SECTION 01 1000

SUMMARY

1.01 PROJECT TEAM

Project Name: Cerrillos Senior Center & Turquoise Trail Fire Station #3.

A. Owner's Name: Santa Fe County.
B. Owner's Representative: Curt Temple Santa Fe Country Public Works Project Manager
C. Architect's Name: Lloyd & Associates Architects.

1.01 CONTRACT DESCRIPTION

A. Contract Type: Santa Fe County's Two prime contract based on a Stipulated Price as described in Document 00 5200 - Agreement Form; See Santa Fe County 'front end'.

1.02 SUMMARY OF SCOPE OF WORK

A. Provide and coordinate PNM electrical line extension. (See PNM Electric Line Extension Agreement. Dated 7-30-2019).
B. Provide Utilities to site as shown in drawings and specifications.
C. Provide new site work as shown on drawings and specifications.
D. Provide to new buildings as shown on drawings and specifications

1.03 WORK BY OWNER

A. Items noted NIC (Not in Contract) will be supplied and installed by Owner before Substantial Completion. items include:
   1. None fixed Worktables in Commercial Kitchen.
   2. Furniture & Furnishings.
   3. Small equipment.
   4. Artwork.
   5. Shelving.

1.04 WORK PROVIDED BY OWNER THAT COORDINATES WITH WORK IN CONTRACT

A. Items noted NIC (Not in Contract) that will be supplied and installed by Owner before Substantial Completion and relate to work In Contract and require coordination by contractor items include:
   1. Security system fixtures.
   2. Data wire pulling and fixture terminations (Pathways, rough-in and backbox's are in contractor).
   3. IT Racks
   4. AV Equipment.
   5. Kiln
   6. Specialty Equipment.
      a. Bunker Gear Extractor.
      b. Apparatus Bay Exhaust Control System.
   7. Photovoltaic System and shade structure.
   8. Electric car charging stations.

1.04 FUTURE WORK

A. A location to the west has been preserved for future expansion of the fire station however this work has not been designed or phased in any way.

1.05 OWNER OCCUPANCY

A. Owner intends to occupy the entire Project upon completion of work.

1.06 CONTRACTOR USE OF SITE AND PREMISES

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. Provide secured access to adjacent roadway through construction.
   2. Do not obstruct roadways, sidewalks, or other public ways without permit.

C. Utility Outages and Shutdown:
   1. Prevent accidental disruption of utility services to other facilities.

1.07 WORK SEQUENCE

A. Coordinate construction schedule and operations with Architect and Owner.

PART 2 PRODUCTS - NOT USED

PART 3 EXECUTION - NOT USED

END OF SECTION 01 1000

SECTION 01 2500

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.

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 specifiedproduct.

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 thesubmitter:

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.

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:

b. Substitution Request Information:

c. Attached Comparative Data: Provide point-by-point, side-by-side comparison addressing essential attributes specified, as appropriate and relevant for the item:

d. Impact of Substitution:

E. Limit each request to a single proposed substitution item.

3.02 SUBSTITUTION PROCEDURES DURING CONSTRUCTION

A. 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.

B. 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 projectschedule.

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.

C. Substitutions will not be considered under one or more of the followingcircumstances:

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 the Contract Documents.

3.03 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 rejectrequest.

3.04 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.

3.05 CLOSEOUT ACTIVITIES

A. See Section 01 7800 - 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 2500

SECTION 01 3000

ADMINISTRATIVE REQUIREMENTS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. General administrative requirements.

B. Preconstruction meeting.

C. Site mobilization meeting.

D. Progress meetings.

E. Construction progress schedule.

F. Progress photographs.

G. Submittals for review, information, and project closeout.

H. Number of copies of submittals.

I. Requests for Information (RFI) procedures.

J. Submittal procedures.

1.02 RELATED REQUIREMENTS

A. Section 00 7200 - General Conditions: Dates for applications for payment.

B. Section 01 3216 - Construction Progress Schedule: Form, content, and administration of schedules.

C. Section 01 6000 - Product Requirements: General product requirements.

D. Section 01 7000 - Execution and Closeout Requirements: Additional coordinationrequirements.

E. Section 01 7800 - Closeout Submittals: Project record documents; operation and maintenance data; warranties and bonds.

1.03 REFERENCE STANDARDS

A. AIA G716 - Request for Information; 2004.

B. AIA G810 - Transmittal Letter; 2001.

1.04 GENERAL ADMINISTRATIVE REQUIREMENTS

A. Conform to requirements of Section 01 7000 - 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 Information (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 PRECONSTRUCTION MEETING

A. Owner will schedule a meeting after Notice of Award.

B. Attendance Required:

1. Owner.
2. Architect.
3. Contractor.

C. Agenda:

1. Execution of Owner-Contractor Agreement.
2. Submission of executed bonds and insurance certificates.
3. Distribution of Contract Documents.
4. Submission of list of subcontractors, list of products, schedule of values, and progress schedule.
5. Procedures and processing of field decisions, submittals, substitutions, applications for payments, proposal request, Change Orders, and Contract closeout procedures.
6. Scheduling.
7. Scheduling activities of a Geotechnical Engineer.

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.

3.02 SITE MOBILIZATION MEETING

A. Owner will schedule meeting at the Project site prior to Contractor occupancy.

B. Attendance Required:

1. Contractor.
2. Owner.
3. Architect.
4. Special consultants.
5. Contractor's superintendent.
6. 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.
6. Security and housekeeping procedures.
7. Schedules.
8. Application for payment procedures.
9. Procedures for testing.
10. Procedures for maintaining record documents.
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.

3.03 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.
6. Review of RFIs log and status of responses.
7. Maintenance of progress schedule.
8. Corrective measures to regain projected schedules.
9. Planned progress during succeeding work period.
10. Maintenance of quality and work standards.
11. Effect of proposed changes on progress schedule and coordination.
12. 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 decisionsmade.

3.04 CONSTRUCTION PROGRESS SCHEDULE - SEE SECTION 01 3216

A. Within 10 days after date of the Agreement, submit preliminary schedule defining planned operations for the first 60 days of work, with a general outline for remainder ofwork.

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. Submit updated schedule with each Application for Payment.

3.05 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. In addition to periodic, recurring views, take photographs of each of the following events:

D. 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.

E. 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. 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.

3.06 REQUESTS FOR INFORMATION (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 the 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 the 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 .

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 the 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 6000 - Product Requirements)

c. Changes that entail change in Contract Time and Contract Sum (comply with provisions of the Conditions of the Contract).

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

F. 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.

G. Review Time: Architect will respond and return RFIs to Contractor within fourteen 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.

H. 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.

3.07 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 conformance with information given and the design concept expressed in the 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 7800 - Closeout Submittals.

3.08 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. No action will be taken

.

3.09 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 conformance to requirements of Section 01 7800 - Closeout Submittals:

1. Project record documents.

2. Operation and maintenance data.

3. Warranties.

4. Bonds.

5. Other types as indicated.

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

3.10 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. Documents for Review, only if required by the Architect for project specificelements:

1. Small Size Sheets, Not Larger Than 12 by 18 inches inches: Submit the number of copies that Contractor requires, plus two copies that will be retained byArchitect.

C. Documents for Information: Submit two copies if physical copies are provided..

D. Extra Copies at Project Closeout: See Section 01 7800.

E. 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 sostated.

3.11 SUBMITTAL PROCEDURES

A. General Requirements:

1. Use a separate transmittal for each item.

2. Submit separate packages of submittals for review and submittals for information, when included in the same specification section.

B. Submit Submittal Schedule during project mobilization.

1. Information to include in Schedule

a. Submittal Description.

b. Sub-contractor (if any).

c. Date Submittal to be issued.

d. Date of expected return.

2. Submittal schedule shall become part of contract once Architect has reviewed and approved it. If submittal schedule does not meet the requirements of these technical specifications, Architect will supply contractor with a corrected schedule that conforms with the specifications.

3. If multiple Submittals are submitted to Architect or Owner within the same 15 day review window contractor shall prioritize each submittal.

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. 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. The 15 day review time applies to one submittal at a time, if multiple submittals are issued with-in the same review window, each submittal shall be prioritized by the contractor and will have their own respective review window.

8. Identify variations from Contract Documents and product or system limitations that may be detrimental to successful performance of the completed work.

9. Provide space for Contractor and Architect review stamps.

10. When revised for resubmission, identify all changes made since previous submission.

11. Distribute reviewed submittals. Instruct parties to promptly report inability to comply with requirements.

12. 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.

13. Submittals not requested will be recognized, and will be returned "Not Reviewed",

C. Product Data Procedures:

1. Submit only information required by individual specification sections.

2. Collect required information into a single submittal.

3. Do not submit (Material) Safety Data Sheets for materials or products.

D. Shop Drawing Procedures:

1. Prepare accurate, drawn-to-scale, original shop drawing documentation by interpreting the Contract Documents and coordinating related work.

2. Generic, non-project-specific information submitted as shop drawings do not meet the requirements for shop drawings.

E. 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.

3.12 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.

D. Architect's and consultants' actions on items submitted for review:

1. Authorizing purchasing, fabrication, delivery, and installation:

a. "Accepted as Submitted", or language with same legal meaning.

b. "Accepted 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.

b. "Not Accepted".

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 for Processing, No Action Required" - to notify the Contractor that the submittal has been received for record only.

F. Architect's review and action is only for conformance with the design concept of the work and with the information given in the Contract Documents. Architect's acceptance of a specific item shall not indicate acceptance of an assembly of which the item is a component.

END OF SECTION 01 3000

SECTION 01 3216

CONSTRUCTION PROGRESS SCHEDULE

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Preliminary schedule.

B. Construction progress schedule, bar chart type.

1.01 RELATED SECTIONS

A. Section 01 1000 - Summary: Work sequence.

1.02 REFERENCE STANDARDS

A. AGC (CPSM) - Construction Planning and Scheduling Manual; 2004.

1.03 SUBMITTALS

A. Within 10 days after date of Agreement, submit preliminary schedule defining planned operations for the first 30 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.

D. Submit updated schedule with each Application for Payment.

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. Diagram Sheet Size: Maximum 22 x 17 inches.

C. Sheet Size: Multiples of 8-1/2 x 11 inches.

D. 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. Show accumulated percentage of completion of each item, and total percentage of Work completed, as of the first day of each month.

E. 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 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.

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 3216

SECTION 01 3553

SECURITY PROCEDURES

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Security measures including formal security program, entry control, personnel identification, guard service.

1.02 RELATED REQUIREMENTS

A. Section 01 1000 - Summary: use of premises and occupancy.

B. Section 01 5000 - Temporary Facilities and Controls: Temporary lighting.

1.03 SECURITY PROGRAM

A. Protect Work from theft, vandalism, and unauthorized entry.

1.04 ENTRY CONTROL

A. Restrict entrance of persons and vehicles into Project site,

B. Allow entrance only to authorized persons with proper identification.

C. Maintain log of workers and visitors, make available to Owner on request.

PART 2 PRODUCTS - NOT USED PART 3

EXECUTION - NOT USED

END OF SECTION 01 3553

SECTION 01 4000

QUALITY REQUIREMENTS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. References and standards.

B. Testing and inspection agencies and services.

C. Control of installation.

D. Tolerances.

E. Manufacturers' field services.

F. Defect Assessment.

1.02 RELATED REQUIREMENTS

A. Document 00 3100 - Available Project Information: Soil investigation data.

B. Section 01 4216 - Definitions.

1.03 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. Conform to 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 the Contract Documents by mention or inference otherwise in any reference document.

1.04 TESTING AND INSPECTION AGENCIES AND SERVICES

A. Owner will employ and pay for services of an independent testing agency to perform specified testing.

B. Employment of agency in no way relieves Contractor of obligation to perform Work in accordance with requirements of Contract Documents.

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 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.

3.03 TESTING AND INSPECTION

A. See individual specification sections for testing and inspection required.

B. Testing Agency Duties:

1. Provide qualified personnel at site. Cooperate with Architect and Contractor in performance of services.

2. Perform specified sampling and testing of products in accordance with specified standards.

3. Ascertain compliance of materials and mixes with requirements of Contract Documents.

4. Promptly notify Architect and Contractor of observed irregularities or non-conformance of Work or products.

5. Perform additional tests and inspections required by Architect.

6. Submit reports of all tests/inspections specified.

C. 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.

D. 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.

E. Re-testing required because of non-conformance to specified requirements shall be performed by the same agency on instructions by Architect.

F. Re-testing required because of non-conformance to specified requirements shall be paid for by Contractor.

3.04 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.

3.05 DEFECT ASSESSMENT

A. Replace Work or portions of the Work not conforming to specified requirements.

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

END OF SECTION 01 4000

SECTION 01 4216

DEFINITIONS

PART 1 GENERAL

1.01 SUMMARY

A. Other definitions are included in individual specification sections.

1.02 DEFINITIONS

A. Furnish: To supply, deliver, unload, and inspect for damage.

B. Install: To unpack, assemble, erect, apply, place, finish, cure, protect, clean, start up, and make ready for use.

C. Product: Material, machinery, components, equipment, fixtures, and systems forming the work result. Not materials or equipment used for preparation, fabrication, conveying, or erection and not incorporated into the work result. Products may be new, never before used, or re-used materials or equipment.

D. Provide: To furnish and install.

E. Supply: Same as Furnish.

PART 2 PRODUCTS - NOT USED

PART 3 EXECUTION - NOT USED

END OF SECTION 01 4216

SECTION 01 5000

TEMPORARY FACILITIES AND CONTROLS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Temporary telecommunications services.

B. Temporary sanitary facilities.

C. Temporary Controls: Barriers, enclosures, and fencing.

D. Security requirements.

E. Vehicular access and parking.

F. Waste removal facilities and services.

G. Project identification sign.

1.02 TELECOMMUNICATIONS SERVICES

A. Provide, maintain, and pay for telecommunications services to field office at time of project mobilization.

1.03 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.

1.04 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. Protect non-owned vehicular traffic, stored materials, site, and structures from damage.

1.05 FENCING

A. Provide 6 foot high fence around construction site; equip with vehicular and pedestrian gates with locks.

1.06 SECURITY - SEE SECTION 01 3553

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

B. Coordinate with Owner's security program.

1.07 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.

1.08 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.

1.10 PROJECT IDENTIFICATION

A. Provide project identification sign of design, construction, and location approved by Owner.

B. No other signs are allowed without Owner permission except those required by law.

1.11 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 10 persons.

1.12 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.

PART 2 PRODUCTS - NOT USED PART 3

EXECUTION - NOT USED

END OF SECTION 01 5000

SECTION 01 5100

TEMPORARY UTILITIES

PART 1 GENERAL

1.01 Section includes

A. Temporary Utilities: Provision of electricity, lighting, heat, ventilation, and water.

1.02 RELATED REQUIREMENTS

A. Section 01 5000 - Temporary Facilities and Controls:

1. Temporary telecommunications services for administrative purposes.

2. Temporary sanitary facilities required by law.

1.03 REFERENCE STANDARDS

A. 29 CFR 1926 - U.S. Occupational Safety and Health Standards; current edition.

1.04 TEMPORARY ELECTRICITY

A. Cost: By contractor.

B. Provide Power to Project Site.

1. Existing Project Site does not have power.

2. Contractor shall provide extension of PNM electrical Service.

a. See 00 2000 INFORMATION AVAILABLE.

3. Temporary power shall be from temporary power pole coordinated & provided by contractor once power line extension is completed.

4. Previous to power line extension being completed, contactor shall provide other means of temporary power.

a. Diesel Generators shall be used.

b. Contractor my submit alternative means of temporary power with Owner and Architect approval.

5. Exercise measures to conserve energy.

C. Provide temporary electric feeder from existing building electrical service at location as directed.

D. Complement existing power service capacity and characteristics as required.

E. Provide power outlets for construction operations, with branch wiring and distribution boxes located at each floor. Provide flexible power cords as required.

F. Provide main service disconnect and over-current protection at convenient location and meter.

G. Permanent convenience receptacles may be utilized during construction.

1.05 TEMPORARY LIGHTING FOR CONSTRUCTION PURPOSES

A. Provide and maintain LED, compact fluorescent, or high-intensity discharge lighting as suitable for the application for construction operations in accordance with requirements of 29 CFR 1926 and authorities having jurisdiction.

B. Provide and maintain 1 watt/sq ft lighting to exterior staging and storage areas after dark for security purposes.

C. Provide and maintain 0.25 watt/sq ft H.I.D. lighting to interior work areas after dark for security purposes.

D. Provide branch wiring from power source to distribution boxes with lighting conductors, pigtails, and lamps as required.

E. Maintain lighting and provide routine repairs.

F. Permanent building lighting may be utilized during construction.

1.06TEMPORARY HEATING

A. Cost of Energy: By contractor.

B. Provide heating devices and heat as needed to maintain specified conditions for construction operations.

C. Maintain minimum ambient temperature of 50 degrees F in areas where construction is in progress, unless indicated otherwise in specifications.

D. Prior to operation of permanent equipment for temporary heating purposes, verify that installation is approved for operation, equipment is lubricated and filters are in place. Provide and pay for operation, maintenance, and regular replacement of filters and worn or consumed parts.

1.07TEMPORARY COOLING

A. Cost of Energy: By contractor.

B. Provide cooling devices and cooling as needed to maintain specified conditions for construction operations.

C. Maintain maximum ambient temperature of 80 degrees F in areas where construction is in progress, unless indicated otherwise in specifications.

D. Prior to operation of permanent equipment for temporary cooling purposes, verify that installation is approved for operation, equipment is lubricated and filters are in place. Provide and pay for operation, maintenance, and regular replacement of filters and worn or consumed parts.

1.08TEMPORARY VENTILATION

A. Utilize temporary fan units as required to maintain clean air for construction operations.

1.09TEMPORARY WATER SERVICE

A. Cost of Water Used: By Contractor.

B. Provide and maintain suitable quality water service for construction operations at time of project mobilization.

C. No existing water source on site; Contractor scope of work includes extending adjacent water line to site.

1. Until waterline extension is complete contractor shall provide water sufficient for construction by water tuck.

2. Exercise measures to conserve water.

D. Extend branch piping with outlets located so water is available by hoses with threaded connections. Provide temporary pipe insulation to prevent freezing.

PART 2 PRODUCTS - NOT USED P

ART 3 EXECUTION - NOT USED

END OF SECTION 01 5100

SECTION 01 6000

PRODUCT REQUIREMENTS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. General product requirements.

B. Re-use of existing products.

C. Transportation, handling, storage and protection.

D. Product option requirements.

E. Substitution limitations.

F. Procedures for Owner-supplied products.

G. Maintenance materials, including extra materials, spare parts, tools, and software.

1.02 RELATED REQUIREMENTS

A. Section 01 2500 - Substitution Procedures: Substitutions made during and after the Bidding/Negotiation Phase.

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 the Contract Documents.

B. DO NOT USE products having any of the following characteristics:

1. Made using or containing CFC's or HCFC's.

2. Made of wood from newly cut old growth timber.

3. Containing lead, cadmium, asbestos.

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 2500 - 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 economicallyfeasible.

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.

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

C. Store with seals and labels intact and legible.

D. Store sensitive products in weather tight, climate controlled, enclosures in an environment favorable to product.

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

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

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

H. Do not store products directly on the ground.

I. Cover products subject to deterioration with impervious sheet covering. Provide ventilation to prevent condensation and degradation of products.

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

K. Prevent contact with material that may cause corrosion, discoloration, orstaining.

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

M. 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 6000

SECTION 01 7000

EXECUTION AND CLOSEOUT REQUIREMENTS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Examination, preparation, and general installation procedures.

B. Requirements for alterations work, including selective demolition.

C. Pre-installation meetings.

D. Cutting and patching.

E. Surveying for laying out the work.

F. Cleaning and protection.

G. Starting of systems and equipment.

H. Demonstration and instruction of Owner personnel.

I. Closeout procedures, including Contractor's Correction Punch List, except payment procedures.

J. General requirements for maintenance service.

1.02 RELATED REQUIREMENTS

A. Section 01 1000 - Summary: Limitations on working in existing building; continued occupancy; work sequence; identification of salvaged and relocated materials.

B. Section 01 3000 - Administrative Requirements: Submittals procedures.

C. Section 01 5000 - Temporary Facilities and Controls: Temporary exterior enclosures.

D. Section 01 5000 - Temporary Facilities and Controls: Temporary interior partitions.

E. Section 01 5100 - Temporary Utilities: Temporary heating, cooling, and ventilating facilities.

F. Section 07 8400 - Firestopping.

1.03 REFERENCE STANDARDS

A. NFPA 241 - Standard for Safeguarding Construction, Alteration, and Demolition Operations; 2013.

1.04 QUALIFICATIONS

A. For surveying work, employ a land surveyor registered in New Mexico 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,

1.05 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. Ventilate enclosed areas to assist cure of materials, to dissipate humidity, and to prevent accumulation of dust, fumes, vapors, or gases.

D. Dust Control: Execute work by methods to minimize raising dust from construction operations. Provide positive means to prevent air-borne dust from dispersing into atmosphere and over adjacent property.

1. Provide dust-proof enclosures to prevent entry of dust generated outdoors.

2. Provide dust-proof barriers between construction areas and areas continuing to be occupied by Owner.

E. 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.

F. Noise Control: Provide methods, means, and facilities to minimize noise produced by construction operations.

G. Pest and Rodent Control: Provide methods, means, and facilities to prevent pests and insects from damaging the work.

H. 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.

1.06 COORDINATION

A. See Section 01 1000 for occupancy-related requirements.

B. Coordinate scheduling, submittals, and work of the various sections of the Project Manual to ensure efficient and orderly sequence of installation of interdependent construction elements, with provisions for accommodating items installed later.

