OF SECTION 26 51 00
PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Exterior luminaires with LEDs and drivers.

1.2 DEFINITIONS

A. CCT: Correlated color temperature.

B. CRI: Color-rendering index.

C. HID: High-intensity discharge.

D. LER: Luminaire efficacy rating.

E. Luminaire: Complete lighting fixture, including ballast housing if provided.

1.3 SUBMITTALS

A. Product Data: For each luminaire and support component, arranged in order of lighting unit designation. Include data on features, accessories, finishes, and the following:

1. Physical description of luminaire, including materials, dimensions, effective projected area, and verification of indicated parameters.
2. Details of attaching luminaires and accessories.
3. Details of installation and construction.
4. Luminaire materials.
5. Photometric data based on laboratory tests of each luminaire type, complete with indicated lamps, ballasts, and accessories.

1.4 QUALITY ASSURANCE

A. Luminaire Photometric Data Testing Laboratory Qualifications: Provided by manufacturers’ laboratories that are accredited under the National Volunteer Laboratory Accreditation Program for Energy Efficient Lighting Products.

B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.


D. Comply with NFPA 70.

1.5 WARRANTY

A. Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace products that fail in materials or workmanship; that corrode; or that fade, stain, perforate, erode, or chalk due to effects of weather or solar radiation within specified warranty period. Manufacturer may exclude lightning damage, hail damage, vandalism, abuse, or unauthorized repairs or alterations from special warranty coverage.

1. Warranty Period for Luminaires: One year with extended warranties provided by manufacturers.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Products: Subject to compliance with requirements, provide product indicated on Drawings.

2.2 GENERAL REQUIREMENTS FOR LUMINAIRES

A. Luminaires shall comply with UL 1598 and be listed and labeled for installation in wet locations by an NRTL acceptable to authorities having jurisdiction.

1. LER Tests Fluorescent Fixtures: Where LER is specified, test according to NEMA LE 5 and NEMA LE 5A as applicable.

2. LER Tests HID Fixtures: Where LER is specified, test according to NEMA LE 5B.

B. Lateral Light Distribution Patterns: Comply with IESNA RP-8 for parameters of lateral light distribution patterns indicated for luminaires.

C. Metal Parts: Free of burrs and sharp corners and edges.

D. Sheet Metal Components: Corrosion-resistant aluminum unless otherwise indicated. Form and support to prevent warping and sagging.

E. Housings: Rigidly formed, weather- and light-tight enclosures that will not warp, sag, or deform in use. Provide filter/breather for enclosed luminaires.

F. Doors, Frames, and Other Internal Access: Smooth operating, free of light leakage under operating conditions, and designed to permit relamping without use of tools. Designed to prevent doors, frames, lenses, diffusers, and other components from falling accidentally during relamping and when secured in operating position. Doors shall be removable for cleaning or replacing lenses. Designed to disconnect ballast when door opens.

G. Exposed Hardware Material: Stainless steel.

H. Plastic Parts: High resistance to yellowing and other changes due to aging, exposure to heat, and UV radiation.

I. Light Shields: Metal baffles, factory installed and field adjustable, arranged to block light distribution to indicated portion of normally illuminated area or field.

J. Reflecting surfaces shall have minimum reflectance as follows unless otherwise indicated:

1. White Surfaces: 85 percent.
2. Specular Surfaces: 83 percent.
3. Diffusing Specular Surfaces: 75 percent.

K. Lenses and Refractors Gaskets: Use heat- and aging-resistant resilient gaskets to seal and cushion lenses and refractors in luminaire doors.

L. Luminaire Finish: Manufacturer's standard paint applied to factory-assembled and -tested luminaire before shipping. Where indicated, match finish process and color of pole or support materials.

M. Factory-Applied Finish for Steel Luminaires: Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.

1. Surface Preparation: Clean surfaces to comply with SSPC-SP 1, "Solvent Cleaning," to remove dirt, oil, grease, and other contaminants that could impair paint bond. Grind welds and polish surfaces to a smooth, even finish. Remove mill scale and rust, if present, from uncoated steel, complying with SSPC-SP 5/NACE No. 1, "White Metal Blast Cleaning," or SSPC-SP 8, "Pickling."

2. Exterior Surfaces: Manufacturer's standard finish consisting of one or more coats of primer and two finish coats of high-gloss, high-build polyurethane enamel.
   a. Color: As selected by Architect from manufacturer's full range.