C. Notify affected utility companies and comply with their requirements.

D. Verify that utility requirements and characteristics of new operating equipment are compatible with building utilities. Coordinate work of various sections having interdependent responsibilities for installing, connecting to, and placing in service, such equipment.

E. Coordinate space requirements, supports, and installation of mechanical and electrical work that are indicated diagrammatically on drawings. Follow routing indicated for pipes, ducts, and conduit, as closely as practicable; place runs parallel with lines of building. Utilize spaces efficiently to maximize accessibility for other installations, for maintenance, and for repairs.

F. In finished areas except as otherwise indicated, conceal pipes, ducts, and wiring within the construction. Coordinate locations of fixtures and outlets with finish elements.

G. Coordinate completion and clean-up of work of separate sections.

H. After Owner occupancy of premises, coordinate access to site for correction of defective work and work not in accordance with Contract Documents, to minimize disruption of Owner's activities.

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 6000 - 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 miss fabrication.

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 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.

J. Periodically verify layouts by same means.

K. Maintain a complete and accurate log of control and survey work as it progresses.

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. See Alterations article above for additional requirements.

C. 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-conforming work.

D. 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.

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 8400, 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.

3.10 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. When specified in individual specification Sections, require manufacturer to provide authorized representative to be present at site to inspect, check, and approve equipment or system installation prior to start-up, and to supervise placing equipment or system in operation.

G. Submit a written report that equipment or system has been properly installed and is functioning correctly.

3.11 DEMONSTRATION AND INSTRUCTION

A. Demonstrate start-up, operation, control, adjustment, trouble-shooting, servicing, maintenance, and shutdown of each item of equipment at scheduled time, at equipment location.

B. For equipment or systems requiring seasonal operation, perform demonstration for other season within six months.

C. Provide a qualified person who is knowledgeable about the Project to perform demonstration and instruction of Owner's personnel.

3.12 ADJUSTING

A. Adjust operating products and equipment to ensure smooth and unhindered operation.

3.13 FINAL CLEANING

A. Execute final cleaning prior to final project assessment.

1. Clean areas to be occupied by Owner prior to final completion beforeOwner occupancy.

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, 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.

3.14 CLOSEOUT PROCEDURES

A. Make submittals that are required by governing or other authorities.

1. Provide copies to Architect and Owner.

B. Notify Architect when work is considered ready for Architect's Substantial Completion inspection.

C. 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.

D. Owner will occupy portions of the building as specified in Section 011000.

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.

3.15 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 7000

SECTION 01 7123

FIELD ENGINEERING

PART 1 GENERAL

A. **SECTION INCLUDES** Field engineering services by Contractor.

1.02 DESCRIPTION OF SERVICES

A. Specific services listed in this section are in addition to, and do not supersede, general Execution and Closeout Requirements.

B. Sole responsibility for establishing all locations, dimensions and levels of items ofwork.

C. Sole responsibility for provision of all materials required to establish and maintain benchmarks and control points, including batter boards, grade stakes, structure elevation stakes, and other items.

D. Keeping a transit, theodolite, or TST (total station theodolite with electronic distance measurement device); leveling instrument; and related implements such as survey rods and other measurement devices, at the project site at all times.

E. Provision of facilities and assistance necessary for Architect to check lines and grade points placed by Contractor.

1. Performance of excavation or embankment work until after all cross-sectioning necessary for determining payment quantities for Unit Price work have been completed and accepted by Architect.

F. Preparation and maintenance of daily reports of activity on the work. Submission of reports containing key progress indicators and job conditions to Architect.

1. Number of employees at the Site.
2. Number employees at the Site for each of Contractor's subcontractors.
3. Breakdown of employees by trades.
4. Major equipment and materials installed as part of the work.
5. Location of areas in which construction was performed.
6. Work performed, including field quality control measures and testing.
7. Weather conditions.
8. Safety.
9. Instructions received from Architect or Owner, if any.

G. Preparation and maintenance of professional-quality, accurate, well organized, legible notes of all measurements and calculations made while surveying and laying out thework.

1.03 REFERENCE STANDARDS

A. State Plane Coordinate System for New Mexico.

PART 2 PRODUCTS - NOT USED PART 3

EXECUTION

3.01 EXAMINATION

A. Verify layout information shown on Drawings, in relation to the property survey and existing benchmarks. Notify Owner's Representative and Architect of any discrepancies immediately in writing before proceeding to lay out the work. Locate and protect existing benchmarks and base line. Preserve permanent reference points during construction.

B. Existing Utilities and Equipment: The existence and location of underground and other utilities and construction indicated as existing are not guaranteed. Before beginning sitework, investigate and verify existing conditions.

3.02 FIELD ENGINEERING

A. Maintain field office files, drawings, specifications, and record documents.

B. Coordinate field engineering services with Contractor's subcontractors, installers, and suppliers as appropriate.

C. Prepare layout and coordination drawings for construction operations.

D. Check and coordinate the work for conflicts and interferences, and immediately advise Architect and Owner of all discrepancies of which Contractor is aware.

E. Cooperate as required with Architect and Owner in observing the work and performing field inspections.

F. Review and coordinate work on a regular basis with shop drawings and Contractor's other submittals.

G. Check the location, line and grade of every major element as the work progresses. Notify the Architect when deviations from required lines or grades exceed allowable tolerances. Include in such notifications a thorough explanation of the problem, and a proposed plan and schedule for remedying the deviation. Do not proceed with remedial work without Owner's concurrence of the remediation plan.

3.03 LAND SURVEYING

A. General: Follow standards for geospatial positioning accuracy.

B. Coordinate survey data with the State Plane Coordinate System of New Mexico.

C. Contractor is responsible for the restoration of all property corners and control monuments damaged or destroyed by construction-related activities. Any disturbed monuments must be replaced at Contractor's expense by a surveyor licensed in New Mexico, and approved by the Architect.

1. Temporarily suspend work at such points and for such reasonable times as the Owner may require for resetting monuments. The Contractor will not be entitled to any additional compensation or extension of time.

3.04 CONSTRUCTION SURVEYING

A. General: Perform surveying as applicable to specific items necessary for proper execution of work.

1. Alignment Staking: Provide alignment stakes at 50 foot intervals on tangent, and at 25 foot intervals on curves.

2. Slope Staking: Provide slope staking at 50 foot intervals on tangent, and at 25 foot intervals on curves. Re-stake at every ten-foot difference in elevation.

3. Structure: Stake out structures, including elevations, and check prior to and during construction.

4. Pipelines: Stake out pipelines including elevations, and check prior to and during construction.

5. Site Utilities: Stake out utility lines including elevations, and check prior to and during construction.

6. Road: Stake out roadway elevations at 50 foot intervals on tangent, and at 25 foot intervals on curves.

7. Record Staking: Provide permanent stake at each blind flange and each utility cap is provided for future connections. Use stakes for record staking of material(s) acceptable to Architect.

B. Record Log: Maintain a log of layout control work. Record any deviations from required lines and levels. Include beginning and ending dates and times of surveys, weather conditions, name and duty of each survey party member, and types of instruments and tapes used.

C. Accuracy:

1. Establish Contractor's temporary survey references points for Contractor’s use to at least second-order accuracy (e.g., 1:10000). Set construction staking used as a guide for the work to at least third-order accuracy (e.g., 1:5000). Provide the absolute margin for error specified below on the basis established by such orders.

a. Accuracy of other staking shall be plus or minus 0.04 feet horizontally and plus or minus 0.02 feet vertically.

b. Include an error analysis sufficient to demonstrate required accuracy in survey calculations.

2. Owner reserves the right to check the Contractor's survey, measurements, and calculations. The requirement for accuracy will not be waived, whether this right is exercised or not.

3.05 TIME-LAPSE PHOTOGRAPHY

A. Provide as part of Construction Progress documentation.

B. Set a pole at appropriate location(s), and provide a time-lapse camera to record the entire construction project. Camera (or cameras) is required to provide a field of view of the entire project area.

C. Provide a camera that records at one frame per second rate, or as approved by Architect. Resulting time-lapse will be viewed at standard 25 frames-per-second speed.

1. Program camera, or provide a timer-controller, to only record during construction work hours.

D. Submit to the Owner and Architect a DVD containing the raw video on a weekly basis. Submit entire digital time-lapse photography record at the conclusion of the project.

3.06 RECORDS

A. Maintain at the Site a complete and accurate log of control and survey work as it progresses.

1. Organize and record survey data in accordance with recognized professional surveying standards, Laws and Regulations, and prevailing standards of practice in New Mexico. Record Contractor's surveyor's original field notes, computations, and other surveying data in Contractor-furnished hard-bound field books. Contractor is solely responsible for completeness and accuracy of survey work, and completeness and accuracy of survey records, including field books. Survey records,(including field books) may be rejected by Owner due to failure to organize and maintain survey records in a manner that allows reasonable and independent verification of calculations, and/or allows identification of elevations, dimensions, and grades of the work.

2. Illegible notes or data, and erasures on any page of field books, are unacceptable. Do not submit copied notes or data. Corrections by ruling or lining out errors will be unacceptable unless initialed by the surveyor. Violation of these requirements may require re-surveying the data questioned by Architect.

B. Submit three copies of final property survey to Owner. Include on the survey a certification, signed by the surveyor, that principal metes, bounds, lines, and levels of the Project are accurately positioned as shown on the survey. Include the following information:

END OF SECTION 01 7123

SECTION 01 7800

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 00 7200 - General Conditions and 00 7300 - Supplementary Conditions: Performance bond and labor and material payment bonds, warranty, and correction ofwork.

B. Section 01 3000 - Administrative Requirements: Submittals procedures, shop drawings, product data, and samples.

C. Section 01 7000 - Execution and Closeout Requirements: Contract closeoutprocedures.

D. Individual Product Sections: Specific requirements for operation and maintenance data.

E. 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 afteracceptance.

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.
5. Reviewed shop drawings, product data, and samples.
6. Manufacturer's instruction for assembly, installation, and adjusting.

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 and Shop 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.

2. Information for re-ordering custom manufactured products.

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. 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. 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.

E. 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.

F. Provide servicing and lubrication schedule, and list of lubricants required.

G. Include manufacturer's printed operation and maintenance instructions.

H. Include sequence of operation by controls manufacturer.

I. Provide original manufacturer's parts list, illustrations, assembly drawings, and diagrams required for maintenance.

J. Provide control diagrams by controls manufacturer as installed.

K. Provide Contractor's coordination drawings, with color coded piping diagrams as installed.

L. Provide charts of valve tag numbers, with location and function of each valve, keyed to flow and control diagrams.

M. Provide list of original manufacturer's spare parts, current prices, and recommended quantities to be maintained in storage.

N. Include test and balancing reports.

O. 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.

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 arenotarized.

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 withdurable 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 7800

SECTION 02 4100

SITE DEMOLITION

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Selective demolition of built site elements.

B. Selective demolition of vegetation.

1.02 RELATED REQUIREMENTS

A. Section 01 1000 - Summary: Limitations on Contractor's use of site and premises.

B. Section 01 1000 - Summary: Sequencing and staging requirements.

C. Section 01 1000 - Summary: Description of items to be salvaged or removed for re-use by Contractor.

D. Section 01 5000 - Temporary Facilities and Controls: Site fences, security, protective barriers, and waste removal.

E. Section 01 6000 - Product Requirements: Handling and storage of items removed for salvage and relocation.

F. Section 01 7000 - 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.

G. Section 07 0150.19 - Preparation for Re-Roofing: Removal of existing roofing, roof insulation, flashing, trim, and accessories.

H. Section 31 1000 - Site Clearing: Vegetation and existing debris removal.

I. Section 31 2323 - Fill: Fill material for filling holes, pits, and excavations generated as a result of removal operations.

J. Section 32 9300 - Plants: Relocation of existing trees, shrubs, and other plants.

1.03 SUBMITTALS

A. See Section 01 3000 - Administrative Requirements, for submittal procedures.

B. Project Record Documents: Accurately record actual locations of capped and active utilities and subsurface construction.

PART 2 PRODUCTS -- NOT USED PART 3

EXECUTION

3.01 SCOPE

A. Remove sections of curb and gutter as shown on drawings.

B. Remove abandoned sign on site as shown on drawings.

C. Remove existing vegetation as shown on drawings.

D. Existing abandoned concrete structures on site as show.

E. Remove other items indicated, for salvage, relocation, and recycling.

F. Fill excavations, open pits, and holes in ground areas generated as result of removals, using specified fill; compact fill as specified in Section 31 2200.

SECTION 4100

SITE DEMOLITION

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. Provide, erect, and maintain temporary barriers and security devices.
2. Use physical barriers to prevent access to areas that could be hazardous to workers or the
3. public.

B. Do not begin removal until vegetation to be relocated has been removed and specified measures have been taken to protect vegetation to remain.

C. Partial Removal of Paving and Curbs: Neatly saw cut at right angle to surface.

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 on site to remain from damage.

C. Do not disrupt public utilities without permit from authority having jurisdiction.

D. 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.

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 4100

SECTION 02 5000

GEOTECHNICAL REPORT

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Geotechnical Investigation and Recommendations.

1- See separately provided document provided by owner.

a. Report by GEO-TEST, INC.

b. Titled GEOTECHNICAL ENGINEERING SERVICES REPORT

c. Report No. 1-70414

d. Dated May 23rd, 2017

END OF SECTION 02 5000

SECTION 03 3000 CAST-IN-PLACE CONCRETE

PART 1 GENERAL

1.01 Sheet Specifications provided in drawings

END OF SECTION 03 3000

SECTION 05 1200

STRUCTURAL STEEL FRAMING

PART 1

1.01 General

A. See drawings for Sheet Specifications on sheet S002.

B. See Section 13 120 for relevant specifications.

END OF SECITON 05 1200

SECTION 05 4000

COLD-FORMED METAL FRAMING

PART 1

1.02 General

A. See drawings for Sheet Specifications on sheet S002.

B. See Section 13 120 for relevant specifications.

END OF SECITON 05 4000

SECTION 06 1000

ROUGH CARPENTRY

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Rough opening framing for doors, windows, and roof openings.

B. Roof-mounted curbs.

C. Roofing nailers.

D. Communications and electrical room mounting boards.

E. Concealed wood blocking, nailers, and supports.

F. Miscellaneous wood nailers, furring, and grounds.

1.02 RELATED REQUIREMENTS

A. Section 09 2116 - Gypsum Board Assemblies: Gypsum-based sheathing.

B. Section 09 2216 - Non-structural metal framing.

1.03 REFERENCE STANDARDS

A. ASTM A153/A153M - Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware; 2016a.

B. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2017.

C. PS 1 - Structural Plywood; 2009.

D. PS 20 - American Softwood Lumber Standard; 2015.

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 any species graded by the agency specified; if no grading agency is specified, provide lumber graded by any grading agency meeting the specified requirements.

2. Grading Agency: Any grading agency whose rules are approved by the Board of Review, American Lumber Standard Committee (www.alsc.org) and who provides grading service for the species and grade specified; provide lumber stamped with grade mark unless otherwise indicated.

B. Lumber fabricated from old growth timber is not permitted.

2.02 DIMENSION LUMBER FOR CONCEALED APPLICATIONS

A. Sizes: Nominal sizes as indicated on drawings, S4S.

B. Moisture Content: S-dry or MC19.

C. 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

A. 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.

2.04 ACCESSORIES

A. Fasteners and Anchors:

1. Metal and Finish: Hot-dipped galvanized steel complying with ASTM A153/A153M for high humidity and preservative-treated wood locations, unfinished steel elsewhere.

PART 3 EXECUTION

3.01 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.

3.02 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 non-structural 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.

3.03 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 specifically indicated otherwise. Form corners by alternating lapping side members.

3.04 INSTALLATION OF CONSTRUCTION PANELS

A. 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.

END OF SECTION 06 1000

SECTION 06 1643

GYPSUM SHEATHING

PART 1 GENERAL

A. SUMMARY

1. Section Includes: Fiberglass-mat faced, moisture and mold resistant gypsum sheathing.

B. Related Sections:

1. Section 05 41 00 Structural Metal Stud Framing.

2- Section 06 10 00 Rough Carpentry.

2. Section 09 21 16 Gypsum Board Assemblies.

1.02 REFERENCES

A. ASTM International (ASTM):

1. ASTM C473 Standard Test Methods for Physical Testing of Gypsum Panel Products.

2. ASTM C518 Standard Test Method for Steady-State Thermal Transmission Properties by Means of the Heat Flow Meter Apparatus.

3. ASTM C1002 Standard Specification for Steel Self-Piercing Tapping Screws for the Application of Gypsum Panel Products or Metal Plaster Bases to Wood Studs or Steel Studs.

4. ASTM C1177 Standard Specification for Glass Mat Gypsum Substrate for Use as Sheathing.

5. ASTM C1280 Standard Specification for Application of Gypsum Sheathing.

6. ASTM D3273 Standard Test Method for Resistance to Growth of Mold on the Surface of Interior Coatings in an Environmental Chamber.

7. ASTM D6329 Standard Guide for Developing Methodology for Evaluating the Ability of Indoor Materials to Support Microbial Growth Using Static Environmental Chambers**.**

8. ASTM E72 Standard Test Methods of Conducting Strength Tests of Panels for Building Construction.

9. ASTM E96 Standard Test Methods for Water Vapor Transmission of Materials.

10. ASTM C1396 Standard Specification for Gypsum Board

11. ASTM E 136 Standard Test Method for Behavior of Materials in a Vertical Tube Furnace at 750°C

12. ASTM E 84 Standard Test Method for Surface Burning Characteristics of Building Materials

B. Gypsum Association (GA): GA-253 Application of Gypsum Sheathing.

1.03 SUBMITTALS

A. Product Data: Manufacturer's specifications and installation instructions for each product specified.

1.04 WARRANTY

A. Provide products that offer twelve months of coverage against in-place exposure damage (delamination, deterioration and decay) commencing with the date of installation of the product in such structure.

B. Manufacturer's Warranty:

1. Five years against manufacturing defects from the date of purchase of the product for installation

PART 2 PRODUCTS

2.01 MANUFACTURERS- BASIS OF DESIGN; APPROVED EQUALS ALLOWED.

A. Georgia-Pacific Gypsum LLC:

1. Fiberglass-Mat Faced Gypsum Sheathing: DensGlass Sheathing.
2. Fiberglass-Mat Faced Gypsum Sheathing, Type X for Fire Rated Designs: DensGlass Fireguard Sheathing.

B. GOLD BOND BUILDING PRODUCTS, LLC

1. Gold Bond®eXP®Sheathing, Gold Bond®

2.02 MATERIALS

A. Fiberglass-Mat Faced Gypsum Sheathing: ASTM C1177:

1. Thickness: 1/2 inch.
2. Width: 4 feet.
3. Length: [8 feet] [9 feet] [10 feet].
4. Weight: 1.9 lb/sq. ft.
5. Edges: Square.
6. Surfacing: Fiberglass mat on face, back, and long edges.
7. Racking Strength (Ultimate, not design value) (ASTM E72): Not less than 540 pounds per square foot, dry.
8. Flexural Strength, Parallel (ASTM C473): 80 lbf, parallel.
9. Humidified Deflection (ASTM C1177): Not more than 2/8 inch.
10. Permeance (ASTM E96): Not less than 23 perms.
11. R-Value (ASTM C518): 0.52 - 0.56.
12. Mold Resistance (ASTM D3273): 10, in a test as manufactured.

13. Microbial Resistance (ASTM D6329, UL Environmental GREENGUARD 3-week protocol): Will not support microbial growth.

2.03 ACCESSORIES

A. Screws: ASTM C1002, corrosion resistant treated.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verification of Conditions:

1. Inspection: Verify that project conditions and substrates are acceptable, to the installer, to begin installation of work of this section.

3.02 INSTALLATION

A. General: In accordance with GA-253, ASTM C1280 and the manufacturer's recommendations.

1. Manufacturer's Recommendations:

a. Respective "Product Catalog",

3.03 PROTECTION

A. Protect gypsum board installations from damage and deterioration until date of Substantial Completion.

END OF SECTION 06 1643

SECTION 06 4100

ARCHITECTURAL WOOD CASEWORK

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Specially fabricated cabinet units.

B. Cabinet hardware.

C. Factory finishing.

D. Preparation for installing utilities.

1.02 RELATED REQUIREMENTS

A. Section 12 3600 - Countertops.

1.03 REFERENCE STANDARDS

A. AWI/AWMAC/WI (AWS) - Architectural Woodwork Standards; 2014, with Errata (2016).

B. AWMAC/WI (NAAWS) - North American Architectural Woodwork Standards, U.S. Version 3.1; 2016, with Errata (2017).

C. BHMA A156.9 - American National Standard for Cabinet Hardware; 2015.

D. NEMA LD 3 - High-Pressure Decorative Laminates; 2005.

E. F.S.C. Certified Forest Stewardship Council

1.04 ADMINISTRATIVE REQUIREMENTS

A. Preinstallation Meeting: Convene a preinstallation meeting not less than one week before starting work of this section; require attendance by all affected installers.