N. Factory-Applied Finish for Aluminum Luminaires: Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.

1. Finish designations prefixed by AA comply with the system established by the Aluminum Association for designating aluminum finishes.
2. Natural Satin Finish: Provide fine, directional, medium satin polish (AA-M32); buff complying with AA-M20; and seal aluminum surfaces with clear, hard-coat wax.
3. Class I, Color Anodic Finish: AA-M32C22A42/A44 (Mechanical Finish: medium satin; Chemical Finish: etched, medium matte; Anodic Coating: Architectural Class I, integrally colored or electrolytically deposited color coating 0.018 mm or thicker) complying with AAMA 611.
   a. Color: As selected by Architect from manufacturer's full range.

O. Factory-Applied Labels: Comply with UL 1598. Include recommended lamps and ballasts. Labels shall be located where they will be readily visible to service personnel, but not seen from normal viewing angles when lamps are in place.

1. Label shall include the following lamp and ballast characteristics:
   a. "USES ONLY" and include specific lamp type.
   b. Lamp diameter code (T-4, T-5, T-8, T-12), tube configuration (twin, quad, triple), base type, and nominal wattage for fluorescent and compact fluorescent luminaires.
   c. Lamp type, wattage, bulb type (ED17, BD56, etc.) and coating (clear or coated) for HID luminaires.
   d. Start type (preheat, rapid start, instant start) for fluorescent and compact fluorescent luminaires.
   e. ANSI ballast type (M98, M57, etc.) for HID luminaires.
   f. CCT and CRI for all luminaires.
2.3 LED LUMINAIRS

A. General: Except as otherwise indicated, provide LED luminaires, of types and sizes indicated on fixture schedules.

B. Material and specifications for each luminaire are as follows:

1. Each Luminaire shall consist of an assembly that utilizes LEDs as the light source. In addition, a complete luminaire shall consist of a housing, LED array, and electronic driver (power supply).
2. Each luminaire shall be rated for a minimum operational life of 50,000 hours at an average operating time of 11.5 hours per night at 40°C (104°F).
3. The rated operating temperature range shall be -30°C (-22°F) to +40°C (104°F).
4. Each luminaire is capable of operating above 104°F (40°C), but not expected to comply with photometric requirements at elevated temperatures.
5. Photometry must be compliant with IESNA LM-79 and shall be conducted at 25°C ambient temperature.
6. Each luminaire shall meet all parameters of this specification throughout the minimum operational life when operated at the average nighttime temperature.
7. The individual LEDs shall be constructed such that a catastrophic loss or the failure of one LED will not result in the loss of the entire luminaire.
8. Luminaire shall be constructed such that LED modules may be replaced or repaired without replacement of whole luminaire.
9. Each luminaire shall be listed with Underwriters Laboratory, Inc. under UL1598 for luminaires, or an approved equivalent standard from a nationally recognized testing laboratory.

PART 3 - EXECUTION

3.1 LUMINAIRE INSTALLATION

A. Install lamps in each luminaire.

B. Fasten luminaire to indicated structural supports.

1. Use fastening methods and materials selected to resist seismic forces defined for the application and approved by manufacturer.

C. Adjust luminaires that require field adjustment or aiming.

3.2 CORROSION PREVENTION

A. Aluminum: Do not use in contact with earth or concrete. When in direct contact with a dissimilar metal, protect aluminum by insulating fittings or treatment.

B. Steel Conduits: Comply with Section 26 05 33 "Raceways and Boxes for Electrical Systems." In concrete foundations, wrap conduit with 0.010-inch- thick, pipe-wrapping plastic tape applied with a 50 percent overlap.

3.3 GROUNDING

A. Ground metal poles and support structures according to Division 26 Section "Grounding and Bonding."
1. Install grounding electrode for each pole unless otherwise indicated.
2. Install grounding conductor pigtail in the base for connecting luminaire to grounding system.

B. Ground nonmetallic poles and support structures according to Division 26 Section "Grounding and Bonding."

1. Install grounding electrode for each pole.
2. Install grounding conductor and conductor protector.
3. Ground metallic components of pole accessories and foundations.

3.4 FIELD QUALITY CONTROL

A. Inspect each installed fixture for damage. Replace damaged fixtures and components.

B. Illumination Observations: Verify normal operation of lighting units after installing luminaires and energizing circuits with normal power source.

1. Verify operation of photoelectric controls.

END OF SECTION 26 56 00
PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Fire-alarm control unit.
   3. System smoke detectors.
   7. Addressable interface device.
   8. Digital alarm communicator transmitter.
  10. System printer.

1.2 DEFINITIONS

A. EMT: Electrical Metallic Tubing.
B. FACP: Fire Alarm Control Panel.
C. NICET: National Institute for Certification in Engineering Technologies.

1.3 SUBMITTALS

A. Product Data: For each type of product, including furnished options and accessories.
   1. Include construction details, material descriptions, dimensions, profiles, and finishes.
   2. Include rated capacities, operating characteristics, and electrical characteristics.

B. Shop Drawings: For fire-alarm system.
   1. Comply with recommendations and requirements in the "Documentation" section of the "Fundamentals" chapter in NFPA 72.
   2. Include plans, elevations, sections, details, and attachments to other work.
   3. Include details of equipment assemblies. Indicate dimensions, weights, loads, required clearances, method of field assembly, components, and locations. Indicate conductor sizes, indicate termination locations and requirements, and distinguish between factory and field wiring.
   4. Detail assembly and support requirements.
   5. Include voltage drop calculations for notification-appliance circuits.
   6. Include battery-size calculations.
   7. Include input/output matrix.
   8. Include statement from manufacturer that all equipment and components have been tested as a system and meet all requirements in this Specification and in NFPA 72.
   9. Include performance parameters and installation details for each detector.
   10. Verify that each duct detector is listed for complete range of air velocity, temperature, and humidity possible when air-handling system is operating.
11. Include voice/alarm signaling-service equipment rack or console layout, grounding schematic, amplifier power calculation, and single-line connection diagram.
12. Include floor plans to indicate final outlet locations showing address of each addressable device. Show size and route of cable and conduits and point-to-point wiring diagrams.

C. General Submittal Requirements:
1. Submittals shall be approved by authorities having jurisdiction prior to submitting them to Architect.
2. Shop Drawings shall be prepared by persons with the following qualifications:
   a. Trained and certified by manufacturer in fire-alarm system design.
   b. NICET-certified, fire-alarm technician; Level IV minimum.

D. Delegated-Design Submittal: For notification appliances and smoke and heat detectors, in addition to submittals listed above, indicate compliance with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.
1. Drawings showing the location of each notification appliance and smoke and heat detector, ratings of each, and installation details as needed to comply with listing conditions of the device.
2. Design Calculations: Calculate requirements for selecting the spacing and sensitivity of detection, complying with NFPA 72. Calculate spacing and intensities for strobe signals and sound-pressure levels for audible appliances.
3. Indicate audible appliances required to produce square wave signal per NFPA 72.

E. Qualification Data: For Installer.
F. Field quality-control reports.
G. Sample Warranty.

1.4 CLOSEOUT SUBMITTALS
A. Operation and Maintenance Data: For fire-alarm systems and components to include in emergency, operation, and maintenance manuals.
1. In addition to items specified in Section 01 78 23 "Operation and Maintenance Data," include the following:
   a. Comply with the "Records" section of the "Inspection, Testing and Maintenance" chapter in NFPA 72.
   b. Provide "Fire Alarm and Emergency Communications System Record of Completion Documents" according to the "Completion Documents" Article in the "Documentation" section of the "Fundamentals" chapter in NFPA 72.
   c. Complete wiring diagrams showing connections between all devices and equipment. Each conductor shall be numbered at every junction point with indication of origination and termination points.
   d. Riser diagram.
   e. Device addresses.
   f. Air-sampling system sample port locations and modeling program report showing layout meets performance criteria.
   g. Record copy of site-specific software.
h. Provide "Inspection and Testing Form" according to the "Inspection, Testing and Maintenance" chapter in NFPA 72, and include the following:
   1) Equipment tested.
   2) Frequency of testing of installed components.
   3) Frequency of inspection of installed components.
   4) Requirements and recommendations related to results of maintenance.
   5) Manufacturer's user training manuals.

i. Manufacturer's required maintenance related to system warranty requirements.

j. Abbreviated operating instructions for mounting at fire-alarm control unit and each annunciator unit.