1.05 SUBMITTALS

A. See Section 01 3000 - Administrative Requirements, for submittal procedures.

B. Shop Drawings: Indicate materials, component profiles, fastening methods, jointing details, and accessories.

C. Product Data: Provide data for hardware accessories.

1.06 QUALITY ASSURANCE

A. Fabricator Qualifications: Company specializing in fabricating the products specified in this section with minimum five years of documented experience.

1. Accredited participant in the specified certification program prior to the commencement of fabrication and throughout the duration of the project.

B. Quality Certification:

1. Provide labels or certificates indicating that the installed work complies with AWI/AWMAC/WI (AWS) or AWMAC/WI (NAAWS) requirements for grade or grades specified.
2. Provide designated labels on shop drawings as required by certification program.
3. Provide designated labels on installed products as required by certification program.
4. Submit certifications upon completion of installation that verifies this work is in compliance with specified requirements.
5. Replace, repair, or rework all work for which certification is refused.

C. Relevant Material shall meet specified percentage of F.S.C. Certification,

1. 50% of wood products shall be F.S.C. Certified.

1.07 DELIVERY, STORAGE, AND HANDLING

A. Protect units from moisture damage.

1.08 FIELD CONDITIONS

A. During and after installation of custom cabinets, maintain temperature and humidity conditions in building spaces at same levels planned for occupancy.

PART 2 PRODUCTS

2.01 CABINETS

A. Quality Standard: Custom Grade, in accordance with AWI/AWMAC/WI (AWS) or AWMAC/WI (NAAWS), unless noted otherwise.

B. Plastic Laminate Faced Cabinets: Custom grade.

C. Relevant Material shall meet specified percentage of F.S.C. Certification,

1. 50% of wood products shall be F.S.C. Certified.

2.02 LAMINATE MATERIALS

A. Manufacturers:

1. Formica Corporation: www.formica.com.
2. Panolam Industries International, Inc; Nevamar: www.nevamar.com.
3. Wilsonart LLC: www.wilsonart.com/#sle.
4. Substitutions: See Section 01 6000 - Product Requirements.

B. High Pressure Decorative Laminate (HPDL): NEMA LD 3, types as recommended for specific applications.

C. Provide specific types as indicated.

1. Horizontal Surfaces: HGS, 0.048 inch nominal thickness, through color, color as selected, finish as indicated.
2. Vertical Surfaces: VGS, 0.028 inch nominal thickness, through color, color as selected, finish as indicated.
3. Post-Formed Horizontal Surfaces: HGP, 0.039 inch nominal thickness, through color, finish as indicated.
4. Cabinet Liner: CLS, 0.020 inch nominal thickness, color as selected.

2.03 COUNTERTOPS

A. Countertops are specified in Section 12 3600.

2.04 ACCESSORIES

A. Adhesive: Type recommended by fabricator to suit application.

B. Plastic Edge Banding: Extruded PVC, flat shaped; smooth finish; self locking serrated tongue; of width to match component thickness.

1. Color: As selected by Architect from manufacturer's standard range.

C. Fasteners: Size and type to suit application.

D. Bolts, Nuts, Washers, Lags, Pins, and Screws: Of size and type to suit application; galvanized or chrome-plated finish in concealed locations and stainless steel or chrome-plated finish in exposed locations.

E. Concealed Joint Fasteners: Threaded steel.

F. Grommets: Standard plastic, painted metal, or rubber grommets for cut-outs, in color to match adjacent surface.

2.05 HARDWARE

A. Hardware: BHMA A156.9, types as recommended by fabricator for quality grade specified.

B. Adjustable Shelf Supports: Standard side-mounted system using recessed metal shelf standards or multiple holes for pin supports and coordinated self rests, polished chrome finish, for nominal 1 inch spacing adjustments.

C. Drawer and Door Pulls: "U" shaped wire pull, steel with chrome finish, 4 inch centers.

D. Cabinet Locks: Keyed cylinder, two keys per lock, master keyed, steel with chrome finish.

E. Catches: Magnetic.

F. Drawer Slides:

1. Type: Extension types as indicated.
2. Static Load Capacity: Commercial grade.
3. Mounting: Side mounted.
4. Stops: Integral type.
5. Features: Provide self closing/stay closed type.

G. Hinges: European style concealed self-closing type, steel with polished finish.

2.06 FABRICATION

A. Assembly: Shop assemble cabinets for delivery to site in units easily handled and to permit passage through building openings.

B. Edging: Fit shelves, doors, and exposed edges with specified edging. Do not use more than one piece for any single length.

C. Fitting: When necessary to cut and fit on site, provide materials with ample allowance for cutting. Provide matching trim for scribing and site cutting.

D. Plastic Laminate: Apply plastic laminate finish in full uninterrupted sheets consistent with manufactured sizes. Fit corners and joints hairline; secure with concealed fasteners. Slightly bevel arises. Locate counter butt joints minimum 2 feet from sink cut-outs.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify adequacy of backing and support framing.

B. Verify location and sizes of utility rough-in associated with work of this section.

3.02 INSTALLATION

A. Install work in accordance with AWI/AWMAC/WI (AWS) or AWMAC/WI (NAAWS) requirements for grade indicated.

B. Set and secure custom cabinets in place, assuring that they are rigid, plumb, and level.

C. Use fixture attachments in concealed locations for wall mounted components.

D. Use concealed joint fasteners to align and secure adjoining cabinet units.

E. Carefully scribe casework abutting other components, with maximum gaps of 1/32 inch. Do not use additional overlay trim for this purpose.

3.03 ADJUSTING

A. Test installed work for rigidity and ability to support loads.

B. Adjust moving or operating parts to function smoothly and correctly.

3.04 CLEANING

A. Clean casework, counters, shelves, hardware, fittings, and fixtures.

END OF SECTION 06 4100

SECTION 07 1113

BITUMINOUS DAMPPROOFING

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Bituminous dampproofing.

B. Protection boards.

1.02 RELATED REQUIREMENTS

A. Section 07 2100 - Thermal Insulation: Rigid insulation board used as protection board.

1.03 REFERENCE STANDARDS

A. ASTM D4479/D4479M - Standard Specification for Asphalt Roof Coatings - Asbestos-Free; 2007, with Editorial Revision (2012).

1.04 SUBMITTALS

A. See Section 01 3000 - Administrative Requirements, for submittal procedures.

B. Product Data: Provide properties of primer, bitumen, and mastics.

C. Manufacturer's Installation Instructions: Indicate special procedures and perimeter conditions requiring special attention.

1.05 QUALITY ASSURANCE

A. Installer Qualifications: Company specializing in performing the work of this section with at least three years of documented experience.

1.06 FIELD CONDITIONS

A. Maintain ambient temperatures above 40 degrees F for 24 hours before and during application until dampproofing has cured.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Bituminous Dampproofing Manufacturers:

1. Karnak Corporation: www.karnakcorp.com.
2. Mar-Flex Systems, Inc: www.mar-flex.com/sle.
3. W. R. Meadows, Inc: www.wrmeadows.com/sle.
4. Substitutions: See Section 01 6000 - Product Requirements.

2.02 BITUMINOUS DAMPPROOFING

A. Bituminous Dampproofing: Cold-applied, spray-grade; asphalt base, volatile petroleum solvents, and other content, suitable for application by spray, brush, roller, or squeegee; asbestos-free; suitable for application on vertical and horizontal surfaces.

1. Composition: ASTM D4479/D4479M Type I, minimum, asbestos free.

2. VOC Content: Not more than permitted by local, State, and federal regulations.

3. Applied Thickness: 1/16 inch, minimum, wet film.

4. Products:

a. W. R. Meadows, Inc; Sealmastic Spray-Mastic: www.wrmeadows.com/sle.

b. Substitutions: See Section 01 6000 - Product Requirements.

B. Primers, Mastics, and Related Materials: Type as recommended by dampproofing manufacturer.

2.03 ACCESSORIES

A. Protection Board: Rigid insulation specified in Section 07 2100.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify existing conditions are acceptable prior to starting this work.

B. Verify substrate surfaces are durable, free of matter detrimental to adhesion or application of dampproofing system.

C. Verify that items penetrating surfaces to receive dampproofing are securely installed.

3.02 PREPARATION

A. Protect adjacent surfaces not designated to receive dampproofing.

B. Clean and prepare surfaces to receive dampproofing in accordance with manufacturer's instructions.

C. Do not apply dampproofing to surfaces unacceptable to manufacturer.

D. Apply mastic to seal penetrations, small cracks, or minor honeycombs in substrate.

3.03 APPLICATION

A. Apply bitumen by spray application.

B. Apply from 2 inches below finish grade elevation down to top of footings.

C. Seal items watertight with mastic, that project through dampproofing surface.

D. Place protection board directly over dampproofing, butt joints, and adhere to tacky dampproofing.

E. Scribe and cut boards around projections, penetrations, and interruptions.

END OF SECTION 07 1113

SECTION 07 2100

THERMAL INSULATION

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Board insulation at perimeter foundation wall, underside of floor slabs, and exterior wall behind cement plaster wall finish.

B. Batt insulation and vapor retarder in exterior wall construction.

C. Batt insulation for filling perimeter window and door shim spaces and crevices in exterior wall and roof.

D. Board insulation at roof over roof deck and under roof membrane

1.02 RELATED REQUIREMENTS

A. Section 07 2500 - Weather Barriers: Separate air barrier and vapor retarder materials.

B. Section 07 5423 - Thermoplastic Membrane Roofing: Insulation specified as part of roofing system.

C. Section 09 2116 - Gypsum Board Assemblies: Acoustic insulation inside walls and partitions.

1.03 REFERENCE STANDARDS

A. ASTM C578 - Standard Specification for Rigid, Cellular Polystyrene Thermal Insulation; 2017a.

B. ASTM C665 - Standard Specification for Mineral-Fiber Blanket Thermal Insulation for Light Frame Construction and Manufactured Housing; 2017.

C. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2017.

D. ASTM E2357 - Standard Test Method for Determining Air Leakage of Air Barrier Assemblies; 2017.

1.04 SUBMITTALS

A. See Section 01 3000 - Administrative Requirements, for submittal procedures.

B. Product Data: Provide data on product characteristics, performance criteria, and product limitations.

C. Manufacturer's Certificate: Certify that products meet or exceed specified requirements.

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 in Metal Framed Walls: Batt insulation with integral vapor retarder.

D. Insulation over metal deck at roofs: Batt insulation with batts over top metal purlins

2.02 FOAM BOARD INSULATION MATERIALS UNDER SLAB

A. Extruded Polystyrene (XPS) Board Insulation: Complies with ASTM C578 with either rnatural 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) per 1 inch thickness at 75 degrees F mean temperature.

5. Manufacturers:

a. Dow Chemical Company; STYROFOAMHIGHLOAD 40: www.dowbuildingsolutions.com/#sle.

b. Owens Corning Corporation; FOAMULAR Extruded Polystyrene (XPS) Insulation: www.ocbuildingspec.com/#sle.

c. Substitutions: See Section 01 6000 - Product Requirements.

2.03 FOAM BOARD INSULATION MATERIALS IN ROOF ASSEMPLIES

A. See Section 07 2130

2.04 BATT INSULATION MATERIALS AT INTERIOR WALLS

A. Fiber Glass 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.

3. Thickness: Full depth of stud dimension.

4. Manufacturers: all that fit minimum R-value shown on drawings.

2.05 ACCESSORIES

A. Sheet Vapor Retarder: Specified in Section 07 2500.

B. Flashing Tape: Special polyolefin film with high performance adhesive.

1. Application: Interior window and door sill flashing tape.

2. Width: Are required for application.

C. Tape joints of rigid insulation if required by and in accordance with roofing and insulation manufacturers' instructions.

D. Insulation Fasteners: Appropriate for purpose intended.

E. Protection Board for Below Grade Insulation: Cementitious, 1/4 inch thick.

F. 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 inch 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:

C. Install boards vertically 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.

3.03 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.

3.04 BATT INSTALLATION AT INTERIOR WALLS

A. Install insulation and vapor retarder 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.

E. Install with factory applied vapor retarder membrane facing warm side of building spaces. Lap ends and side flanges of membrane over framing members.

F. Tape insulation batts in place.

G. Tape seal butt ends, lapped flanges, and tears or cuts in membrane.

H. At metal framing, place vapor retarder on warm side of insulation; lap and seal sheet retarder joints over member face.

I. Tape seal tears or cuts in vapor retarder.

J. Extend vapor retarder tightly to full perimeter of adjacent window and door frames and other items interrupting the plane of the membrane. Tape seal in place.

3.05 BOARD INSTALLATION AT ROOF

A. See section 07 5423

END OF SECTION 07 2100

SECTION 07 2130

PRE-ENGINEERED BUILDING INSULATION

PART 1 GENERAL

1.01SECTION INCLUDES

A. SECTION INCLUES. Pre-Engineered Building Insulation for New Construction.

1.02RELATED SECTIONS

A. Section 13121 - Pre-Engineered Metal Buildings.
B. Section 13900 - Fire Protection Systems.
C. Division 15 - Mechanical; Rough-in utilities.
D. Division 16 - Electrical; Rough-in utilities.

1.03REFERENCES

A. ASTM E 84 - Standard Test Method for Surface Burning Characteristics of Building Materials.
B. ASTM E 96 - Standard Test Method for Water Vapor Transmission of Materials in Sheet Form (Procedure B).
C. ASTM C 665 - Standard Specification for Mineral-Fiber Blanket Thermal Insulation for Light Frame Construction and Manufactured Housing.
D. NFPA 255 - Standard Method of Test of Surface Burning Characteristics of Building Materials.
E. UL 723 - Tests for Surface Burning Characteristics of Building Materials.
F. ASTM C 1136 - Standard Specification for Flexible, Low Permeance Vapor Retarders for Thermal Insulation.

1.04DESIGN REQUIREMENTS

A- HEATED EXTERIOR WALLS Thermal Resistance of Installed System: R-Value of 19.2.

B- HEATED ROOFS Thermal Resistance of Installed System: R-Value of 28.6.

C- Insulating system shall have a continuous vapor barrier inside of building purlins, girts, and insulation to provide complete isolation from inside conditioned air.

1.05SUBMITTALS

A- Submit under provisions of Section 01300.

B- Manufacturer's data sheets on each product to be used, including:

1. Preparation instructions and recommendations.
2. Storage and handling requirements and recommendations.
3. Installation instructions.

C- Shop Drawings: Indicate locations of connections and attachments, general details, anchorages and method of anchorage and installation.

D- Verification Samples: For each finish product specified, two samples, minimum size 6 inches (150 mm) square or long, representing actual products required for this project.

E- Manufacturer's Certificate: Certify products meet or exceed specified requirements.

PART 2 QUALITY ASSURANCE

2.01 Manufacturer Qualifications:

A. Company specializing in manufacturing product systems specified in this section with minimum five years documented experience.

B.-Installer Qualifications: Company shall specialize performing work of this section.

C.- Insulation system components to include a ten-year limited material warranty.

2.02DELIVERY, STORAGE, AND HANDLING

A. Store products in manufacturer's unopened packaging until ready for installation.

Store products indoors and protect from moisture, construction traffic, and damage.

2.03 PROJECT CONDITIONS

A. 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.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Acceptable Manufacturer: Thermal Design, Inc., Simple Saver System. P.O. Box 468, 601 N. Main Street, Madison, NE 68748. ASD. Tel: (800) 255-0776 or (402) 454-6591. Fax: (402) 454-2708. Email: sales@thermaldesign.com, www.thermaldesign.com.

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

2.2 MATERIALS

A. Simple Saver System consists of Batt Insulation, Roof Insulation, Wall Insulation, Vapor Barrier Liner Fabric, Thermal Breaks, Straps, and other devices and components in a proprietary insulation system as follows:

1. Roof Insulation: Formaldehyde-free fiberglass batt or fiberglass blanket complying with ASTM C 991 Type 1 and ASTM E 84 with a thermal resistance and thickness as follows:
   R-30; 9-1/2 inches (241 mm), plus 3-1/2 inches (89 mm) (two layers).

2. Wall Insulation: Formaldehyde-free fiberglass blanket or batt complying with ASTM C 991 Type 1, ASTM E 136 and ASTM E 84 with a thermal resistance and thickness as follows:
   a. R-25; 8 inches (228.6 mm).

3. Vapor Barrier Liner Fabric: Syseal® type woven, reinforced, high-density polyethylene yarns coated on both sides with a continuous white or colored polyethylene coatings, as follows:
   a. Product complies with ASTM C 1136, Types I through Type VI.
   b. Perm rating: 0.02 for fabric and for seams in accordance with ASTM E 96.
   c. Flame/Smoke Properties:
      1) 25/50 in accordance with ASTM E 84.
      2) Self-extinguishes with field test using matches or butane lighter.
   d. Ultra violet radiation inhibitor to minimum UVMAX® rating of 8.
   e. Size and seaming: Manufactured in large custom pieces by triple extrusion welding from roll goods, and fabricated to substantially fit defined building area with minimum practicable job site sealing.
   f. Provide with factory triple, extrusion welded seams. Stapled seams or heat-melted seams are not acceptable due to degradation of fabric.
   g. Factory-folded to allow for rapid installation.
   h. Color:
      1) White.
      4. Vapor Barrier Lap Sealant: Solvent-based, Simple Saver polyethylene fabric adhesive.
      5. Vapor Barrier Tape: Double-sided sealant tape 3/4 inch (19 mm) wide by 1/32 inch (.79 mm) thick.
      6. Vapor Barrier Patch Tape: Single-sided, adhesive backed sealant tape 3 inches (76 mm) wide made from same material as Syseal® type liner fabric.
      7. Thermal Breaks:
      a. 3/16 inch (4.7 mm) thick by 3 inch (76 mm) wide white, closed-cell polyethylene foam with pre-applied adhesive film and peel-off backing.
      8. Straps:
      a. 100 KSI minimum yield tempered, high-tensile-strength steel.
      b. Size: Not less than 0.020 inch (0.50 mm) thick by 1 inch (25 mm) by continuous length.
      c. Galvanized, primed, and painted to match specified finish color on the exposed side.

d. Color:
1) White.
9. Fasteners:
a. For light gage steel: #12 by 3/4 (19 mm) inch plated Tek 2 type screws with sealing washer, painted to match specified color.
b. For heavy gage steel: #12 by 1-1/2 inch (38 mm) plated Tek 4 type screws with sealing washer, painted to match specified color.
c. For wood, concrete, other materials: As recommended by manufacturer.
10. Wall Insulation Hangers: Fast-R preformed rigid hangers, 32 inch (813 mm) long galvanized steel strips with barbed arrows every 8 inches (203 mm) along its length.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that building structure including all bracing and any concealed building systems are completed and approved prior to installing liner system and insulation in the structure.

B. Correct any unsatisfactory conditions before proceeding.

C. If conditions are the responsibility of another installer, notify Architect of unsatisfactory preparation before proceeding.

3.02 INSTALLATION - GENERAL

A. 1.Install pre-engineered building insulation system in accordance with manufacturer's installation instructions and the approved shop drawings.

B. Prepare surfaces using the methods recommended by the manufacturer for achieving the best result for the substrate under the project conditions.

C. Install in exterior spaces without gaps or voids. Do not compress insulation.

D. Trim insulation neatly to fit spaces. Insulate miscellaneous gaps and voids.

E. 5- Fit insulation tight in spaces and tight to exterior side of the sealed liner fabric and around mechanical and electrical services within plane of insulation.

3.03 ROOF INSULATION INSTALLATION

A. Straps:
1. Cut straps to length and install in the pattern and spacings indicated on shop drawings.
2. Tension straps to required value.

B. Vapor Barrier Fabric:
1. Install vapor barrier fabric in large one-piece custom fabricated pieces to substantially fit defined building areas with minimum practicable job site sealing.
2. Position pre-folded fabric on the strap platform along one eave purlin.
3. Clamp the two bottom corners at the eave and also centered on the bay.
4. Pull the other end of the pleat-folded fabric across the building width on the strap platform, pausing only at the ridge to fasten the straps and fabric in position where plane of roof changes and to release temporary fasteners on the opposite ridge purlins.
5. Once positioned, install fasteners from the bottom side at each strap/purlins intersection.
6. Trim edges and seal along the rafters.
7. All seams must be completely sealed and stapled seams not acceptable.

C. Insulation:
1 Unpack, and shake to a thickness exceeding the specified thickness.
2 Ensure that cavities are filled completely with insulation.
3 Place on the vapor barrier liner fabric without voids or gaps.

4 Place top layer of insulation over and perpendicular to the purlins without voids or gaps, as roof sheathing is applied.

D- Seal vapor barrier fabric to the wall fabric and elsewhere as required to provide a continuous vapor barrier.

SECTION 3.04 WALL INSULATION INSTALLATION

A. Insulation:

1 Install thermal break to exterior surface of girts as wall sheathing is applied.
2 Position and secure Fast-R hangers to girts on the inside face of the wall sheathing.
3 Cut insulation to required lengths to fit vertically between girts.
4 Fluff the insulation to the full-specified thickness.
5 Neatly position in place and secure to Fast-R hangers.
6 Ensure that cavities are filled completely with insulation.

B. Vapor Barrier Fabric:

1 Install vapor barrier fabric in large one-piece custom fabricated pieces to substantially fit defined building areas with minimum practicable job site sealing.
2 Apply the vapor barrier fabric by clamping it in position over eave strap and installing fasteners through the eave strap into each roof strap, permanently clamping the wall fabric between them.
3 Once in position, draw the vapor barrier fabric down over the column flanges to the base angle and install vertical straps along each column and 5 feet 0 inches on center, maximum, fastening to each girt to retain system permanently in place.
4 All seams must be completely sealed and stapled seams not acceptable.