B. Software and Firmware Operational Documentation:
   1. Software operating and upgrade manuals.
   2. Program Software Backup: On magnetic media or compact disk, complete with data files.
   3. Device address list.
   4. Printout of software application and graphic screens.

1.5 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 III technician.

C. NFPA Certification: Obtain certification according to NFPA 72 by a UL-listed alarm company.

1.6 WARRANTY

A. Special Warranty: Manufacturer agrees to repair or replace fire-alarm system equipment and components that fail in materials or workmanship within specified warranty period.
   1. Warranty Extent: All equipment and components not covered in the Maintenance Service Agreement.
   2. Warranty Period: One year from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 SYSTEM DESCRIPTION

A. Noncoded, UL-certified addressable system, with multiplexed signal transmission and voice/strobe evacuation.

B. All components provided shall be listed for use with the selected system.

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 SYSTEMS OPERATIONAL DESCRIPTION

A. Fire-alarm signal initiation shall be by one or more of the following devices and systems:
2. Heat detectors.
3. Flame detectors.
4. Smoke detectors.
5. Duct smoke detectors.

B. Fire-alarm signal shall initiate the following actions:

1. Continuously operate alarm notification appliances, including voice evacuation notices.
2. Identify alarm and specific initiating device at fire-alarm control unit and remote annunciators.
3. Transmit an alarm signal to the remote alarm receiving station.
4. Switch heating, ventilating, and air-conditioning equipment controls to fire-alarm mode.
5. Recall elevators to primary or alternate recall floors.
6. Activate elevator power shunt trip.
7. Activate emergency lighting control.
8. Record events in the system memory.
9. Record events by the system printer.
10. Indicate device in alarm on the graphic annunciator.

C. Supervisory signal initiation shall be by one or more of the following devices and actions:

1. Valve supervisory switch.
2. High- or low-air-pressure switch of a dry-pipe or preaction sprinkler system.
3. Elevator shunt-trip supervision.
4. User disabling of zones or individual devices.
5. Loss of communication with any panel on the network.

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 communication with any addressable sensor, input module, relay, control module, remote annunciator, printer interface, or Ethernet module.
4. Loss of primary power at fire-alarm control unit.
5. Ground or a single break in internal circuits of fire-alarm control unit.
6. Abnormal ac voltage at fire-alarm control unit.
7. Break in standby battery circuitry.
8. Failure of battery charging.
9. Abnormal position of any switch at fire-alarm control unit or annunciator.
11. Hose cabinet door open.

2.3 FIRE-ALARM CONTROL UNIT

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Notifier.
2. Simplex Grinnell
3. Silent Knight.
4. Edwards EST.
B. General Requirements for Fire-Alarm Control Unit:

1. Field-programmable, microprocessor-based, modular, power-limited design with electronic modules, complying with UL 864.
   a. System software and programs shall be held in nonvolatile flash, electrically erasable, programmable, read-only memory, retaining the information through failure of primary and secondary power supplies.
   b. Include a real-time clock for time annotation of events on the event recorder and printer.
   c. Provide communication between the FACP and remote circuit interface panels, annunciators, and displays.
   d. The FACP shall be listed for connection to a central-station signaling system service.
   e. Provide nonvolatile memory for system database, logic, and operating system and event history. The system shall require no manual input to initialize in the event of a complete power down condition. The FACP shall provide a minimum 500-event history log.

2. Addressable Initiation Device Circuits: The FACP shall indicate which communication zones have been silenced and shall provide selective silencing of alarm notification appliance by building communication zones.

3. Addressable Control Circuits for Operation of Notification Appliances and Mechanical Equipment: The FACP shall be listed for releasing service.

C. Alphanumeric Display and System Controls: Arranged for interface between human operator at fire-alarm control unit and addressable system components including annunciation and supervision. Display alarm, supervisory, and component status messages and the programming and control menu.

1. Annunciator and Display: Liquid-crystal type, 80 characters, minimum.
2. Keypad: Arranged to permit entry and execution of programming, display, and control commands.

D. Initiating-Device, Notification-Appliance, and Signaling-Line Circuits:

1. Pathway Class Designations: NFPA 72, Class B.
2. Notification Appliance Circuits: Style W.
5. Install number of addressable devices as per recommendations/requirements from system supplier
6. Serial Interfaces:
   a. One dedicated RS 485 port for central-station operation using point ID DACT.
   b. One RS 485 port for remote annunciators, Ethernet module, or multi-interface module (printer port).
   c. One USB port for PC configuration.
   d. One RS 232 port for VESDA HLI connection.
   e. One RS 232 port for voice evacuation interface.

E. Smoke-Alarm Verification:

1. Initiate audible and visible indication of an "alarm-verification" signal at fire-alarm control unit.
2. Activate an approved "alarm-verification" sequence at fire-alarm control unit and detector.
3. 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.

F. Notification-Appliance Circuit:
1. Audible appliances shall sound in a three-pulse temporal pattern, as defined in NFPA 72.
2. Where notification appliances provide signals to sleeping areas, the alarm signal shall be a 520-Hz square wave with an intensity 15 dB above the average ambient sound level or 5 dB above the maximum sound level, or at least 75 dBA, whichever is greater, measured at the pillow.
3. Visual alarm appliances shall flash in synchronization where multiple appliances are in the same field of view, as defined in NFPA 72.

G. Elevator Recall:
1. Elevator recall shall be initiated only by one of the following alarm-initiating devices:
   a. Elevator lobby detectors except the lobby detector on the designated floor.
   b. Smoke detectors in elevator hoistway.
2. Elevator controller shall be programmed to move the cars to the alternate recall floor if lobby detectors located on the designated recall floors are activated.
3. Water-flow alarm connected to sprinkler in an elevator shaft shall shut down elevators associated with the location without time delay.
   a. Water-flow switch associated with the sprinkler in the elevator pit may have a delay to allow elevators to move to the designated floor.

H. Voice/Alarm Signaling Service: Central emergency communication system with redundant microphones, preamplifiers, amplifiers, and tone generators provided as a special module that is part of fire-alarm control unit.
1. Indicate number of alarm channels for automatic, simultaneous transmission of different announcements to different zones or for manual transmission of announcements by use of the central-control microphone. Amplifiers shall comply with UL 1711.
   a. Allow the application of, and evacuation signal to, indicated number of zones and, at the same time, allow voice paging to the other zones selectively or in any combination.
   b. Programmable tone and message sequence selection.
   c. Standard digitally recorded messages for "Evacuation" and "All Clear."
   d. Generate tones to be sequenced with audio messages of type recommended by NFPA 72 and that are compatible with tone patterns of notification-appliance circuits of fire-alarm control unit.

I. Transmission to Remote Alarm Receiving Station: Automatically transmit alarm, supervisory, and trouble signals to a remote alarm station.

J. Printout of Events: On receipt of signal, print alarm, supervisory, and trouble events. Identify zone, device, and function. Include type of signal (alarm, supervisory, or trouble) and date and time of occurrence. Differentiate alarm signals from all other printed indications. Also print system reset event, including same information for device, location, date, and time. Commands initiate the printing of a list of existing alarm, supervisory, and trouble conditions in the system and a historical log of events.
K. Primary Power: 24-V dc obtained from 120-V ac service and a power-supply module. Initiating devices, notification appliances, signaling lines, trouble signals, supervisory signals, and digital alarm communicator transmitters shall be powered by 24-V dc source.

1. Alarm current draw of entire fire-alarm system shall not exceed 80 percent of the power-supply module rating.

L. Secondary Power: 24-V dc supply system with batteries, automatic battery charger, and automatic transfer switch.


M. Instructions: Computer printout or typewritten instruction card mounted behind a plastic or glass cover in a stainless-steel or aluminum frame. Include interpretation and describe appropriate response for displays and signals. Briefly describe the functional operation of the system under normal, alarm, and trouble conditions.

2.4 MANUAL FIRE-ALARM BOXES

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. Notifier.
2. Silent Knight.
3. SimplexGrinnell LP.

B. 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, pull-lever 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.
3. Weatherproof Protective Shield: Factory-fabricated, clear plastic enclosure hinged at the top to permit lifting for access to initiate an alarm.

2.5 SYSTEM SMOKE DETECTORS

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-Lite Alarms.
2. Gentex Corporation.
4. Silent Knight.
5. SimplexGrinnell LP.
B. 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.

C. 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.).

D. Ionization Smoke Detector:
   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.).

E. 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 for smoke detection in HVAC system ducts.
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.