C. Seal wall fabric to the roof fabric, to the base angle and up the columns to provide a continuous vapor barrier.

3.05 CLEANING

A. Clean dirt or exposed sealant from the exposed vapor barrier fabric.
B. Remove scraps and debris from the site.

3.06 PROTECTION

A- Protect system products until completion of installation.
B- Repair or replace damaged products before completion of insulation system installation.

END OF SECTION 07 2130

SECTION 07 2500

EATHER BARRIERS

PART 1 GENERAL

1.01 SECTION INLCUDES

BUILDING PAPER, VAPOR BARRIERS & VAPOR RETARDERS

PART 2 PRODUCTS

1.01 WEATHER BARRIER ASSEMBLIES

A. Water-Resistive Barrier: Provide on exterior walls under exterior cladding.

1. Use building paper unless otherwise indicated.

2. Under Portland cement stucco, use two separate layers of building paper.

B. See Section 13 120 for Weather Barriers at Pre-Engineered Buildings.

1.02 WATER-RESISTIVE BARRIER MATERIALS (NEITHER AIR BARRIER OR VAPOR RETARDER)

A. Drainable Barrier Sheet: Non-woven and non-perforated polypropylene material with 1/16 inch gap created by spacers providing drainage space.

1. Width: 5 feet, minimum.

2. Water Vapor Permeance: 19 perms, minimum, when tested in accordance with ASTM E96/E96M Procedure A (desiccant procedure).

3. Ultraviolet and Weathering Resistance: Approved in writing by manufacturer for up to 120 days of weather exposure.

4. Surface Burning Characteristics: Flame spread index of 25 or less, smoke developed index of 450 or less (Class A), when tested in accordance with ASTM E84.

5. Seam and Perimeter Tape: As recommended by sheet manufacturer.

6. Manufacturers:

a. Tamlyn; Drainable Wrap - TWD5X100: www.tamlyn.com/#sle.

b. Substitutions: See Section 01 6000 - Product Requirements.

1.03 ACCESSORIES

A. Sealants, Tapes, and Accessories for Sealing Weather Barrier and Sealing Weather Barrier to Adjacent Substrates: As specified or as recommended by weather barrier manufacturer.

PART 3 EXECUTION

2.01 EXAMINATION

A. Verify that surfaces and conditions are ready to accept the work of this section.

2.02 PREPARATION

A. Remove projections, protruding fasteners, and loose or foreign matter that might interfere with proper installation.

2.03 INSTALLATION

A. Install materials in accordance with manufacturer's instructions.

B. Water-Resistive Barriers: Install continuous barrier over surfaces indicated, with sheets lapped to shed water but with seams not sealed.

C. Mechanically Fastened Sheets - On Exterior:

1. Install sheets shingle-fashion to shed water, with seams generally horizontal.

2. Overlap seams as recommended by manufacturer but at least 6 inches.
3. Overlap at outside and inside corners as recommended by manufacturer but at least 12 inches.
4. Attach to framed construction with fasteners extending through sheathing into framing. Space fasteners at 12 to 18 inches on center along each framing member supporting sheathing.
5. Where stud framing rests on concrete or masonry, extend lower edge of sheet at least 4 inches below bottom of framing and seal to foundation with sealant.
6. Install water-resistive barrier over jamb flashings.
7. Install head flashings under weather barrier.
8. At openings to be filled with frames having nailing flanges, wrap excess sheet into opening; at head, seal sheet over flange and flashing.

D. Openings and Penetrations in Exterior Weather Barriers:

1. Install flashing over sills, covering entire sill frame member, extending at least 5 inches onto weather barrier and at least 6 inches up jambs; mechanically fasten stretched edges.

2. At openings to be filled with frames having nailing flanges, seal head and jamb flanges using a continuous bead of sealant compressed by flange and cover flanges with sealing tape at least 4 inches wide; do not seal sill flange.

3. At openings to be filled with non-flanged frames, seal weather barrier to each side of opening framing, using flashing at least 9 inches wide, covering entire depth of framing.

4. At head of openings, install flashing under weather barrier extending at least 2 inches beyond face of jambs; seal weather barrier to flashing.

5. At interior face of openings, seal gap between window/door frame and rough framing, using joint sealant over backer rod.

6. Service and Other Penetrations: Form flashing around penetrating item and seal to weather barrier surface.

204 PROTECTION

A. Do not leave materials exposed to weather longer than recommended by manufacturer.

END OF SECTION 07 2500

SECTION 07 41 13 –

METAL ROOF PANELS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes: Metal lap-seam wall panels with exposed fasteners [including trim and accessories.

B. Roofing my be provided through Section 13 120 Pre-Engineered Buildings or through this section.

C.. Related Sections: Section(s) related to this section include:

1. Division 00 8100 Bidding Requirements & Instructions
2. Division 05 Section "Structural Steel Framing" for structural steel framing supporting metal panels.
3. Division 05 Section "Steel Decking" for continuous metal decking supporting metal panels.
4. Division 07 Section ["Thermal Insulation"] ["Roof Insulation"] for thermal insulation installed under metal panels.
5. Division 07 Section "Air Barriers" for air barriers within roof assembly and adjacent to roof assembly.
6. Division 07 Section "Metal Wall Panels" for factory-formed metal wall [and soffit] panels.
7. Division 07 Section "Sheet Metal Flashing and Trim" for formed sheet metal copings, flashings, reglets, and roof drainage items in addition to items specified in this Section.
8. Division 07 Section "Manufactured Roof Specialties" for manufactured copings, reglets, and roof drainage items in addition to items specified in this Section.
9. Division 07 Section "Joint Sealants" for field-applied Joint Sealants.
9. Division 13 Section 120 Pre-Engineered Buildings.

1.2 REFERENCES

A. General: Standards listed by reference form a part of this specification section. Standards listed are identified by issuing authority, abbreviation, designation number, title or other designation. Standards subsequently referenced in this Section are referred to by issuing authority abbreviation and standard designation.

B. ASTM International:

1. ASTM A 792 - Standard Specification for Steel Sheet, 55% Aluminum-Zinc Alloy-Coated by the Hot-Dip Process.

2. ASTM D 2244 - Standard Practice for Calculation of Color Tolerances and Color Differences from Instrumentally Measured Color Coordinates.

3. ASTM D 4214 - Standard Test Methods for Evaluating the Degree of Chalking of Exterior Paint Films.

4. ASTM E 283 - Standard Test Method for Determining Rate of Air Leakage Through Exterior Windows, Curtain Walls, and Doors Under Specified Pressure Differences Across the Specimen.

5. ASTM E 331 - Standard Test Method for Water Penetration of Exterior Windows, Skylights, Doors, and Curtain Walls by Uniform Static Air Pressure Difference.

6. ASTM E 1646 - Standard Test Method for Water Penetration of Exterior Metal Roof Panel Systems by Uniform Static Air Pressure Difference.

7. ASTM E 1680 - Standard Test Method for Rate of Air Leakage through Exterior Metal Roof Panel Systems

C. Underwriters Laboratories (UL):

1. UL 263 - Fire Tests of Building Construction and Materials.

2. UL 580 - Tests For Uplift Resistance of Roof Assemblies.

3. UL 790 - Standard Test Methods for Fire Tests of Roof Coverings.

4. UL 2218 - Impact Resistance of Prepared Roof Covering Materials.

D. Sheet Metal and Air Conditioning Contractors' National Association (SMACNA): "Architectural Sheet Metal Manual."

E. State of Florida: Florida Building Code 2010:

1. 10999.1.

1.3 ADMINISTRATIVE REQUIREMENTS

A. Preinstallation Meetings: Conduct preinstallation meeting to clarify Project requirements, substrate conditions, manufacturer’s installation instructions and manufacturer’s warranty requirements.

1.4 ACTION SUBMITTALS

A. Product Technical Data: For each type of product required, including manufacturer's preparation recommendations, storage and handling requirements, and recommended installation methods.

B. Shop Drawings: Showing methods of installation, plans, sections, elevations and details of roof and wall panels, specified loads, flashings, roof curbs, vents, sealants, interfaces with all materials not supplied by the metal panel system manufacturer, and identification of proposed component parts and their finishes. Do not proceed with fabrication prior to approval of shop drawings.

C. Samples: Selection and verification samples for finishes, colors and textures. Submit two complete sample sets of each type of panel, trim, clip and fastener required.

D. Certificates: Product certificates signed by manufacturer certifying materials comply with specified performance characteristics, criteria and physical requirements.

E. Test and Evaluation Reports: Showing compliance with specified performance characteristics and physical properties.

F. Qualifications Statements: For manufacturer and installer.

1.5 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For installed products including maintenance methods and precautions against cleaning materials and methods detrimental to finishes and performance.

B. Warranty: Warranty documents required in this section.

1.7 QUALITY ASSURANCE

A. Manufacturer Qualifications:

1. Provider of advanced installer training.

2. Minimum of ten years experience in manufacturing metal roof systems.

3. Provider of products produced in a permanent factory environment with fixed roll-forming equipment.

B. Installer Qualifications:

1. At least five years experience in the installation of architectural metal roof panels.

2. Experience on at least five projects of similar size, type and complexity as this Project that have been in service for a minimum of two years with satisfactory performance of the roof system.

3. Employer of workers for this Project who are competent in techniques required by manufacturer for installation indicated and who shall be supervised at all times when material is being installed.

1.8 DELIVERY, STORAGE AND HANDLING

A. General: Comply with manufacturer’s current printed product storage recommendations.

B. Delivery: Deliver materials in manufacturer’s original, unopened, undamaged containers with identification labels intact.

C. Storage: Store materials above ground, under waterproof covering, protected from exposure to harmful weather conditions and at temperature and humidity conditions recommended by manufacturer. Provide proper ventilation of metal panel system to prevent condensation build-up between each panel and trim or flashing component. Tilt stack to drain in wet conditions. Remove strippable plastic film before storage under high-heat conditions. Store products in manufacturer's unopened packaging until just prior to installation.

D. Handling: Exercise caution in unloading and handling metal panel system to prevent bending, warping, twisting and surface damage.

1.9 WARRANTY

A. Special Exposed Panel Finish Warranty: Manufacturer's standard form Warranty for film integrity, chalk rating and fade rating in which manufacturer agrees to repair or replace panels that show evidence of deterioration within specified warranty period.

1. Deterioration shall include but is not limited to:

a. Color fading of more than 5 Hunter units when tested according to ASTM D 2244.

b. Chalking in excess of a No. 8 rating when tested according to ASTM D 4214.

c. Cracking, checking, peeling or failure of paint to adhere to bare metal.

2. Warranty Period: Film integrity for 25 years and chalk and fade rating for 25 years from date of Substantial Completion.

3. Manufacturer’s warranty may exclude surface deterioration due to physical damage and exposure to salt air environments.

PART 2 – PRODUCTS

2.1 METAL ROOF PANELS

A. Basis of Design Product: Subject to compliance with requirements provide Metal Sales Manufacturing Corporation; 7/8” Corrugated.

B. Substitution Limitations: **Submit substitution request in accordance with Section 012500 -** >.

C. Product Options:

1. Panel coverage: 32 inches (812.8 mm).

2. Rib Height: 7/8 inch (22.2 mm).

3. Material: Aluminum-zinc alloy-coated steel sheet, ASTM A 792, [**AZ55**] coating designation, structural quality, [**Grade 50**], [**0.0236-inch (0.60-mm)** minimum thickness.

4. Minimum Roof Slope Capability: 1:12.

5. Attachment: Exposed direct fastened panel.

6. Application: Designed for application over open framing or solid substrate.

7. Rib Configuration: Sinusoidal.

8. Surface Finish:] [**Acrylic Coated Galvalume**].

9. Color: [**Galvalume (41) owner shall confirm from samples chips.**]

10. Fire Resistance Rating: Comply with UL 263 and UL 790 Class A Fire Resistance Ratings**.**

11. Impact Resistance: Comply with UL 2218, Class 4.

12. Wind Uplift Resistance: Comply with UL 580, Class 90 Wind Uplift, Construction #649.

13. Air Leakage: 0.004 cfm/sq. ft. at 6.24 psf when tested according to ASTM E 283.

14. Air Leakage: 0.007 cfm/sq. ft. at 6.24 psf when tested according to ASTM E 1680.

15. Water Penetration: None at 12 psf when tested according to ASTM E 331.

16. Water Penetration: None at 12 psf when tested according to ASTM E 1646.

17. Code and Testing Agency Approvals: Comply with 2010 State of Florida Building Code Approval 10999.1.

2.2 FIELD-INSTALLED THERMAL INSULATION

A. General: Refer to and coordinate with requirements in Section **07 2130 Pre Engineered Metal Building Insulation.**

2.3 SUBSTRATE BOARDS

A. General: No Substrate, install directly on PEMB

2.3 ACCESSORIES

A. See Section 07 7200

2.6 SOURCE QUALITY CONTROL

A. Source: Obtain architectural metal roof panels, trim and other accessories from a single manufacturer.

B. Quality Control: Obtain architectural metal roof panels, trim and other accessories from a manufacturer capable of providing on-site technical support and installation assistance.

PART 3 - EXECUTION

3.1 PREPARATION

A. Miscellaneous Framing: Install furring, eave angles, subpurlins, and other miscellaneous roof panel support members and anchorage according to metal roof panel manufacturer's recommendations.

3.2 UNDERLAYMENT INSTALLATION

A. Install flashing in compliance with requirements in Division 07 Section "Sheet Metal Flashing and Trim."

3.4 THERMAL INSULATION INSTALLATION

A. Section **07 2130 Pre Engineered Metal Building Insulation.**

3.5 ARCHITECTURAL METAL ROOF PANEL INSTALLATION

A. General: Comply with panel manufacturer's installation instructions including but not limited to special techniques, interface with other work, and integration of systems.

B. Fasten metal roof panels to supports with concealed clips at each standing-seam joint at location, spacing, and using proper fasteners as recommended by panel manufacturer.

3.6 ACCESSORY INSTALLATION

A. General: Install accessories using techniques recommended by manufacturer and which will assure positive anchorage to building and weather tight mounting. Provide for thermal movement. Coordinate installation with flashings and other components.

B. Flashing and Trim: Comply with performance requirements, manufacturer's written installation instructions, and the SMACNA "Architectural Sheet Metal Manual." Provide concealed fasteners where possible, and install units to true level. Install work with laps, joints, and seams that will be permanently watertight.

3.7 FIELD QUALITY CONTROL

A. Manufacturer's Field Services: If requested by Owner, provide manufacturer's field service consisting of product use recommendations and periodic site visits for inspection of product installation in accordance with manufacturer's instructions.

3.8 CLEANING

A. Remove temporary coverings and protection of adjacent work areas.

B. Repair or replace any installed products that have been damaged.

C. Clean installed panels in accordance with manufacturer's instructions prior to Owner's acceptance.

D. Remove and lawfully dispose of construction debris from Project site.

3.9 PROTECTION

A. Protect installed product and finish surfaces from damage during construction.

END OF SECTION 07 41 13 –

SECTION 07 42 13.13–

METAL WALL PANELS

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes: Metal lap-seam wall panels with exposed fasteners [including trim and accessories.

B. Related Sections: Section(s) related to this section include:

1. S
ection 07 2130 Pre Engineered Metal Building Insulation.

2. Division 07 Section "Sheet Metal Flashing and Trim" for formed sheet metal copings, flashings, reglets, and roof drainage items in addition to items specified in this Section.

3. Division 07 Section "Manufactured Roof Specialties" for manufactured copings, reglets, and roof drainage items in addition to items specified in this Section.

4. Division 07 Section "Joint Sealants" for field-applied Joint Sealants.

C. Location:

1. Fire Station Apparatus Bays.

D. Use:

1. Interior Liner Panels

1.2 REFERENCES

A. General: Standards listed by reference form a part of this specification section. Standards listed are identified by issuing authority, abbreviation, designation number, title or other designation. Standards subsequently referenced in this Section are referred to by issuing authority abbreviation and standard designation.

B. ASTM International:

1. ASTM A 653 – Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.

2. ASTM A 792 – Stqndard Specification for Steel Sheet, 55% Aluminum-Zinc Alloy-Coated by the Hot-Dip Process.

3. ASTM A 1011 – Standard Specification for Steel, Sheet and Strip, Hot-Rolled, Carbon, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, and Ultra-High Strength.

4. ASTM D 2244 – Standard Practice for Calculation of Color Tolerances and Color Differences from Instrumentally Measured Color Coordinates.

5. ASTM D 4214 – Standard Test Methods for Evaluating the Degree of Chalking of Exterior Paint Films.

6. ASTM E 84 – Standard Test Method for Surface Burning Characteristics of Building Materials.

7. ASTM E 283 – Standard Test Method for Determining Rate of Air Leakage Through Exterior Windows, Curtain Walls, and Doors Under Specified Pressure Differences Across the Specimen.

8. ASTM E 330 – Standard Test Method for Structural Performance of Exterior Windows, Doors, Skylights and Curtain Walls by Uniform Static Air Pressure Difference.

9. ASTM E 331 – Standard Test Method for Water Penetration of Exterior Windows, Skylights, Doors, and Curtain Walls by Uniform Static Air Pressure Difference.

10. ASTM E 1592 – Standard Test Method for Structural Performance of Sheet Metal Roof and Siding Systems by Uniform Static Air Pressure Difference.

C. Underwriters Laboratories (UL):

1. UL 263 - Fire Tests of Building Construction and Materials.

D. Sheet Metal and Air Conditioning Contractors' National Association (SMACNA): "Architectural Sheet Metal Manual."

1.3 ADMINISTRATIVE REQUIREMENTS

A. Preinstallation Meetings: Conduct preinstallation meeting to clarify Project requirements, substrate conditions, manufacturer’s installation instructions and manufacturer’s warranty requirements.

1.4 ACTION SUBMITTALS

A. Product Technical Data: For each type of product required, including manufacturer's preparation recommendations, storage and handling requirements, and recommended installation methods.

B. Shop Drawings: Showing methods of installation, plans, sections, elevations and details of roof and wall panels, specified loads, flashings, vents, sealants, interfaces with all materials not supplied by the metal panel system manufacturer, and identification of proposed component parts and their finishes. Do not proceed with fabrication prior to approval of shop drawings.

C. Samples: Selection and verification samples for finishes, colors and textures. Submit two complete sample sets of each type of panel, trim, clip and fastener required.

D. Certificates: Product certificates signed by manufacturer certifying materials comply with specified performance characteristics, criteria and physical requirements.

E. Test and Evaluation Reports: Showing compliance with specified performance characteristics and physical properties.

F. Qualifications Statements: For manufacturer and installer.

1.5 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For installed products including maintenance methods and precautions against cleaning materials and methods detrimental to finishes and performance.

B. Warranty: Warranty documents required in this section.

1.6 MAINTENANCE MATERIAL

A. Extra Materials: Deliver to Owner extra materials from same production run as products installed. Package products with protective covering and identify with descriptive labels. Comply with Division 01 Closeout Submittals Section.

1.7 QUALITY ASSURANCE

A. Manufacturer Qualifications:

1. Provider of advanced installer training.

2. Minimum of ten years of experience in manufacturing metal wall panel systems.

3. Provider of products produced in a permanent factory environment with fixed roll-forming equipment.

B. Installer Qualifications:

1. At least five years of experience in the installation of metal wall panels.

2. Experience on at least five projects of similar size, type and complexity as this Project that have been in service for a minimum of two years with satisfactory performance of the wall panel system.

3. Employer of workers for this Project who are competent in techniques required by manufacturer for installation indicated and who shall be supervised at all times when material is being installed.

1.8 DELIVERY, STORAGE AND HANDLING

A. General: Comply with manufacturer’s current printed product storage recommendations.

B. Delivery: Deliver materials in manufacturer’s original, unopened, undamaged containers with identification labels intact.

C. Storage: Store materials above ground, under waterproof covering, protected from exposure to harmful weather conditions and at temperature and humidity conditions recommended by manufacturer. Provide proper ventilation of metal panel system to prevent condensation build-up between each panel and trim or flashing component. Tilt stack to drain in wet conditions. Remove strippable plastic film before storage under high-heat conditions. Store products in manufacturer's unopened packaging until just prior to installation.

D. Handling: Exercise caution in unloading and handling metal panel system to prevent bending, warping, twisting and surface damage.

1.9 WARRANTY

A. Special Exposed Panel Finish Warranty: Manufacturer's standard form PVDF Fluorocarbon System Warranty for film integrity, chalk rating and fade rating in which manufacturer agrees to repair or replace panels that show evidence of deterioration within specified warranty period.

1. Deterioration shall include but is not limited to:

a. Color fading of more than 5 Hunter units when tested according to ASTM D 2244.

b. Chalking in excess of a No. 8 rating when tested according to ASTM D 4214.

c. Cracking, checking, peeling or failure of paint to adhere to bare metal.

d. Perforation

2. Warranty Period: Film integrity for 45 years and chalk and fade rating for 35 years, and perforation for 25 years from date of Substantial Completion.

3. Manufacturer’s warranty may exclude surface deterioration due to physical damage and exposure to salt air environments.