2.6 HEAT DETECTORS

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-Lite Alarms.
2. Gentex Corporation.
4. Silent Knight.
5. SimplexGrinnell LP.

B. General Requirements for Heat Detectors: Comply with UL 521.

1. Temperature sensors shall test for and communicate the sensitivity range of the device.

C. Heat Detector, Combination Type: Actuated by either a fixed temperature of 135 deg F or a rate of rise that exceeds 15 deg F per minute unless otherwise indicated.

1. Mounting: Adapter plate for outlet box mounting.
2. Integral Addressable Module: Arranged to communicate detector status (normal, alarm, or trouble) to fire-alarm control unit.

2.7 NOTIFICATION APPLIANCES

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:

2. SimplexGrinnell LP.

B. 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.

C. 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.

1. Combination Devices: Factory-integrated audible and visible devices in a single-mounting assembly, equipped for mounting as indicated, and with screw terminals for system connections.

D. Chimes, Low-Level Output: Vibrating type, 75-dBA minimum rated output.

E. Chimes, High-Level Output: Vibrating type, 81-dBA minimum rated output.
F. Horns: Electric-vibrating-polarized type, 24-V dc; with provision for housing the operating mechanism behind a grille. Comply with UL 464. Horns shall produce a sound-pressure level of 90 dBA, measured 10 feet from the horn, using the coded signal prescribed in UL 464 test protocol.

G. Visible Notification Appliances: Xenon strobe lights complying with UL 1971, with clear or nominal white polycarbonate lens mounted on an aluminum faceplate. The word “FIRE” is engraved in minimum 1-inch- high letters on the lens.
   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.

H. Voice/Tone Notification Appliances:
   1. Comply with UL 1480.
   2. Speakers for Voice Notification: Locate speakers for voice notification to provide the intelligibility requirements of the "Notification Appliances" and "Emergency Communications Systems" chapters in NFPA 72.
   3. High-Range Units: Rated 2 to 15 W.
   4. Low-Range Units: Rated 1 to 2 W.
   5. Mounting: Surface mounted and bidirectional.
   6. Matching Transformers: Tap range matched to acoustical environment of speaker location.

I. Exit Marking Audible Notification Appliance:
   1. Exit marking audible notification appliances shall meet the audibility requirements in NFPA 72.
   2. Provide exit marking audible notification appliances at the entrance to all building exits.
   3. Provide exit marking audible notification appliances at the entrance to areas of refuge with audible signals distinct from those used for building exit marking.

2.8 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.
2.9 ADDRESSABLE INTERFACE DEVICE

A. General:
1. Include address-setting means on the module.
2. Store an internal identifying code for control panel use to identify the module type.
3. Listed for controlling HVAC fan motor controllers.

B. Monitor Module: Microelectronic module providing a system address for alarm-initiating devices for wired applications with normally open contacts.

C. Integral Relay: Capable of providing a direct signal to circuit-breaker shunt trip for power shutdown.

1. Allow the control panel to switch the relay contacts on command.
2. Have a minimum of two normally open and two normally closed contacts available for field wiring.

D. Control Module:
1. Operate notification devices.
2. Operate solenoids for use in sprinkler service.

2.10 DIGITAL ALARM COMMUNICATOR TRANSMITTER

A. Digital alarm communicator transmitter shall be acceptable to the remote central station and shall comply with UL 632.

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.
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.
5. Loss of power.
6. Low battery.
7. Abnormal test signal.

E. Secondary Power: Integral rechargeable battery and automatic charger.

F. Self-Test: Conducted automatically every 24 hours with report transmitted to central station.

2.11 NETWORK COMMUNICATIONS
A. Provide network communications for fire-alarm system according to fire-alarm manufacturer's written requirements.
B. Provide network communications pathway per manufacturer's written requirements and requirements in NFPA 72 and NFPA 70.
C. Provide integration gateway using BACnet or Modbus for connection to building automation system.

2.12 SYSTEM PRINTER
A. Printer shall be listed and labeled as an integral part of fire-alarm system.

2.13 DEVICE GUARDS
A. Description: Welded wire mesh of size and shape for the manual station, smoke detector, gong, or other device requiring protection.
   1. Factory fabricated and furnished by device manufacturer.
   2. Finish: Paint of color to match the protected device.

PART 3 - EXECUTION
3.1 EXAMINATION
A. Examine areas and conditions for compliance with requirements for ventilation, temperature, humidity, and other conditions affecting performance of the Work.
   1. Verify that manufacturer's written instructions for environmental conditions have been permanently established in spaces where equipment and wiring are installed, before installation begins.
B. Examine roughing-in for electrical connections to verify actual locations of connections before installation.
C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 EQUIPMENT INSTALLATION
A. Comply with NFPA 72, NFPA 101, and requirements of authorities having jurisdiction for installation and testing of fire-alarm equipment. Install all electrical wiring to comply with requirements in NFPA 70 including, but not limited to, Article 760, "Fire Alarm Systems."
   1. Devices placed in service before all other trades have completed cleanup shall be replaced.
2. Devices installed but not yet placed in service shall be protected from construction dust, debris, dirt, moisture, and damage according to manufacturer's written storage instructions.

B. Install wall-mounted equipment, with tops of cabinets not more than 78 inches above the finished floor.

C. Manual Fire-Alarm Boxes:

1. Install manual fire-alarm box in the normal path of egress within 60 inches of the exit doorway.
3. The operable part of manual fire-alarm box shall be between 42 inches and 48 inches above floor level. All devices shall be mounted at the same height unless otherwise indicated.

D. Smoke- or Heat-Detector Spacing:

1. Comply with the "Smoke-Sensing Fire Detectors" section in the "Initiating Devices" chapter in NFPA 72, for smoke-detector spacing.
2. Comply with the "Heat-Sensing Fire Detectors" section in the "Initiating Devices" chapter in NFPA 72, for heat-detector spacing.
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 Annex A or Annex B in NFPA 72.
5. HVAC: Locate detectors not closer than 36 inches from air-supply diffuser or return-air opening.
6. Lighting Fixtures: Locate detectors not closer than 12 inches from any part of a lighting fixture and not directly above pendant mounted or indirect lighting.

E. Install a cover on each smoke detector that is not placed in service during construction. Cover shall remain in place except during system testing. Remove cover prior to system turnover.

F. Duct Smoke Detectors: Comply with NFPA 72 and NFPA 90A. Install sampling tubes so they extend the full width of duct. Tubes more than 36 inches long shall be supported at both ends.

   1. Do not install smoke detector in duct smoke-detector housing during construction. Install detector only during system testing and prior to system turnover.

G. Single-Station Smoke Detectors: Where more than one smoke alarm is installed within a dwelling or suite, they shall be connected so that the operation of any smoke alarm causes the alarm in all smoke alarms to sound.

H. Remote Status and Alarm Indicators: Install in a visible location near each smoke detector, sprinkler water-flow switch, and valve-tamper switch that is not readily visible from normal viewing position.

I. Audible Alarm-Indicating Devices: Install not less than 6 inches below the ceiling. Install bells and horns on flush-mounted back boxes with the device-operating mechanism concealed behind a grille. Install all devices at the same height unless otherwise indicated.

J. Visible Alarm-Indicating Devices: Install adjacent to each alarm bell or alarm horn and at least 6 inches below the ceiling. Install all devices at the same height unless otherwise indicated.
K. Device Location-Indicating Lights: Locate in public space near the device they monitor.

3.3 PATHWAYS

A. Pathways above recessed ceilings and in nonaccessible locations may be routed exposed.
   1. Exposed pathways located less than 96 inches above the floor shall be installed in EMT.

B. Pathways shall be installed in EMT.

C. Exposed EMT shall be painted red enamel.

3.4 CONNECTIONS

A. For fire-protection systems related to doors in fire-rated walls and partitions and to doors in smoke partitions, comply with requirements in Section 08 71 00 "Door Hardware." Connect hardware and devices to fire-alarm system.
   1. Verify that hardware and devices are listed for use with installed fire-alarm system before making connections.

B. Make addressable connections with a supervised interface device to the following devices and systems. Install the interface device less than 36 inches from the device controlled. Make an addressable confirmation connection when such feedback is available at the device or system being controlled.
   1. Alarm-initiating connection to smoke-control system (smoke management) at firefighters’ smoke-control system panel.
   2. Alarm-initiating connection to stairwell and elevator-shaft pressurization systems.
   3. Smoke dampers in air ducts of designated HVAC duct systems.
   4. Alarm-initiating connection to elevator recall system and components.
   5. Alarm-initiating connection to activate emergency lighting control.
   6. Alarm-initiating connection to activate emergency shutoffs for gas and fuel supplies.
   7. Supervisory connections at elevator shunt-trip breaker.
   8. Data communication circuits for connection to building management system.