B. Special Exposed Panel Finish Warranty: Manufacturer's standard form proprietary two coat roll coated System Warranty for film integrity, chalk rating and fade rating in which manufacturer agrees to repair or replace panels that show evidence of deterioration within specified warranty period.

1. Deterioration shall include but is not limited to:

a. Color fading of more than 5 Hunter units on vertical applications or more than 6 Hunter units on non-vertical applications when tested according to ASTM D 2244.

b. Chalking in excess of a No. 8 rating on vertical applications or a No. 7 rating on non-vertical applications when tested according to ASTM D 4214.

c. Cracking, checking, peeling or failure of paint to adhere to bare metal.

d. Perforation.

2. Warranty Period: Film integrity for 45 years, chalk and fade rating for 30 years, and perforation for 25 years from date of Substantial Completion.

3. Manufacturer’s warranty may exclude surface deterioration due to physical damage and exposure to salt air environments.

PART 2 PRODUCTS

2.1 METAL WALL PANELS

A. Basis of Design Product: Subject to compliance with requirements provide Metal Sales Manufacturing Corporation; 7/8” Corrugated.

B. Substitution Limitations:**: Submit substitution request in accordance with Section 012500 - "Substitution Procedures"**]

C. Product Options:

1. Panel coverage: 34-2/3 inches (880.5 mm).

2. Rib Height: 7/8 inch (22.2 mm).

3. Material: Aluminum-zinc alloy-coated steel sheet, ASTM A 792, **AZ55**] structural quality [**0.0296-inch (0.75-mm)**] minimum thickness.

4. Attachment: Exposed direct fastened panel.

5. Application: Designed for application over open framing

6. Rib Configuration: Sinusoidal.

7. Surface Finish: **Acrylic Coated Galvalume**.

8. Color: None

9. Fire Resistance Rating: Comply with UL 263**.**

10. Air Leakage: 0.004 cfm/sq. ft. when tested according to ASTM E 283.

11. Water Penetration: None at 12 psf when tested according to ASTM E 331.

12. Structural Performance: Tested according to requirements of ASTM E 330 and ASTM E 1592.

13. Code and Testing Agency Approvals: Comply with 2010 State of Florida Building Code Approval 9482.1.

2.3 FIELD-INSTALLED THERMAL INSULATION

A. General: Refer to and coordinate with requirements in Division 07 - Thermal Insulation.

B. Products: <See Metal Building Insulation Section>.

2.5 ACCESSORIES

A. General: Inside and outside corner trim, to trim.

B. Products:

1. Basis of Design Product: Subject to compliance with requirements provide Metal Sales Manufacturing Corporation.

2. Color: to match panels

2.6 SOURCE QUALITY CONTROL

A. Source: Obtain metal wall panels, trim and other accessories from a single manufacturer.

B. Quality Control: Obtain metal wall panels, trim and other accessories from a manufacturer capable of providing on-site technical support and installation assistance.

PART 3 EXECUTION

3.1 PREPARATION

A. Miscellaneous Framing: Install furring, angles, subpurlins, and other miscellaneous wall panel support members and anchorage according to metal wall panel manufacturer's recommendations.

3.2 THERMAL INSULATION INSTALLATION

A. Blanket Insulation:. Comply with installation requirements in Division 07 Section "Thermal Insulation."

3.3 METAL WALL PANEL INSTALLATION

A. General: Comply with panel manufacturer’s installation instructions including but not limited to special techniques, interface with other work, and integration of systems.

B. Fasten metal wall panels to supports with concealed clips at each standing-seam joint at location, spacing, and using proper fasteners as recommended by panel manufacturer.

3.4 ACCESSORY INSTALLATION

A. General: Install accessories using techniques recommended by manufacturer and which will assure positive anchorage to building and weather tight mounting. Provide for thermal movement. Coordinate installation with flashings and other components.

B. Flashing and Trim: Comply with performance requirements, manufacturer's written installation instructions, and the SMACNA "Architectural Sheet Metal Manual." Provide concealed fasteners where possible, and install units to true level. Install work with laps, joints, and seams that will be permanently watertight.

3.6 FIELD QUALITY CONTROL

A. Manufacturer’s Field Services: If requested by Owner, provide manufacturer’s field service consisting of product use recommendations and periodic site visits for inspection of product installation in accordance with manufacturer’s instructions.

3.7 CLEANING

A. Remove temporary coverings and protection of adjacent work areas.

B. Repair or replace any installed products that have been damaged.

C. Clean installed panels in accordance with manufacturer’s instructions prior to Owner’s acceptance.

D. Remove and lawfully dispose of construction debris from Project site.

3.8 PROTECTION

A. Protect installed product and finish surfaces from damage during construction.

END OF SECTION 07 42 13 –

SECTION 07 5423

THERMOPLASTIC POLYOLEFIN (TPO) MEMBRANE ROOFING PART 1

GENERAL

1.01 SECTION INCLUDES

A. Adhered system with thermoplastic polyolefin (TPO) roofing membrane.

B. Vapor retarder.

C. Deck sheathing.

D. Flashings and Coping.

E. Roofing cant strips, stack boots, roofing expansion joints, and walkway pads.

1.02 RELATED REQUIREMENTS

A. Section 06 1000 - Rough Carpentry: Wood nailers and curbs.

B. Section 07 6200 – Sheet Metal Flashing and Trim

C. Section 07 7200 - Roof Accessories

D. Section 22 1006 - Plumbing Piping Specialties: Roof drains.

1.03 REFERENCE STANDARDS

A. ASCE 7 - Minimum Design Loads and Associated Criteria for Buildings and Other Structures; 2016.

B. ASTM C1177/C1177M - Standard Specification for Glass Mat Gypsum Substrate for Use as Sheathing; 2013.

C. ASTM C1289 - Standard Specification for Faced Rigid Cellular Polyisocyanurate Thermal Insulation Board; 2017.

D. ASTM D6878/D6878M - Standard Specification for Thermoplastic Polyolefin Based Sheet Roofing; 2017.

E. FM DS 1-28 - Wind Design; 2016.

F. FM DS 1-29 - Roof Deck Securement and Above-Deck Roof Components; Factory Mutual System; 2016.

G. NRCA (RM) - The NRCA Roofing Manual; 2018.

H. UL 790 - Standard for Standard Test Methods for Fire Tests of Roof Coverings; Current Edition, Including All Revisions.

1.04 ADMINISTRATIVE REQUIREMENTS

A. Preinstallation Meeting: Convene one week before starting work of this section.

1. Review preparation and installation procedures and coordinating and scheduling required with related work.

2.

1.05 SUBMITTALS

A. See Section 01 3000 - Administrative Requirements, for submittal procedures.

B. Product Data: Provide manufacturer's written information listed below.

1. Product data indicating membrane materials, flashing materials, insulation, vapor retarder, surfacing, and fasteners.

2. Preparation instructions and recommendations.

3. Storage and handling requirements.

C. Shop Drawings: Indicate joint or termination detail conditions, conditions of interface with other materials, and paver layout.

D. Manufacturer's Installation Instructions: Indicate membrane seaming precautions and perimeter conditions requiring special attention.

E. Warranty:

1. Submit manufacturer warranty and ensure that forms have been completed in Owner's name and registered with manufacturer.

2. Submit installer's certification that installation complies with all warranty conditions for the waterproof membrane.

F. Installer's Qualification Statement.

1.06 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum twenty (20) years of documented experience.

B. Installer Qualifications: Company specializing in performing the work of this section:

1. With minimum five (5) years documented experience.

2. Approved by membrane manufacturer.

C. Single Source Responsibility: Provide and install products from single source.

1.07 DELIVERY, STORAGE, AND HANDLING

A. Deliver products in manufacturer's original containers, dry, undamaged, with seals and labels intact.

B. Store products in weather protected environment, clear of ground and moisture.

C. Protect foam insulation from direct exposure to sunlight.

D. Keep Material Safety Data Sheets (MSDS) at the project site at all times during transportation, storage, and installation of materials.

E. Comply with all requirements of Owner to prevent overloading or disturbance of the structure when loading materials onto the roof.

1.08 FIELD CONDITIONS

A. Do not apply roofing membrane during unsuitable weather. Refer to manufacturer's written instructions.

B. Do not apply roofing membrane to damp or frozen deck surface or when precipitation is expected or occurring.

C. Do not expose materials vulnerable to water or sun damage in quantities greater than can be weatherproofed the same day.

D. Proceed with work so new roofing materials are not subject to construction traffic as work progresses.

E. Do not allowgrease, oil, fats, or other contaminants to come into direct contact with membrane.

1.09 WARRANTY

A. See Section 01 7800 - Closeout Submittals, for additional warranty requirements.

B. Material Warranty: Provide membrane manufacturer's warranty agreeing to replace material that shows manufacturing defects within 10 years after installation.

C. System Warranty: Provide manufacturer's system warranty agreeing to repair or replace roofing that leaks or is damaged due to wind or other natural causes.

1. Warranty Term: 20 years.

2. For repair and replacement include costs of both material and labor in warranty.

3. Include accidental punctures according to the manufacturer's standard warranty terms.

4. Include hail damage according to the manufacturer's standard warranty terms.

5. Exceptions NOT Permitted:

a. Damage due to roof traffic.

b. Damage due to wind of speed greater than 56 mph but less than 90 mph.

PART 2 PRODUCTS

2.01 MANUFACTURER

A. Basis of Design: Carlisle SynTec Sure-Weld TPO Fully Adhered: www.carlisle-syntec.com/#sle.

B. Substitutions: See Section 01 6000 - Product Requirements.

2.02 ROOFING APPLICATIONS

A. TPO Membrane Roofing: One ply membrane, asphalt adhered, over insulation.

B. Roofing Assembly Performance Requirements and Design Criteria:

1. Roof Covering External Fire Resistance Classification: Class A when tested per UL 790.

2. Wind Uplift:

a. Designed to withstand wind uplift forces calculated with ASCE 7.

3. Insulation Thermal Resistance (R-Value): 3 per inch, minimum; provide insulation of thickness required.

4. Drainage: No standing water within 48 hours after precipitation.

2.03 ROOFING MEMBRANE AND ASSOCIATED MATERIALS

A. Membrane:

1. Material: Thermoplastic Polyolefin (TPO) complying with ASTM D6878/D6878M.

2. Reinforcing: Internal fabric.

3. Thickness: 60 mils (0.060 inch), minimum.

4. Sheet Width: Factory fabricated into largest sheets possible.

5. Color: Tan.

6. Product:

a. Carlisle Sure-Weld.

B. Seaming Materials: As recommended by membrane manufacturer.

C. Membrane Fasteners: Fully adhered by manufactures specifications.

D. Vapor Retarder: Material approved by roof manufacturer complying with requirements of fire rating classification; compatible with roofing and insulation materials.

1. Fire-retardant adhesive.

E. Flexible Flashing Material: Same material as membrane.

F. Base Flashing: Provide waterproof, fully adhered base flashing system at all penetrations, plane transitions, and terminations.

2.04 ROOF CRICKETING

A. Flat Foam Roof Insulation with Fiber-Reinforced Facers; closed-cell polyisocyanurate foam core bonded to fiber-reinforced facers on both sides; conforming to ASTM C 1289, Type II, Class 1 with square edges and slopped top profile of ¼”=1’-0”

1. Basis of design; insulBase Papered Polyiso

B. Pocket roofs of 2x wood framing covered with densdeck may be used as an alternate where applicable.

2.05 ACCESSORIES

A. Prefabricated Flashing Accessories:

1. Corners and Seams: Same material as membrane, in manufacturer's standard thicknesses.

a. Carlisle Sure-Weld TPO Inside Corners; 60 mils (0.060 inch) thick.

b. Carlisle Sure-Weld TPO Outside Corners; 60 mils (0.060 inch) thick.

c. Carlisle Sure-Weld TPO T-Joint Covers; 60 mils (0.060 inch) thick, 4-1/2 inch diameter.

d. Carlisle TPO Curb Wrap Corners; 45 mils (0.045 inch) thick, 6 inch wide flange and 12 inch overall height.

2. Penetrations: Same material as membrane, with manufacturer's standard cut-outs, rigid inserts, clamping rings, and flanges.

3. Sealant Pockets: Same material as membrane, with manufacturer's standard accessories, in manufacturer's standard configuration.

4. Pressure Sensitive Cover Strips: 6 inch wide, 45 mils (0.045 inch) thick, non-reinforced TPO membrane laminated to 35 mils (0.035 inch) thick cured synthetic rubber with pressure sensitive adhesive.

5. TPO Pressure Sensitive RUSS:

a. 6 inch wide, 40 mils (0.040 inch) thick, reinforced TPO membrane with 3 inch wide, 35 mils (0.035 inch) thick cured synthetic rubber with pressure sensitive adhesive laminated to one edge.

6. Walkway Rolls: Sure-Flex Heat Weldable Walkway Rolls; 80 mils (0.080 inch) thick; gray membrane.

7. Miscellaneous Flashing: Non-reinforced TPO membrane; 80 mils (0.080 inch) thick, in manufacturer's standard lengths and widths.

B. Membrane Adhesive: As recommended by membrane manufacturer.

1. Carlisle Sure-Weld Bonding Adhesive.

C. Surface Conditioner for Adhesives: Compatible with membrane and adhesives.

D. Strip Reglet Devices: Galvanized steel, maximum possible lengths per location, with attachment flanges. See Section 07 7200 Roof Accessories/ 2.05.

E. Sealants: As recommended by membrane manufacturer.

F. Cleaner: Manufacturer's standard, clear, solvent-based cleaner.

1. Carlisle Weathered Membrane Cleaner.

G. Primer: Manufacturer's recommended product.

1. Carlisle TPO Primer.

H. Edgings and Terminations: Manufacturer's standard edge and termination accessories.

1. Reglet

a. See Section 07 7200 Roof Accessories/ 2.05

2. Termination Bar.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that surfaces and site conditions are ready to receive work.

B. Verify deck is supported and secure.

C. Verify deck is clean and smooth, flat, free of depressions, waves, or projections, properly sloped and suitable for installation of roof system.

D. Verify deck surfaces are dry and free of snow or ice.

E. Verify that roof openings, curbs, and penetrations through roof are solidly set, and cant strips are in place.

3.02 PREPARATION, GENERAL

A. Clean substrate thoroughly prior to roof application.

B. Do not begin work until other work that requires foot or equipment traffic on roof is complete.

3.03 METAL DECK PREPARATION

A. Install preformed sound absorbing glass fiber insulation strips supplied by Section 05 3100 in acoustic deck flutes. Install in accordance with manufacturer's instructions.

B. Install deck sheathing on metal deck:

1. Lay with long side at right angle to flutes; stagger end joints; provide support at ends.

2. Cut sheathing cleanly and accurately at roof breaks and protrusions to provide smooth surface.

3. Tape joints.

4. Mechanically fasten sheathing to roof deck, in accordance with Factory Mutual recommendations and roofing manufacturer's instructions.

a. Over entire roof area, fasten sheathing using 6 fasteners with washers per sheathing board.

b. At roof perimeter to a distance of 4 ft in from edges, fasten sheathing using 6 fasteners with washers per board.

3.04 INSTALLATION - GENERAL

A. Perform work in accordance with manufacturer's instructions and NRCA (RM) applicable requirements.

B. Do not apply roofing membrane during unsuitable weather.

C. Do not apply roofing membrane when ambient temperature is outside the temperature range recommended by manufacturer.

D. Do not apply roofing membrane to damp or frozen deck surface or when precipitation is expected or occurring.

E. Do not expose materials vulnerable to water or sun damage in quantities greater than can be weatherproofed the same day.

3.05 INSULATION APPLICATION

A. Apply vapor retarder to deck surface with adhesive in accordance with manufacturer's instructions.

1. Extend vapor retarder under cant strips and blocking to deck edge.

2. Install flexible flashing from vapor retarder to air seal material of wall construction, lap and seal to provide continuity of the air barrier plane.

B. Ensure vapor retarder is clean and dry, continuous, and ready for application ofinsulation.

C. Attachment of Insulation:

1. Mechanically fasten first layer of insulation to deck in accordance with roofing manufacturer's instructions and Factory Mutual requirements.

2. Embed second layer of insulation into full bed of adhesive in accordance with roofing and insulation manufacturers' instructions.

D. Lay subsequent layers of insulation with joints staggered minimum 6 inch from joints of preceding layer.

E. Place tapered insulation to the required slope pattern in accordance with manufacturer's instructions.

F. On metal deck, place boards parallel to flutes with insulation board edges bearing on deck flutes.

G. Lay boards with edges in moderate contact without forcing, and gap between boards no greater than 1/4 inch. Cut insulation to fit neatly to perimeter blocking and around penetrations through roof.

H. Tape joints of insulation in accordance with roofing and insulation manufacturers' instructions.

I. At roof drains, use factory-tapered boards to slope down to roof drains over a distance of 18 inches.

J. Do not apply more insulation than can be completely waterproofed in the sameday.

3.06 MEMBRANE APPLICATION

A. Roll out membrane, free from wrinkles or tears. Place sheet into place without stretching.

B. Shingle joints on sloped substrate in direction of drainage.

C. Fully Adhered Application: Apply adhesive at manufacturer's recommended rate. Fully embed membrane in adhesive except in areas directly over or within 3 inches of expansion joints. Fully adhere one roll before proceeding to adjacent rolls.

D. Seam Welding:

1. Seam Welding: Overlap edges and ends and seal seams by heat welding, minimum 2 inches.
2. Cover seams with manufacturer's recommended joint covers.
3. Probe seams once welds have thoroughly cooled. (Approximately 30 minutes.)
4. Repair deficient seams within the same day.
5. Seal cut edges of reinforced membrane after seam probe is complete.

E. At intersections with vertical surfaces:

1. Extend membrane over cant strips and up a minimum of 4 inches onto vertical surfaces.
2. Fully adhere flexible flashing over membrane and up to nailing strips.

F. At copings, extend membrane under coping and to the outside face of the wall.

G. Install roofing expansion joints where recommended by manufacturer. Make joints watertight.

H. Install prefabricated joint components in accordance with manufacturer's instructions.

I. Coordinate installation of roof drains and sumps and related flashings. Locate all field splices away from low areas and roof drains. Lap upslope sheet over downslope sheet.

J. Install walkway pads at areas of concentrated traffic and as shown on Drawings. Space pad joints to permit drainage.

K. Daily Seal: Install daily seal per manufacturers instructions at the end of each work day. Prevent infiltration of water at incomplete flashings, terminations, and at unfinished membrane edges.

3.07 FIELD QUALITY CONTROL

A. See Section 01 4000 - Quality Requirements, for general requirements for field quality control and inspection.

B. Require site attendance of roofing and insulation material manufacturers daily during installation of the Work.

3.08 CLEANING

A. See Section 01 7419 - Construction Waste Management and Disposal, for additional requirements.

B. Remove wrappings, empty containers, paper, and other debris from the roof daily. Dispose of debris in compliance with local, State, and Federal regulations.

C. Remove bituminous markings from finished surfaces.

D. In areas where finished surfaces are soiled by work of this section, consult manufacturer of surfaces for cleaning advice and conform to their documented instructions.

E. Repair or replace defaced or damaged finishes caused by work of this section.

3.09 PROTECTION

A. Protect installed roofing and flashings from construction operations.

B. Where traffic must continue over finished roof membrane, protect surfaces using durable materials.

END OF SECTION 07 5423

SECTION 07 6200

SHEET METAL FLASHING AND TRIM

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Fabricated sheet metal items, including flashings and counterflashings.

B. Sealants for joints within sheet metal fabrications.

1.02 REFERENCE STANDARDS

A. AAMA 2604 - Voluntary Specification, Performance Requirements and Test Procedures for High Performance Organic Coatings on Aluminum Extrusions and Panels (with Coil Coating Appendix); 2017a.

B. ASTM B209 - Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate; 2014.

C. ASTM B209M - Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate (Metric); 2014.

D. ASTM C920 - Standard Specification for Elastomeric Joint Sealants; 2018.

E. ASTM D4586/D4586M - Standard Specification for Asphalt Roof Cement, Asbestos-Free; 2007, with Editorial Revision (2012).

F. ASTM A792/A792M-97a Standard Specifications for Steel Sheet, 55%t Aluminum-Zinc Alloy-Coated by the Hot-Dip Process

1.03 SUBMITTALS

A. See Section 01 3000 - Administrative Requirements, for submittal procedures.

B. Shop Drawings: Indicate material profile, jointing pattern, jointing details, fastening methods, flashings, terminations, and installation details.

1.04 DELIVERY, STORAGE, AND HANDLING

A. Stack material to prevent twisting, bending, and abrasion, and to provide ventilation. Slope metal sheets to ensure drainage.

C. Prevent contact with materials that could cause discoloration or staining.

PART 2 PRODUCTS

2.01 SHEET MATERIALS

A. Pre-Finished Steel: ASTM B209 (ASTM B209M); 20 gage, (0.032 inch) thick; plain finish shop pre-coated with hot dipped Galvalume coating.

1. Galvalume meeting ASTM A792/A792M-97a requirements.
2. Shall be approximately 43% Zinc, 55% Aluminum as well as silicon and iorn.
3. Shall have Acrylic Coating.

2.02 FABRICATION

A. Form sections true to shape, accurate in size, square, and free from distortion or defects.

B. Form pieces in longest possible lengths.

C. Hem exposed edges on underside 1/2 inch; miter and seam corners.

D. Form material with flat lock seams, except where otherwise indicated; at moving joints, use sealed lapped, bayonet-type or interlocking hooked seams.