3.5 IDENTIFICATION

A. Identify system components, wiring, cabling, and terminals. Comply with requirements for identification specified in Section 26 05 53 "Identification for Electrical Systems."

B. Install framed instructions in a location visible from fire-alarm control unit.

3.6 GROUNDING

A. Ground fire-alarm control unit and associated circuits; comply with IEEE 1100. Install a ground wire from main service ground to fire-alarm control unit.

B. Ground shielded cables at the control panel location only. Insulate shield at device location.

3.7 FIELD QUALITY CONTROL

A. Manufacturer's Field Service: Engage a factory-authorized service representative to test and inspect components, assemblies, and equipment installations, including connections.
B. Perform the following tests and inspections:

1. Visual Inspection: Conduct visual inspection prior to testing.
   a. Inspection shall be based on completed record Drawings and system documentation that is
      required by the "Completion Documents, Preparation" table in the "Documentation" section of
      the "Fundamentals" chapter in NFPA 72.
   b. Comply with the "Visual Inspection Frequencies" table in the "Inspection" section of the
      "Inspection, Testing and Maintenance" chapter in NFPA 72; retain the "Initial/Reacceptance"
      column and list only the installed components.

2. System Testing: Comply with the "Test Methods" table in the "Testing" section of the "Inspection,
   Testing and Maintenance" chapter in NFPA 72.

3. Test audible appliances for the public operating mode according to manufacturer's written instructions.
   Perform the test using a portable sound-level meter complying with Type 2 requirements in ANSI S1.4.

4. Test audible appliances for the private operating mode according to manufacturer's written instructions.

5. Test visible appliances for the public operating mode according to manufacturer's written instructions.

6. Factory-authorized service representative shall prepare the "Fire Alarm System Record of Completion"
   in the "Documentation" section of the "Fundamentals" chapter in NFPA 72 and the "Inspection and
   Testing Form" in the "Records" section of the "Inspection, Testing and Maintenance" chapter in
   NFPA 72.

C. Reacceptance Testing: Perform reacceptance testing to verify the proper operation of added or replaced
   devices and appliances.

D. Fire-alarm system will be considered defective if it does not pass tests and inspections.

E. Prepare test and inspection reports.

F. Maintenance Test and Inspection: Perform tests and inspections listed for weekly, monthly, quarterly, and
   semiannual periods. Use forms developed for initial tests and inspections.

G. Annual Test and Inspection: One year after date of Substantial Completion, test fire-alarm system complying
   with visual and testing inspection requirements in NFPA 72. Use forms developed for initial tests and
   inspections.

3.8 MAINTENANCE SERVICE

A. Initial Maintenance Service: Beginning at Substantial Completion, maintenance service shall include 12 months' 
   full maintenance by skilled employees of manufacturer's designated service organization. Include preventive 
   maintenance, repair or replacement of worn or defective components, lubrication, cleaning, and adjusting as 
   required for proper operation. Parts and supplies shall be manufacturer's authorized replacement parts and 
   supplies.

1. Include visual inspections according to the "Visual Inspection Frequencies" table in the "Testing" 
   paragraph of the "Inspection, Testing and Maintenance" chapter in NFPA 72.
2. Perform tests in the "Test Methods" table in the "Testing" paragraph of the "Inspection, Testing and 
   Maintenance" chapter in NFPA 72.
3. Perform tests per the "Testing Frequencies" table in the "Testing" paragraph of the "Inspection, Testing 
   and Maintenance" chapter in NFPA 72.
3.9 SOFTWARE SERVICE AGREEMENT

A. Comply with UL 864.

B. Technical Support: Beginning at Substantial Completion, service agreement shall include software support for two years.

C. Upgrade Service: At Substantial Completion, update software to latest version. Install and program software upgrades that become available within two years from date of Substantial Completion. Upgrading software shall include operating system and new or revised licenses for using software.

   1. Upgrade Notice: At least 30 days to allow Owner to schedule access to system and to upgrade computer equipment if necessary.

3.10 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain fire-alarm system.

END OF SECTION 28 31 11