E. Fabricate corners from one piece with minimum 18 inch long legs; seam for rigidity, seal with sealant.

F. Fabricate flashings to allow toe to extend 2 inches over roofing gravel. Return and brake edges.

2.03 ACCESSORIES

A. Fasteners: Galvanized steel, with soft neoprene washers.

B. Primer: Zinc chromate type.

C. Concealed Sealants: Non-curing butyl sealant.SHEET METAL FLASHING AND TRIM 07 6200 - 2

D. Exposed Sealants: ASTM C920; elastomeric sealant, with minimum movement capability as recommended by manufacturer for substrates to be sealed; color to match adjacent material.

D. Plastic Cement: ASTM D4586/D4586M, Type I.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify roof openings, curbs, pipes, sleeves, ducts, and vents through roof are solidly set, reglets in place, and nailing strips located.

B. Verify roofing termination and base flashings are in place, sealed, and secure.

3.02 PREPARATION

A. Install starter and edge strips, and cleats before starting installation.

B. Back paint concealed metal surfaces with protective backing paint to a minimum dry film thickness of 15 mil.

3.03 INSTALLATION

A. Secure flashings in place using concealed fasteners, and use exposed fasteners only where permitted..

B. Apply plastic cement compound between metal flashings and felt flashings.

C. Fit flashings tight in place; make corners square, surfaces true and straight in planes, and lines accurate to profiles.

E. Seal metal joints watertight.

3.04 FIELD QUALITY CONTROL

A. See Section 01 4000 - Quality Requirements, for field inspection requirements.

B. Inspection will involve surveillance of work during installation to ascertain compliance with specified requirements.

END OF SECTION 07 6200

SECTION 07 7200

ROOF ACCESSORIES

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Curbs.

B. Equipment rails.

C. Roof penetrations mounting curbs.

D. Gutters

E. Downspouts

F. Cap Flashing and Reglet

1.02 RELATED REQUIREMENTS

A. Section 13 120 Pre-Engineered Structures

B. Section 07 6200 Sheet Metal Flashing and Trim

1.03 REFERENCE STANDARDS

A. ASTM A123/A123M - Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products; 2017.

B. ASTM A153/A153M - Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware; 2016a.

F. ASTM A792/A792M-97a Standard Specifications for Steel Sheet, 55%t Aluminum-Zinc Alloy-Coated by the Hot-Dip Process

1.04 SUBMITTALS

A. See Section 01 3000 - 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.

1.05 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.

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 counterflashing with top and edges formed to shed water.

1. Applications: Roof curbs used for roof penetrations/openings as indicated on drawings.

2. Roof Curb Mounting Substrate: Curb substrate consists of flat roof deck sheathing with insulation.

3. Sheet Metal Material:

a. Aluminum: 0.080 inch minimum thickness, with 3003 alloy, and H14 temper.

4. Roofing Cants: Provide integral sheet metal roofing cants dimensioned to begin slope at top of roofing system at 1:1 slope; minimum cant height 4 inches.

5. Provide for layouts and configurations as indicated on drawings.

B. Curbs at Roof Openings: Provide curb at sides of roof opening, with top of curb horizontal and level for equipment mounting.

1. Insulate inside curbs with 1-1/2 inch thick fiberglass insulation.

C. Equipment Rail Curbs: Straight curbs on each side of equipment, with top of curbs horizontal and level with each other for equipment mounting.

1. Height Above Finished Roof Surface: 8 inches, minimum.

D. Equipment Support: Straight curbs on each side of equipment, with top of curbs parallel with metal roofing system and each other for equipment mounting.

E. Pipe, Duct, or Conduit Mounting Curbs: Vertical posts, minimum 8 inches square unless otherwise indicated.

2.02 NON-PENETRATING ROOFTOP SUPPORTS/ASSEMBLIES

A. Non-Penetrating Rooftop Support/Assemblies: Manufacturer-engineered and

factory-fabricated, with pedestal bases that rest on top of roofing membrane, and not requiring any attachment to roof structure and not penetrating roofing assembly.

1. Design Loadings and Configurations: As required by applicable codes.
2. Support Spacing and Base Sizes: As required to distribute load sufficiently to prevent indentation of roofing assembly.
3. Steel Components: Stainless steel, or carbon steel hot-dip galvanized after fabrication in accordance with ASTM A123/A123M.
4. Hardware, Bolts, Nuts, and Washers: Stainless steel, or carbon steel hot-dip galvanized after fabrication in accordance with ASTM A153/A153M.

2.03 Gutters.

A. Seamless steel rectangular gutter sized to manufactures specifications.

1. Shall include wall brackets of matching finish.
2. Finish shall be galvalume.

2.04 Downspouts.

A. Steel 6x6 downspouts with galvalume finish.

B. Shall include mounting brackets and full required assembly, complete.

2.05 Cap Flashing and Reglet's.

A. Use: Flashing styem between Stucco coating of parapet and TPO roofing System.

B. Locations: At Fire Station roof where TPO is used as roofing system.

C. Product: Besis of design Shall be Fry 'Springlo' 'ST' Stucco Reglet.

D. Finish: Galvanized Steel

E. Thickness: 24 Gage

F. See Section Section 07 6200 Sheet Metal Flashing and Trim

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 INSTALLATION

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

3.03 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 7200

SECTION 07 8400

FIRESTOPPING

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Firestopping systems.

B. Firestopping of all joints and penetrations in fire resistance rated and smoke resistant assemblies, whether indicated on drawings or not, and other openings indicated.

1.02 RELATED REQUIREMENTS

A. Section 09 2116 - Gypsum Board Assemblies: Gypsum wallboard fireproofing.

1.03 REFERENCE STANDARDS

A. ASTM E119 - Standard Test Methods for Fire Tests of Building Construction and Materials; 2016a.

B. ASTM E814 - Standard Test Method for Fire Tests of Penetration Firestop Systems; 2013a (Reapproved 2017).

C. ITS (DIR) - Directory of Listed Products; current edition.

D. FM (AG) - FM Approval Guide; current edition.

E. UL 1479 - Standard for Fire Tests of Penetration Firestops; Current Edition, Including All Revisions.

F. UL (FRD) - Fire Resistance Directory; Current Edition.

1.04 SUBMITTALS

A. See Section 01 3000 - Administrative Requirements, for submittal procedures.

B. Product Data: Provide data on product characteristics, performance ratings, and limitations.

1.05 FIELD CONDITIONS

A. Conform to 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.

PART 2 PRODUCTS

2.01 MATERIALS

A. Firestopping Materials: Any materials meeting requirements.

B. Primers, Sleeves, Forms, Insulation, Packing, Stuffing, and Accessories: Provide type of materials as required for tested firestopping assembly.

2.02 FIRESTOPPING ASSEMBLY REQUIREMENTS

A. 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.

2.03 FIRESTOPPING SYSTEMS

A. Firestopping: Any material meeting requirements.

1. Fire Ratings: Use system that is listed by FM (AG), ITS (DIR), or UL (FRD) and tested in accordance with ASTM E814, ASTM E119, or UL 1479 with F Rating equal to fire rating of penetrated assembly and minimum T Rating Equal to F Rating and in compliance with other specified requirements.

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.

3.03 INSTALLATION

A. Install materials in manner described in fire test report and in accordance with manufacturer's instructions, completely closing openings.

END OF SECTION 07 8400

SECTION 07 9200

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 07 8400 - Firestopping: Firestopping sealants.

B. Section 08 8000 - Glazing: Glazing sealants and accessories.

C. Section 09 2116 - Gypsum Board Assemblies: Sealing acoustical and sound-rated walls and ceilings.

1.03 REFERENCE STANDARDS

A. ASTM C661 - Standard Test Method for Indentation Hardness of Elastomeric-Type Sealants by Means of a Durometer; 2015.

B. ASTM C834 - Standard Specification for Latex Sealants; 2017.

C. ASTM C920 - Standard Specification for Elastomeric Joint Sealants; 2018.

D. ASTM C1193 - Standard Guide for Use of Joint Sealants; 2016.

E. ASTM C1248 - Standard Test Method for Staining of Porous Substrate by Joint Sealants; 2008 (Reapproved 2012).

F. ASTM C1330 - Standard Specification for Cylindrical Sealant Backing for Use with Cold Liquid-Applied Sealants; 2002 (Reapproved 2013).

G. ASTM D412 - Standard Test Methods for Vulcanized Rubber and Thermoplastic Elastomers--Tension; 2016.

1.04 SUBMITTALS

A. See Section 01 3000 - 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.

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.

PART 2 PRODUCTS

2.01 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. 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. Type_____- Control and Expansion Joints in Concrete Paving: Self-leveling polyurethane "traffic-grade" sealant.

C. Interior Joints: Use non-sag polyurethane sealant, unless otherwise indicated.

1. Wall and Ceiling Joints in Non-Wet Areas: Acrylic emulsion latex sealant.

D. Interior Wet Areas: Bathrooms, restrooms, kitchens, food service areas, and food processing areas; fixtures in wet areas include plumbing fixtures, food service equipment, countertops, cabinets, and other similar items.

2.02 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. Non-Staining To Porous Stone: Non-staining to light-colored natural stone when tested in accordance with ASTM C1248.

2. Dirt Pick-Up: Reduced dirt pick-up compared to other silicone sealants.

3. Color: To be selected by Architect from manufacturer's standard range.

4. Cure Type: Single-component, neutral moisture curing.

5. Service Temperature Range: Minus 65 to 180 degrees F.

B. 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 25 percent, minimum.

2. Color: Match adjacent finished surfaces.

C. Acrylic Emulsion Latex: Water-based; ASTM C834, single component, non-staining, non-bleeding, non-sagging; not intended for exterior use.

2.03 SELF-LEVELING SEALANTS

A. Self-Leveling Polyurethane Sealant for Horizontal Expansion Joints: ASTM C920, GradeP, Uses T, M and O; multi-component; explicitly approved by manufacturer for horizontal expansion joints.

1. Movement Capability: Plus and minus 25 percent, minimum.

2. Hardness Range: 30 to 35, Shore A, when tested in accordance with ASTM C661.

3. Color: To be selected by Architect from manufacturer's standard range.

4. Tensile Strength: 200 to 250 psi in accordance with ASTM D412.

2.04 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 jointwidth.

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.

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 completelyremovable.

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. Install bond breaker backing tape where backer rod cannot be used.

D. Install sealant free of air pockets, foreign embedded matter, ridges, and sags, and without getting sealant on adjacent surfaces.

E. 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.

F. Nonsag Sealants: Tool surface concave, unless otherwise indicated; remove masking tape immediately after tooling sealant surface.

END OF SECTION 07 9200

SECTION 08 1113

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. Thermally insulated hollow metal doors with frames.

D. Sound-rated hollow metal doors and frames.

E. Hollow metal borrowed lites glazing frames.

1.02 RELATED REQUIREMENTS

A. Section 08 7100 - Door Hardware.

B. Section 08 8000 - Glazing: Glass for doors and borrowed lites.

1.03 REFERENCE STANDARDS

A. ADA Standards - Americans with Disabilities Act (ADA) Standards for Accessible Design; 2010.

B. ANSI/SDI A250.4 - Test

C. Procedure and Acceptance Criteria for Physical Endurance for Steel Doors, Frames and Frame Anchors; 2011.

D. ANSI/SDI A250.8 - Specifications for Standard Steel Doors and Frames (SDI-100); 2014.

E. ANSI/SDI A250.10 - Test Procedure and Acceptance Criteria for Prime Painted Steel Surfaces for Steel Doors and Frames; 2011.

F. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process; 2017.

G. ASTM A1008/A1008M - Standard Specification for Steel, Sheet, Cold-Rolled, Carbon, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, Solution Hardened, and Bake Hardenable; 2016.

H. ASTM A1011/A1011M - Standard Specification for Steel, Sheet and Strip, Hot-Rolled, Carbon, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, and Ultra-High Strength; 2017.

I. ASTM E90 - Standard Test Method for Laboratory Measurement of Airborne Sound Transmission Loss of Building Partitions and Elements; 2009 (Reapproved 2016).

J. BHMA A156.115 - American National Standard for Hardware Preparation in Steel Doors and Steel Frames; 2016.

K. ICC A117.1 - Accessible and Usable Buildings and Facilities; 2017.

L. ITS (DIR) - Directory of Listed Products; current edition.

M. NAAMM HMMA 830 - Hardware Selection for Hollow Metal Doors and Frames; 2002.

N. NAAMM HMMA 831 - Hardware Locations for Hollow Metal Doors and Frames; 2011.

O. NAAMM HMMA 840 - Guide Specifications for Installation and Storage of Hollow Metal Doors and Frames; 2007.

P. NFPA 80 - Standard for Fire Doors and Other Opening Protectives; 2016.

Q. NFPA 105 - Standard for Smoke Door Assemblies and Other Opening Protectives; 2016.

R. NFPA 252 - Standard Methods of Fire Tests of Door Assemblies; 2018.

S. UL (DIR) - Online Certifications Directory; Current Edition.

T. UL 10C - Standard for Positive Pressure Fire Tests of Door Assemblies; Current Edition, Including All Revisions.

U. UL 1784 - Standard for Air Leakage Tests of Door Assemblies; Current Edition, Including All Revisions.

1.04 SUBMITTALS

A. See Section 01 3000 - 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. Samples: Submit two samples of metal, 2 inch by 2 inch in size showing factory finishes, colors, and surface texture.

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 DESIGN CRITERIA

A. Requirements for Hollow Metal Doors and Frames:

1. Steel used for fabrication of doors and frames shall comply with one or more of the following requirements; Galvannealed steel conforming to ASTM A653/A653M, cold-rolled steel

conforming to ASTM A1008/A1008M, or hot-rolled pickled and oiled (HRPO) steel conforming to ASTM A1011/A1011M, Commercial Steel (CS) Type B foreach.

2. Accessibility: Comply with ICC A117.1 and ADA Standards.

3. Exterior Door Top Closures: Flush end closure channel, with top and door facesaligned.

4. Door Edge Profile: Manufacturers standard for application indicated.

5. Typical Door Face Sheets: Flush.

6. Glazed Lights: Non-removable stops on non-secure side; sizes and configurations as indicated on drawings. Style: Manufacturers standard.

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 andframes.

   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. 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.

2.02 HOLLOW METAL DOORS

A. Door Finish: Factory primed and field finished.

B. 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/SDIA250.4.

   c. Model 1 - Full Flush.

   d. Door Face Metal Thickness: 20 gage, 0.032 inch, minimum.

2. Door Thickness: 1-3/4 inch, nominal.

C. 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/SDIA250.4.

   c. Model 1 - Full Flush.

d. Door Face Metal Thickness: 20 gage, 0.032 inch, minimum.

2. Door Thickness: 1-3/4 inch, nominal.

D. Sound-Rated Interior 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 gage, 0.032 inch, minimum.

2. Sound Transmission Loss (STL) of Door and Frame Assembly: STL of 40 db at 500 to 1250 Hz, minimum, in accordance with ASTM E90 testing.

3. Door Thickness: As required to meet acoustic requirements indicated.

4. Opening Force of Sound-Rated Doors, Non-Fire Rated: 5 lbs, maximum, in compliance with ADA Standards.

2.03 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: Full profile/continuously welded type.

1. Weatherstripping: Separate, see Section 08 7100.

D. Interior Door Frames, Non-Fire Rated: Full profile/continuously welded type.

1. Frame Metal Thickness: 18 gage, 0.042 inch, minimum.

E. Door Frames, Fire-Rated: Full profile/continuously welded type.

1. Fire Rating: Same as door, labeled.

2. Frame Metal Thickness: 18 gage, 0.042 inch, minimum.

F. Sound-Rated Door Frames: Full profile/continuously welded type.

1. Frame Metal Thickness: 18 gage, 0.042 inch, minimum.

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.

2.04 FINISHES

A. Primer: Rust-inhibiting, complying with ANSI/SDI A250.10, door manufacturer's standard.

2.05 ACCESSORIES

A. Glazing: As specified in Section 08 8000, factory installed.

B. 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 centermullions.

C. 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 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. Install door hardware as specified in Section 08 7100.

E. Comply with glazing installation requirements of Section 08 8000.

3.03 TOLERANCES

A. Maximum Diagonal Distortion: 1/16 inch measured with straight edge, corner to corner.

3.04 ADJUSTING

A. Adjust for smooth and balanced door movement.

B. Adjust sound control doors so that seals are fully engaged when door is closed.

C. Test sound control doors for force to close, latch, and unlatch; adjust as necessary in compliance with requirements.

3.05 SCHEDULE

A. Refer to Door and Frame Schedule on the drawings.

END OF SECTION 08 1113

SECTION 08 1416
FLUSH WOOD DOORS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Flush wood doors; flush and flush glazed configuration; fire-rated, non-rated, acoustical, and special function.

1.02 RELATED REQUIREMENTS

A. Section 08 1113 - Hollow Metal Doors and Frames.

B. Section 08 7100 - Door Hardware.

C. Section 08 8000 - Glazing.

1.03 SUBMITTALS

A. See Section 01 3000 - Administrative Requirements, for submittal procedures.

B. Product Data: Indicate door core materials and construction; veneer species, type and characteristics.

C. Shop Drawings: Show doors and frames, elevations, sizes, types, swings, undercuts, beveling, blocking for hardware, factory machining, factory finishing, cutouts for glazing and other details.

1. Provide information as required by AWI/AWMAC/WI (AWS) or AWMAC/WI (NAAWS).

D. Certificate: Submit labels and certificates required by quality assurance and quality control programs.

E. Test Reports: Show compliance with specified requirements for the following:

1. Sound-retardant doors and frames; sealed panel tests are not acceptable.

2. Electrostatic shielded doors and frames.

F. Warranty, executed in Owner's name.

1.04 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section, with not less than three years of documented experience.

1. Accredited participant in the specified certification program prior to the commencement of fabrication and throughout the duration of the project.

B. Installer Qualifications: Company specializing in performing work of the type specified in this section, with not less than three years of documented experience.

C. Quality Certification:

1. Comply with AWI (QCP) woodwork association quality certification service/program in accordance with requirements for work specified in this section: www.awiqcp.org/#sle.
2. Provide labels or certificates indicating that the installed work complies with AWI/AWMAC/WI (AWS) or AWMAC/WI (NAAWS) requirements for grade or grades specified.
3. Provide designated labels on shop drawings as required by certification program.
4. Provide designated labels on installed products as required by certification program.
5. Submit certifications upon completion of installation that verifies this work is in compliance with specified requirements.

1.05 DELIVERY, STORAGE, AND HANDLING

A. Package, deliver and store doors in accordance with specified quality standard.

B. Accept doors on site in manufacturer's packaging. Inspect for damage.

C. Protect doors with resilient packaging sealed with heat shrunk plastic. Do not store in damp or wet areas; or in areas where sunlight might bleach veneer. Seal top and bottom edges with tinted sealer if stored more than one week. Break seal on site to permit ventilation.

1.06 WARRANTY

A. See Section 01 7800 - Closeout Submittals, for additional warranty requirements.

B. Interior Doors: Provide manufacturer's warranty for the life of the installation.

C. Include coverage for delamination of veneer, warping beyond specified installation tolerances, defective materials, and telegraphing core construction.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Wood Veneer Faced Doors:

B. Sound-Rated Wood Doors:

1. Basis of Design: Overly Door Company: www.overly.com/#sle.

C. Lead Lined (X-ray) Wood Doors:

1. Basis of Design: Ray-Bar Engineering Corporation, http://www.raybar.com.

2.02 DOORS AND PANELS

A. Doors: Refer to drawings for locations and additional requirements.

1. Quality Standard: Custom Grade, Heavy Duty performance, in accordance with AWI/AWMAC/WI (AWS) or AWMAC/WI (NAAWS), unless noted otherwise.

2. Wood Veneer Faced Doors: 7-ply unless otherwise indicated.

B. Interior Doors: 1-3/4 inches thick unless otherwise indicated; flush construction.

1. Provide solid core doors at each location.

2. Fire Rated Doors: Tested to ratings indicated on drawings in accordance with UL 10C - Positive Pressure; Underwriters Laboratories Inc (UL) or Intertek/Warnock Hersey (WHI) labeled without any visible seals when door is open.

3. Sound-Rated Doors: Minimum STC of 49, calculated in accordance with ASTM E413, tested in accordance with ASTM E90.

4. Lead Lined (X-ray) Doors: Minimum of 1/16 inch thick lead, unless otherwise indicated.

5. Wood veneer facing with factory transparent finish as indicated on drawings.

2.03 DOOR AND PANEL CORES

A. Non-Rated Solid Core and 20 Minute Rated Doors: Type particleboard core (PC), plies and faces as indicated.

B. Fire-Rated Doors: Mineral core type, with fire resistant composite core (FD), plies and faces as indicated above; with core blocking as required to provide adequate anchorage of hardware without through-bolting.

C. Sound-Rated Doors: Equivalent to type, with particleboard core (PC) construction as required to achieve STC rating specified; plies and faces as indicated above.

D. Lead Lined Doors: Equivalent to type, with bonded particleboard core (PC) with continuous lead sheet from edge to edge in center of core or between crossband and core; lead thickness; plies and faces as indicated above.

2.04 DOOR FACINGS

A. Veneer Facing for Transparent Finish: Birch, veneer grade in accordance with quality standard indicated, plain sliced (flat cut), with book match between leaves of veneer, running match of spliced veneer leaves assembled on door or panel face.

1. Vertical Edges: Any option allowed by quality standard forgrade.

2. "Running Match" each pair of doors and doors in close proximity to eachother.

3. "Pair Match" each pair of doors; "Set Match" pairs of doors within 10 feet of each other when doors are closed.

2.05 DOOR CONSTRUCTION

A. Fabricate doors in accordance with door quality standard specified.

B. Cores Constructed with stiles and rails:

1. Provide solid blocks at lock edge for hardware reinforcement.

2. Provide solid blocking for other through bolted hardware.

C. Glazed Openings: Non-removable stops on non-secure side; sizes and configurations as indicated on drawings.

D. Factory machine doors for hardware other than surface-mounted hardware, in accordance with hardware requirements and dimensions.

E. Factory fit doors for frame opening dimensions identified on shop drawings, with edge clearances in accordance with specified quality standard.

F. Provide edge clearances in accordance with the quality standard specified.

2.06 FACTORY FINISHING - WOOD VENEER DOORS

A. Finish work in accordance with AWI/AWMAC/WI (AWS) or AWMAC/WI (NAAWS), Section 5 - Finishing for grade specified and as follows:

1. Transparent:

a. System - 1, Lacquer, Nitrocellulose.

b. Stain: As selected by Architect.

c. Sheen: Flat.

2.07 ACCESSORIES

A. Hollow Metal Door Frames: As specified in Section 08 1113.

B. Glazing: As specified in Section 08 8000.

C. Glazing Stops: Wood, of same species as door facing, butted corners; prepared for countersink style tamper proof screws.

D. Door Hardware: As specified in Section 08 7100.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify existing conditions before starting work.

B. Verify that opening sizes and tolerances are acceptable.

C. Verify locations for fire rating, and/or sound control, and/or radiation protection requirements.

D. Do not install doors in frame openings that are not plumb or are out-of-tolerance for size or alignment.

3.02 INSTALLATION

A. Install doors in accordance with manufacturer's instructions and specified quality standard.

1. Install fire-rated doors in accordance with NFPA 80 requirements.

B. Factory-Finished Doors: Do not field cut or trim; if fit or clearance is not correct, replace door.

C. Use machine tools to cut or drill for hardware.

D. Coordinate installation of doors with installation of frames and hardware.

E. Coordinate installation of glazing.

3.03 TOLERANCES

A. Conform to specified quality standard for fit and clearance tolerances.

B. Conform to specified quality standard for telegraphing, warp, and squareness.

3.04 ADJUSTING

A. Adjust doors for smooth and balanced door movement.

B. Adjust closers for full closure.

END OF SECTION 08 1416

SECTION 08 3100

ACCESS DOORS AND PANELS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Wall access door and frame units.

PART 2 PRODUCTS

2.01 ACCESS DOORS AND PANELS ASSEMBLIES

A. Wall-Mounted Units:

1. Location: As indicated in MEP specifications.
2. Material: Steel.
3. Size: As indicated on drawings.
4. Door/Panel: Hinged, standard duty, with tool-operated spring or cam lock and no handle.

B. Wall-Mounted Units in Wet Areas:

1. Location: As indicated in plumbing and mechanical speciation's..
2. Size: As indicated on drawings
3. Door/Panel: Hinged, standard duty, with tool-operated spring or cam lock and no handle.
4. Wall Mounting Criteria: Provide surface-mounted face frame and door surface flush with frame surface.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that rough openings are correctly sized and located.

3.02 INSTALLATION

A. Install units in accordance with manufacturer's instructions.

B. Install frames plumb and level in openings, and secure units rigidly in place.

C. Position units to provide convenient access to concealed equipment when necessary.

END OF SECTION 08 3100

SECTION 08 3313

COILING COUNTER DOORS

1.01 GENERAL

A. Non-fire-rated coiling counter doors and operating hardware.

1.02 RELATED REQUIREMENTS

A. Section 08 7100 - Door Hardware: Cylinder cores and keys.

B. Section 09 2116 - Gypsum Board Assemblies: Rough openings.

1.03 SUBMITTALS

A. See Section 01 3000 - Administrative Requirements, for submittal procedures.

B. Product Data: Submit manufacturer's standard literature showing materials and details of construction and finish. Include data on electrical operation.

C. Shop Drawings: Indicate rough and actual opening dimensions, anchorage methods, hardware locations, and installation details.

D. Operation and Maintenance Data: Indicate modes of operation, lubrication requirements and frequency, and periodic adjustments required.

PART 2 PRODUCTS

2.01 COILING COUNTER DOORS

A. Coiling Counter Doors, Non-Fire-Rated: Aluminum or steel slat curtain.

1. Mounting: Between jambs, within prepared opening.

2. Nominal Slat Size: 1-1/4 inches wide.

3. Slat Profile: Flat.

4. Finish, Aluminum: Anodized or steel

5. Color: As selected by Architect from manufacturer's standard range.

6. Guides: Formed track; same material and finish unless otherwise indicated.

7. Hood Enclosure: Manufacturer's standard; primed steel.

2.02 MATERIALS

A. Curtain Construction: Interlocking, single thickness slats.

1. Slat Ends: Alternate slats fitted with end locks to act as wearing surface in guides and to prevent lateral movement.

2. Curtain Bottom: Fitted with angles to provide reinforcement and positive contact in closed position.

3. Aluminum Slats: ASTM B221 (ASTM B221M), aluminum alloy Type 6063; minimum thickness 0.05 inch. Or steel of equal quality.

B. Guide Construction: Continuous, of profile to retain door in place, with mounting brackets of same metal.

1. Aluminum Guides: Extruded aluminum channel, with wool pile runners along inside. Or steel of equal equality

C. Hood Enclosure: Internally reinforced to maintain rigidity and shape.

D. Lock Hardware:

1. Integral lock provided, accessible from both sides

E. Roller Shaft Counterbalance: Steel pipe and torsion steel spring system, capable of producing torque sufficient to ensure smooth operation of curtain from any position and capable of holding position at mid-travel; with adjustable spring tension; requiring 25 lb nominal force to operate.

F. Operation, Manual operation with pull chain.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that opening sizes, tolerances and conditions are acceptable.

3.02 INSTALLATION

A. Install units in accordance with manufacturer's instructions.

B. Use anchorage devices to securely fasten assembly to wall construction and building framing without distortion or stress.

C. Securely and rigidly brace components suspended from structure. Secure guides to structural members only.

D. Fit and align assembly including hardware; level and plumb, to provide smooth operation.

E. Install perimeter trim as indicated.

3.03 TOLERANCES

A. Maintain dimensional tolerances and alignment with adjacent work.

B. Maximum Variation From Plumb: 1/16 inch.

C. Maximum Variation From Level: 1/16 inch.

D. Longitudinal or Diagonal Warp: Plus or minus 1/8 inch per 10 ft straight edge.

3.04 ADJUSTING

A. Adjust operating assemblies for smooth and noiseless operation.

3.05 CLEANING

A. Clean installed components.

B. Remove labels and visible markings.

END OF SECTION 08 3313

SECTION 08 36 00

SECTIONAL OVERHEAD DOORS

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Insulated Sectional Overhead Doors.
B. Electric Operators and Controls.
C. Operating Hardware, tracks, and support.

1.2 RELATED SECTIONS

A. Section 03300 - Cast-In-Place Concrete: Prepared opening in concrete. Execution requirements for placement of anchors in concrete wall construction.
B. Section 05500 - Metal Fabrications: Steel frame and supports.
C. Section 06114 - Wood Blocking and Curbing: Rough wood framing and blocking for door opening.
D. Section 07900 - Joint Sealers: Perimeter sealant and backup materials.
E. Section 08710 - Door Hardware: Cylinder locks.
F. Section 09900 - Paints and Coatings: Field painting.

1.3 REFERENCES

A. ANSI/DASMA 102 - American National Standard Specifications for Sectional Overhead Type Doors.

1.4 DESIGN / PERFORMANCE REQUIREMENTS

A. Wind Loads: Design and size components to withstand loads caused by pressure and suction of wind acting normal to plane of wall as calculated in accordance with applicable code.
   1. Design pressure see sheet S-002.
B. Wiring Connections: Requirements for electrical characteristics.
   1. 115 volts, single phase, 60 Hz.
   2. 230 volts, single phase, 60 Hz.
   3. 230 volts, three phase, 60 Hz.
   4. 460 volts, three phase, 60 Hz.
C. Single-Source Responsibility: Provide doors, tracks, motors, and accessories from one manufacturer for each type of door. Provide secondary components from source acceptable to manufacturer of primary components.

1.5 SUBMITTALS

A. Submit under provisions of Section 01300.
B. Product Data: Manufacturer's data sheets on each product to be used, including:
   1. Preparation instructions and recommendations.
   2. Storage and handling requirements and recommendations.
   3. Installation methods.
C. Shop Drawings: Indicate plans and elevations including opening dimensions and required tolerances, connection details, anchorage spacing, hardware locations, and installation details.
D. Manufacturer's Certificates: Certify products meet or exceed specified requirements.
E. Operation and Maintenance Data.

1.6 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing products specified in this section with minimum five years documented experience.
B. Installer
C. Qualifications: Authorized representative of the manufacturer with minimum five years documented experience.
D. Products Requiring Electrical Connection: Listed and classified by Underwriters Laboratories, Inc. acceptable to authority having jurisdiction as suitable for purpose specified.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Store products in manufacturer's unopened labeled packaging until ready for installation.
B. Protect materials from exposure to moisture until ready for installation.
C. Store materials in a dry, ventilated weathertight location.

1.8 PROJECT CONDITIONS

A. Pre-Installation Conference: Convene a pre-installation conference just prior to commencement of field operations, to establish procedures to maintain optimum working conditions and to coordinate this work with related and adjacent work.

1.9 WARRANTY

A. Warranty: Manufacturer’s limited door and operators System warranty for 10 year against delamination of polyurethane foam from steel face and all other components for 3 years or 20,000 cycles, whichever comes first.

PART 2 PRODUCTS

2.1 INSULATED SECTIONAL OVERHEAD DOORS

A. Basis of Design: Insulated Steel Sectional Overhead Doors: 592 Series Thermacore Insulated Steel Doors by Overhead Door Corporation. Units shall have the following characteristics:
    1. Door Assembly: Metal/foam/metal sandwich panel construction, with PVC thermal break and weather-tight ship-lap design meeting joints.
        a. Panel Thickness: 2 inches (51 mm).
        b. Exterior Surface: Clear Coated galvanized steel or Anodized Aluminum
        c. Exterior Steel: .015 inch (.38 mm), hot-dipped galvanized or Anodized Aluminum
        d. End Stiles: 16 gauge with thermal break.
        e. Spring Counterbalance: Sized to weight of the door, with a helically wound, oil tempered torsion spring mounted on a steel shaft; cable drum of diecast aluminum with high strength galvanized aircraft cable. Sized with a minimum 7 to 1 safety factor.
            1) Standard cycle spring: 10,000 cycles.
            2) High cycle spring: 25,000 cycles.
            3) High cycle spring: 50,000 cycles.
            4) High cycle spring: 75,000 cycles.
            5) High cycle spring: 100,000 cycles.
        f. Insulation: CFC-free and HCFC-free polyurethane, fully encapsulated.
        g. Thermal Values: R-value of 17.50; U-value of 0.057.
        h. Air Infiltration: 0.08 cfm at 15 mph; 0.08 cfm at 25 mph.
        i. Pass-Door:
            1) Provide with optional pass door.
        j. High-Usage Package: Provide with optional high-usage package.

        k. Full Glazed Aluminum Sash Panels:
            1) 1/2 inch (12.5 mm) Low E Insulated glazing
    2. Finish and Color:.
        a. Interior Two coat baked-on polyester:

1) Interior color, white.
b. Exterior Clear Coated galvanized steel or Anodized Aluminum
3. Windload Design: Provide to meet the Design/Performance requirements specified.
4. Hardware: Galvanized steel hinges and fixtures. Ball bearing rollers with hardened steel races.
5. Lock:
a. Interior mounted slide lock with interlock switch for automatic operator.
6. Weatherstripping:
a. EPDM bulb-type strip at bottom section.
b. Flexible Jamb seals.
c. Flexible Header seal.
7. Track: Provide track as recommended by manufacturer to suit loading required and clearances available.
a. Size:
1) 3 inch (76 mm).
b. Type:
1) Follow roof slope.
8. Manual Operation: Pull rope.
9. Electric Motor Operation: Provide UL listed electric operator, size and type as recommended by manufacturer to move door in either direction at not less than 2/3 foot nor more than 1 foot per second. Operator shall meet UL325/2010 requirements for continuous monitoring of safety devices.
a. Entrapment Protection: Required for momentary contact, includes radio control operation.
1) Pneumatic sensing edge up to 18 feet (5.5 m) wide. Constant contact only complying with UL 325/2010.
2) Electric sensing edge monitored to meet UL 325/2010.
3) Photoelectric sensors monitored to meet UL 325/2010.
b. Operator Controls:
1) Push-button operated control stations with open, close, and stop buttons.
2) Surface mounting.
3) Interior location.
c. Special Operation:
1) Pull switch.
2) Vehicle detector operation.
3) Radio control operation.
4) Commercial light package.
5) Explosion and dust ignition proof control wiring.

PART 3 EXECUTION

3.1 EXAMINATION

A. Do not begin installation until openings have been properly prepared.
B. Verify wall openings are ready to receive work and opening dimensions and tolerances are within specified limits.
C. Verify electric power is available and of correct characteristics.
D. If preparation is the responsibility of another installer, notify Architect of unsatisfactory preparation before proceeding.

3.2 PREPARATION

A. Clean surfaces thoroughly prior to installation.
B. Prepare surfaces using the methods recommended by the manufacturer for achieving the best result for the substrate under the project conditions.

3.3 INSTALLATION

A. Install overhead doors and track in accordance with approved shop drawings and the manufacturer's printed instructions.
B. Coordinate installation with adjacent work to ensure proper clearances and allow for maintenance.
C. Anchor assembly to wall construction and building framing without distortion or stress.
D. Securely brace door tracks suspended from structure. Secure tracks to structural members only.
E. Fit and align door assembly including hardware.
F. Coordinate installation of electrical service. Complete power and control wiring from disconnect to unit components.

3.4 CLEANING AND ADJUSTING

A. Adjust door assembly to smooth operation and in full contact with weatherstripping.
B. Clean doors, frames and glass.
C. Remove temporary labels and visible markings.

3.5 PROTECTION

A. Do not permit construction traffic through overhead door openings after adjustment and cleaning.
B. Protect installed products until completion of project.
C. Touch-up, damaged coatings and finishes and repair minor damage before
D. Substantial Completion.

END OF SECTION 08 3600

SECTION 08 4113

ALUMINUM-FRAMED ENTRANCES AND STOREFRONTS

PART 1 GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SUMMARY

A. Section Includes as Basis of Design: Kawneer Architectural Aluminum Storefront Systems, including perimeter trims, stools, accessories, shims and anchors, and perimeter sealing of storefront units.

1. Types of Kawneer Aluminum Storefront Systems include:

a. Trifab™ VG 451T Framing System - 2" x 4-1/2" (50.8 mm x 114.3 mm) nominal dimension; Thermal; Front, Center, Back, Multi-Plane, Structural Silicone or Weatherseal Glazed (Type B); Screw Spline, Shear Block, Stick or Punched Opening Fabrication.

1.03 DEFINITIONS

A. Definitions: For fenestration industry standard terminology and definitions refer to American Architectural Manufacturers Association (AAMA) - AAMA Glossary (AAMA AG).

1.04 PERFORMANCE REQUIREMENTS

A. Storefront System Performance Requirements:

1. Air Leakage: The test specimen shall be tested in accordance with ASTM E 283. Air Leakage rate shall not exceed 0.06 cfm/ft2 (0.3 l/s · m2) at a static air pressure differential of 6.2 psf (300 Pa) with interior seal, or, rate shall not exceed 0.06 cfm/ft2 (0.3 l/s · m2) at a static air pressure differential of 1.6 psf (75 Pa) without interior seal. CSA A440 Fixed Rating.

2. Water Resistance: The test specimen shall be tested in accordance with ASTM E 331. There shall be no leakage at a minimum static air pressure differential of 8 psf (383 Pa) as defined in AAMA 501.

3. Uniform Load: A static air design load of 35 psf (1680 Pa) shall be applied in the positive and negative direction in accordance with ASTM E 330. There shall be no deflection in excess of L/175 of the span of any framing member. At a structural test load equal to 1.5 times the specified design load, no glass breakage or permanent set in the framing members in excess of 0.2% of their clear spans shall occur.

4. Seismic: When tested to AAMA 501.4, system must meet design displacement of 0.010 x the story height and ultimate displacement of 1.5 x the design displacement.

5. Thermal Movements: Allow for thermal movements resulting from the following maximum change (range) in ambient and surface temperatures:

a. Temperature Change (Range): 0 deg F (-18 deg C); 180 deg F (82 deg C).

b. Test Interior Ambient-Air Temperature: [75 deg F (24 deg C)] .

c. Test Performance: No buckling; stress on glass; sealant failure; excess stress on framing, anchors, and fasteners; or reduction of performance when tested according to AAMA 501.5 for a minimum 3 cycles.

6. Thermal Transmittance (U-factor): When tested to AAMA Specification 1503, the thermal transmittance (U-factor) shall not be more than:

   a. Glass to Exterior - 0.47 (low-e) or 0.61 (clear) BTU/hr/ft2/°F.

   b. Glass to Center - 0.44 (low-e) or 0.61 (clear) BTU/hr/ft2/°F.

   c. Glass to Interior - 0.41 (low-e) or 0.56 (clear) BTU/hr/ft2/°F.

7. Condensation Resistance (CRF): When tested to AAMA Specification 1503, the condensation resistance factor shall not be less than:

   a. Glass to Exterior - 70frame and 69glass (low-e) or 69frame and 58glass (clear).

   b. Glass to Center - 62frame and 68glass (low-e) or 63frame and 56glass (clear).

   c. Glass to Interior - 56frame and 67glass (low-e) or 54frame and 58glass (clear).

1.05 SUBMITTALS

A. Product Data: Include construction details, material descriptions, dimensions of individual components and profiles, hardware, finishes, and installation instructions for each type of aluminum-framed storefront system indicated.

B. Shop Drawings: Include plans, elevations, sections, details, hardware, and attachments to other work, operational clearances and installation details.

C. Samples for Initial Selection: For units with factory-applied color finishes including samples of hardware and accessories involving color selection.

D. Samples for Verification: For aluminum-framed storefront system and components required.

E. Product Test Reports: Based on evaluation of comprehensive tests performed by a qualified testing agency for each type of aluminum-framed storefront.

F. Fabrication Sample: Of each vertical-to-horizontal intersection of aluminum-framed systems, made from 12" (304.8 mm) lengths of full-size components and showing details of the following:

1. Joinery.
2. Anchorage.
3. Expansion provisions.
4. Glazing.
5. Flashing and drainage.

G. Other Action Submittals:

1. Entrance Door Hardware Schedule: Prepared by or under the supervision of supplier, detailing fabrication and assembly of entrance door hardware, as well as procedures and diagrams. Coordinate final entrance door hardware schedule with doors, frames, and related work to ensure proper size, thickness, hand, function, and finish of entrance door hardware.

1.06 QUALITY ASSURANCE

A. Installer Qualifications: An installer which has had successful experience with installation of the same or similar units required for the project and other projects of similar size and scope.

B. Manufacturer Qualifications: A manufacturer capable of providing aluminum-framed storefront system that meet or exceed performance requirements indicated and of documenting this performance by inclusion of test reports, and calculations.

C. Source Limitations: Obtain aluminum-framed storefront system through one source from a single manufacturer.

D. Product Options: Drawings indicate size, profiles, and dimensional requirements of aluminum-framed storefront system and are based on the specific system indicated. Refer to

Division 01 Section “Product Requirements”. Do not modify size and dimensional requirements.

1. Do not modify intended aesthetic effects, as judged solely by Architect, except with Architect's approval. If modifications are proposed, submit comprehensive explanatory data to Architect for review.

E. Pre-installation Conference: Conduct conference at Project site to comply with requirements in Division 01 Section “Project Management and Coordination”.

1.07 PROJECT CONDITIONS

A. Field Measurements: Verify actual dimensions of aluminum-framed storefront openings by field measurements before fabrication and indicate field measurements on Shop Drawings.

1.08 WARRANTY

A. Manufacturer’s Warranty: Submit, for Owner’s acceptance, manufacturer’s standard warranty.

1. Warranty Period: Two (2) years from Date of Substantial Completion of the project provided however that the Limited Warranty shall begin in no event later than six months from date of shipment by manufacturer.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Basis-of-Design Product:

1. Kawneer Company Inc.
2. Trifab™ 451T (Thermal) Framing System
3. System Dimensions: 2" x 4-1/2" (50.8 mm x 114.3 mm)
4. Glass: Center, Exterior or Interior

B. Substitutions: Refer to Substitutions Section for procedures and submission requirements

1. Product Literature and Drawings: Submit product literature and drawings modified to suit specific project requirements and job conditions.
2. Certificates: Submit certificate(s) certifying substitute manufacturer (1) attesting to adherence to specification requirements for storefront system performance criteria, and (2) has been engaged in the design, manufacturer and fabrication of aluminum storefronts for a period of not less than ten (10) years. (Company Name)
3. Test Reports: Submit test reports verifying compliance with each test requirement required by the project.
4. Samples: Provide samples of typical product sections and finish samples in manufacturer's standard sizes.

C. Substitution Acceptance: Acceptance will be in written form, either as an addendum or modification, and documented by a formal change order signed by the Owner and Architect.

2.02 MATERIALS

A. Aluminum Extrusions: Alloy and temper recommended by aluminum storefront manufacturer for strength, corrosion resistance, and application of required finish and not less than 0.070" (1.8 mm) wall thickness at any location for the main frame and complying with ASTM B 221: 6063-T6 alloy and temper.

B. Fasteners: Aluminum, nonmagnetic stainless steel or other materials to be non-corrosive and compatible with aluminum framing members, trim hardware, anchors, and other components.

C. Anchors, Clips, and Accessories: Aluminum, nonmagnetic stainless steel, or zinc-coated steel or iron complying with ASTM B 633 for SC 3 severe service conditions or other suitable zinc coating; provide sufficient strength to withstand design pressure indicated.

D. Reinforcing Members: Aluminum, nonmagnetic stainless steel, or nickel/chrome-plated steel complying with ASTM B 456 for Type SC 3 severe service conditions, or zinc-coated steel or iron complying with ASTM B 633 for SC 3 severe service conditions or other suitable zinc coating; provide sufficient strength to withstand design pressure indicated.

E. Sealant: For sealants required within fabricated storefront system, provide permanently elastic, non-shrinking, and non-migrating type recommended by sealant manufacturer for joint size and movement.

F. Tolerances: Reference to tolerances for wall thickness and other cross-sectional dimensions of storefront members are nominal and in compliance with AA Aluminum Standards and Data.

2.03 STOREFRONT FRAMING SYSTEM

A. Thermal Barrier (Trifab™ VG 451T):

1. Kawneer IsoLock™ Thermal Break with a 1/4" (6.4 mm) separation consisting of a two-part chemically curing, high-density polyurethane, which is mechanically and adhesively joined to aluminum storefront sections.

a. Thermal Break shall be designed in accordance with AAMA TIR-A8 and tested in accordance with AAMA 505.

B. Brackets and Reinforcements: Manufacturer's standard high-strength aluminum with nonstaining, nonferrous shims for aligning system components.

C. Fasteners and Accessories: Manufacturer's standard corrosion-resistant, nonstaining, nonbleeding fasteners and accessories compatible with adjacent materials. Where exposes shall be stainless steel.

D. Perimeter Anchors: When steel anchors are used, provide insulation between steel material and aluminum material to prevent galvanic action

E. Packing, Shipping, Handling and Unloading: Deliver materials in manufacturer's original, unopened, undamaged containers with identification labels intact.

F. Storage and Protection: Store materials protected from exposure to harmful weather conditions. Handle storefront material and components to avoid damage. Protect storefront material against damage from elements, construction activities, and other hazards before, during and after storefront installation.

2.04 GLAZING SYSTEMS

A. Glazing: As specified in Division 08 Section “Glazing”.

B. Glazing Gaskets: Manufacturer's standard compression types; replaceable, extruded EPDM rubber.

C. Spacers and Setting Blocks: Manufacturer's standard elastomeric type.

D. Bond-Breaker Tape: Manufacturer's standard TFE-fluorocarbon or polyethylene material to which sealants will not develop adhesion.

E. Glazing Sealants: For structural-sealant-glazed systems, as recommended by manufacturer for joint type, and as follows:

1. Structural Sealant: ASTM C 1184, single-component neutral-curing silicone formulation that is compatible with system components with which it comes in contact, specifically formulated and tested for use as structural sealant and approved by a structural-sealant manufacturer for use in aluminum-framed systems indicated.

a. Color: Black

2. Weatherseal Sealant: ASTM C 920 for Type S, Grade NS, Class 25, Uses NT, G, A, and O; single-component neutral-curing formulation that is compatible with structural sealant and other system components with which it comes in contact; recommended by structural-sealant, weatherseal-sealant, and aluminum-framed-system manufacturers for this use.

a. Color: Matching structural sealant.

2.05 ENTRANCE DOOR SYSTEMS

A. Entrance Doors: As specified in Division 08 1116 Section “Aluminum Doors and Frames”.

2.06 ACCESSORY MATERIALS

A. Joint Sealants: For installation at perimeter of aluminum-framed systems, as specified in Division 07 Section “Joint Sealants”.

B. Bituminous Paint: Cold-applied, asphalt-mastic paint complying with SSPC-Paint 12 requirements except containing no asbestos; formulated for 30 mil (0.762 mm) thickness per coat.

2.07 FABRICATION

A. Framing Members, General: Fabricate components that, when assembled, have the following characteristics:

1. Profiles that are sharp, straight, and free of defects or deformations.
2. Accurately fit joints; make joints flush, hairline and weatherproof.
3. Means to drain water passing joints, condensation within framing members, and moisture migrating within the system to exterior.
4. Physical and thermal isolation of glazing from framing members.
5. Accommodations for thermal and mechanical movements of glazing and framing to maintain required glazing edge clearances.
6. Provisions for field replacement of glazing.
7. Fasteners, anchors, and connection devices that are concealed from view to greatest extent possible.

B. Mechanically Glazed Framing Members: Fabricate for flush glazing without projecting stops.

C. Structural-Sealant-Glazed Framing Members: Include accommodations for using temporary support device to retain glazing in place while structural sealant cures.

D. Storefront Framing: Fabricate components for assembly using manufacturer’s standard installation instructions.

E. After fabrication, clearly mark components to identify their locations in Project according to Shop Drawings.

2.08 ALUMINUM FINISHES

A. Finish designations prefixed by AA comply with the system established by the Aluminum Association for designating aluminum finishes.

B. Factory Finishing:

1. Kawneer Permanodic™ AA-M10C21A41 / AA-M45C22A41, AAMA 611, Architectural Class I Clear Anodic Coating (Color #14 Clear).

PART 3 EXECUTION

3.01 EXAMINATION

A. Examine openings, substrates, structural support, anchorage, and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of work. Verify rough opening dimensions, levelness of sill plate and operational clearances. Examine wall flashings, vapor retarders, water and weather barriers, and other built-in components to ensure a coordinated, weather tight framed aluminum storefront system installation.

1. Masonry Surfaces: Visibly dry and free of excess mortar, sand, and other construction debris.
2. Wood Frame Walls: Dry, clean, sound, well nailed, free of voids, and without offsets at joints. Ensure that nail heads are driven flush with surfaces in opening and within 3 inches (76 mm) of opening.
3. Metal Surfaces: Dry; clean; free of grease, oil, dirt, rust, corrosion, and welding slag; without sharp edges or offsets at joints.
4. Proceed with installation only after unsatisfactory conditions have beencorrected.

3.02 INSTALLATION

A. Comply with Drawings, Shop Drawings, and manufacturer's written instructions for installing aluminum-framed storefront system, accessories, and other components.

B. Install aluminum-framed storefront system level, plumb, square, true to line, without distortion or impeding thermal movement, anchored securely in place to structural support, and in proper relation to wall flashing and other adjacent construction.

C. Set sill members in bed of sealant or with gaskets, as indicated, for weather tightconstruction.

D. Install aluminum-framed storefront system and components to drain condensation, water penetrating joints, and moisture migrating within aluminum-framed storefront to the exterior.

E. Separate aluminum and other corrodible surfaces from sources of corrosion or electrolytic action at points of contact with other materials.

3.03 FIELD QUALITY CONTROL

A. Field Tests: Architect shall select storefront units to be tested as soon as a representative portion of the project has been installed, glazed, perimeter caulked and cured. Conduct tests for air infiltration and water penetration with manufacturer's representative present. Tests not meeting specified performance requirements and units having deficiencies shall be corrected as part of the contract amount.

1. Testing: Testing shall be performed by a qualified independent testing agency. Refer to Testing Section for payment of testing and testing requirements. Testing Standard perAAMA 503, including reference to ASTM E 783 for Air Infiltration Test and ASTM E 1105 Water Infiltration Test.

a. Air Infiltration Tests: Conduct tests in accordance with ASTM E 783. Allowable air infiltration shall not exceed 1.5 times the amount indicated in the performance requirements or 0.09 cfm/ft2, whichever is greater.

b. Water Infiltration Tests: Conduct tests in accordance with ASTM E 1105. No uncontrolled water leakage is permitted when tested at a static test pressure of

two-thirds the specified water penetration pressure but not less than 6.2 psf (300 Pa).

B. Manufacturer's Field Services: Upon Owner’s written request, provide periodic site visit by manufacturer’s field service representative.

3.04 ADJUSTING, CLEANING, AND PROTECTION

A. Clean aluminum surfaces immediately after installing aluminum-framed storefronts. Avoid damaging protective coatings and finishes. Remove excess sealants, glazing materials, dirt, and other substances.

B. Clean glass immediately after installation. Comply with glass manufacturer's written recommendations for final cleaning and maintenance. Remove nonpermanent labels, and clean surfaces.

C. Remove and replace glass that has been broken, chipped, cracked, abraded, or damaged during construction period.

END OF SECTION 08 4113

SECTION 08 5113

ALUMINUM WINDOWS

1.01 SECTION INCLUDES

A. Extruded aluminum windows with fixed sash and infill panels.

1.02 RELATED REQUIREMENTS

A. Section 07 9200 - Joint Sealants: Sealing joints between window frames and adjacent construction.

B. Section 08 8000 - Glazing.

1.03 REFERENCE STANDARDS

A. AAMA/WDMA/CSA 101/I.S.2/A440 - North American Fenestration Standard/Specification for windows, doors, and skylights; 2017.

B. AAMA CW-10 - Care and Handling of Architectural Aluminum From Shop to Site; 2015.

C. AAMA 611 - Voluntary Specification for Anodized Architectural Aluminum; 2014 (2015Errata).

1.04 SUBMITTALS

A. See Section 01 3000 - Administrative Requirements, for submittal procedures.

B. Product Data: Provide component dimensions, internal drainage details, and descriptions of hardware and accessories.

C. Shop Drawings: Indicate opening dimensions, elevations of different types, framed opening tolerances, method for achieving air and vapor barrier seal to adjacent construction, anchorage locations, and installation requirements.

D. Grade Substantiation: Prior to submitting shop drawings or starting fabrication, submit one of the following showing compliance with specified grade:

1. Evidence of AAMA Certification.
2. Evidence of WDMA Certification.
3. Evidence of CSA Certification.
4. Test report(s) by independent testing agency itemizing compliance and acceptable to authorities having jurisdiction.

E. Warranty: Submit manufacturer warranty and ensure that forms have been completed in Owner's name and registered with manufacturer.

1.05 QUALITY ASSURANCE

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

B. Installer Qualifications: Company specializing in performing work of type specified and with at least three years of documented experience.

1.06 DELIVERY, STORAGE, AND HANDLING

A. Comply with requirements of AAMA CW-10.

B. Protect finished surfaces with wrapping paper or strippable coating during installation. Do not use adhesive papers or sprayed coatings that bond to substrate when exposed to sunlight or weather.

1.07 FIELD CONDITIONS

A. Do not install sealants when ambient temperature is less than 40 degrees F.

B. Maintain this minimum temperature during and 24 hours after installation of sealants.

1.08 WARRANTY

A. See Section 01 7800 - Closeout Submittals, for additional warranty requirements.

B. 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.

C. 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 WINDOWS

A. Aluminum Windows: Extruded aluminum frame and sash, factory fabricated, factory finished, with operating hardware, related flashings, and anchorage and attachment devices.

1. Fabrication: Joints and corners flush, hairline, and weatherproof, accurately fitted and secured; prepared to receive anchors; fasteners and attachments concealed from view; reinforced as required for operating hardware and imposed loads.

2. Perimeter Clearance: Minimize space between framing members and adjacent construction while allowing expected movement.

3. Movement: Accommodate movement between window and perimeter framing and deflection of lintel, without damage to components or deterioration of seals.

4. 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.

B. Performance Requirements: Provide products that comply with the following:

1. Grade: AAMA/WDMA/CSA 101/I.S.2/A440 requirements for specific window type:

a. Performance Class (PC): R.

C. Fixed, Non-Operable Type:

1. Construction: Thermally broken.

2. Glazing: Double; clear; transparent.

3. Exterior Finish: Class I natural anodized.

4. Interior Finish: Class I natural anodized.

2.02 COMPONENTS

A. Frames: Sizes as shown on drawings; thermally broken with interior portion of frame insulated from exterior portion; flush glass stops of snap-on type.

B. Glazing: As specified in Section 08 8000.

C. Glazing Materials: As specified in Section 08 8000.

D. Sealant for Setting Sills and Sill Flashing: Non-curing butyl type.

2.03 FINISHES

A. Class I Natural Anodized Finish: AAMA 611 AA-M12C22A41 Clear anodic coating not less than 0.7 mils thick.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that wall openings and adjoining air and vapor seal materials are ready to receive aluminum windows.

3.02 INSTALLATION

A. Install windows in accordance with manufacturer's instructions.

B. Attach window frame and shims to perimeter opening to accommodate construction tolerances and other irregularities.

C. Align window plumb and level, free of warp or twist. Maintain dimensional tolerances and alignment with adjacent work.

D. Install sill and sill end angles.

E. Provide thermal isolation where components penetrate or disrupt building insulation. Pack fibrous insulation in shim spaces at perimeter of assembly to maintain continuity of thermal barrier.

F. Install glass in accordance with requirements specified in Section 08 8000.

3.03 TOLERANCES

A. Maximum Variation from Level or Plumb: 1/16 inches every 3 ft non-cumulative or 1/8 inches per 10 ft, whichever is less.

3.04 CLEANING

A. Remove protective material from factory finished aluminum surfaces.

B. Wash surfaces by method recommended and acceptable to window manufacturer; rinse and wipe surfaces clean.

END OF SECTION 08 5113

SECTION 08 7100
DOOR HARDWARE

PART 1 -

1.1 SUMMARY

1. Section includes: Mechanical and electrified door hardware

2. Related Sections:

    1. Division 01 Section “Alternates” for alternates affecting this section.
    2. Division 06 Section “Rough Carpentry”
    3. Division 06 Section "Finish Carpentry”
    4. Division 08 sections for doors and frames with hardware specified in this section.

1.2 REFERENCES

1. UL - Underwriters Laboratories

    1. UL 10B - Fire Test of Door Assemblies
    2. UL 10C - Positive Pressure Test of Fire Door Assemblies
    3. UL 1784 - Air Leakage Tests of Door Assemblies
    4. UL 305 - Panic Hardware

2. DHI - Door and Hardware Institute

    1. Sequence and Format for the Hardware Schedule
    2. Recommended Locations for Builders Hardware
    3. Keying Systems and Nomenclature
    4. Installation Guide for Doors and Hardware

3. NFPA – National Fire Protection Association

    1. NFPA 70 – National Electric Code
    2. NFPA 80 – 2016 Edition – Standard for Fire Doors and Other Opening Protectives
    3. NFPA 101 – Life Safety Code
    4. NFPA 105 – Smoke and Draft Control Door Assemblies
    5. NFPA 252 – Fire Tests of Door Assemblies

4. ANSI - American National Standards Institute

    1. ANSI A117.1 – 2017 Edition – Accessible and Usable Buildings and Facilities
    2. ANSI/BHMA A156.1 - A156.29, and ANSI/BHMA A156.31 - Standards for Hardware and Specialties
    3. ANSI/BHMA A156.28 - Recommended Practices for Keying Systems
    4. ANSI/WDMA I.S. 1A - Interior Architectural Wood Flush Doors
    5. ANSI/SDI A250.8 - Standard Steel Doors and Frames

1.3 SUBMITTALS

1. Submit in accordance with Conditions of Contract and Division 01 Submittal Procedures.

    1. Product Data: Submit technical product data for each item of door hardware, installation instructions, maintenance of operating parts and finish, and other information necessary to show compliance with requirements.
    2. Riser and Wiring Diagrams: After final approval of hardware schedule, submit details of electrified door hardware, indicating:
    3. Door Hardware Schedule: Submit with hardware sets in vertical format as illustrated by Sequence of Format for the Hardware Schedule published by DHI. Indicate complete designations of each item required for each door or opening, include all notes and operational descriptions from hardware groups.
    4. Key Schedule: After Keying Conference, provide keying schedule that includes levels of keying, explanations of key system's function, key symbols used, and door numbers controlled. Use ANSI/BHMA A156.28 “Recommended Practices for Keying Systems” as guideline for nomenclature, definitions, and approach for selecting optimal keying system.
    5. Templates: After final approval of hardware schedule, provide for doors, frames and other work specified to be factory or shop prepared for door hardware installation.

1.4 QUALITY ASSURANCE

1. Qualifications:

    1. Supplier: Recognized architectural hardware supplier with record of successful in-service performance for supplying door hardware similar in quantity, type, and quality to that indicated for this Project.
    2. Installer: Qualified tradesperson skilled in the application of commercial grade hardware with experience installing door hardware similar in quantity, type, and quality as indicated for this Project.

2. Certifications:

    1. Fire-Rated Door Openings: Provide door hardware for fire-rated openings that complies with NFPA 80, UL 10C, and requirements of authorities having jurisdiction.
    2. Smoke and Draft Control Door Assemblies: Provide door hardware that meets requirements of assemblies tested according to UL 1784 and NFPA 105.
    3. Accessibility Requirements: This project must comply with all Federal Americans with Disability Act regulations and all Local Accessibility Regulations.

3. Pre-Installation Meetings

    1. Keying Conference: Incorporate keying conference decisions into final keying schedule after reviewing door hardware keying system including:

1.5 DELIVERY, STORAGE, AND HANDLING

1. Inventory door hardware on receipt and provide secure lock-up for hardware delivered to Project site. Promptly replace products damaged during shipping. Deliver keys to manufacturer of key control system for subsequent delivery to Owner

2. Handle hardware in manner to avoid damage, marring, or scratching. Correct, replace or repair products damaged during Work. Protect products against malfunction due to paint, solvent, cleanser, or any

chemical agent. Maintain manufacturer-recommended environmental conditions throughout storage and installation periods.

1.6 COORDINATION

1. Installation Templates: Distribute for doors, frames, and other work specified to be factory or shop prepared. Check Shop Drawings of other work to confirm that adequate provisions are made for locating and installing door hardware to comply with indicated requirements.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

1. Provide products from manufacturers listed in hardware groups. Additional alternate products require prior written approval from Owner and are contingent upon those products providing all functions, features, and meeting all requirements of scheduled manufacturer's product.

2.2 MATERIALS

1. Provide hardware with options specified in the hardware sets, fasteners provided by hardware manufacturer, strikes provided by hardware manufacturer, drop plates, special templates, and other devices necessary for proper hardware installation.

2. Provide necessary fillers, Dutchmen, reinforcements, and fasteners, compatible with existing materials, as required for mounting new opening hardware and to cover existing door and frame preparations. When modifying existing fire-rated openings, provide materials permitted by NFPA 80 as required to maintain fire-rating.

3. Provide each electrified hardware item and wire harnesses with enough and wire gauge with standardized Molex plug connectors to accommodate electric function of specified hardware.

2.3 HINGES: IVES 5BB SERIES

1. Provide 5-knuckle plain bearing hinges conforming to ANSI/BHMA A156.1. Provide hinges in the size, quantity, weight, and base metal according to manufacturer's published recommendations. Provide non-removable pins at out-swinging lockable doors. Adjust hinge width as required for door, frame, and wall conditions to allow proper degree of opening.

2.4 CONTINUOUS HINGES: IVES

1. Provide aluminum geared continuous hinges conforming to ANSI/BHMA A156.26, Grade 1 and fabricated from 6063-T6 aluminum. Size hinges 1 inch (25 mm) shorter in length than nominal height of door, unless otherwise noted or door details require shorter length.

2.5 CYLINDRICAL LOCKS: SCHLAGE ND SERIES

1. Provide cylindrical locks conforming to ANSI/BHMA A156.2 Series 4000, Grade 1, and UL Listed for 3-hour fire doors. Provide locksets with separate anti-rotation thru-bolts, and no exposed screws.

2.6 EXIT DEVICES: VON DUPRIN 99/33A SERIES

1. Provide grooved touchpad exit devices tested to ANSI/BHMA A156.3 Grade 1 and UL listed for Panic Exit or Fire Exit Hardware. Touchpad must extend a minimum of one half of door width. Provide exit devices cut to door width and height with flush end caps. Install exit devices at height recommended by exit device manufacturer, allowable by governing building codes, and approved by Architect. Mount mechanism case flush on face of doors or provide spacers to fill gaps behind devices. Provide exit devices with optional trim designs to match other lever and pull designs used on the project.

2.7 KEYING:

1. Provide cylinders/cores keyed into Owner's existing keying system. Comply with guidelines in ANSI/BHMA A156.28, incorporating decisions made at keying conference.

2. As Directed by Owner: Provide permanent cylinders/cores keyed by the manufacturer according to the Master Keying system and forward to Owner separately from keys. Forward bitting list and keys separately from cylinders in proper quantities. Mark permanent cylinders/cores and keys with applicable blind code for identification. Do not provide blind code marks with actual key cuts. Failure to comply with these requirements will be cause for replacement of cylinders/cores/keys involved at no additional cost to Owner.

2.8 KEY CONTROL SYSTEM: TELKEE

1. Provide key control system, including envelopes, labels, tags with self-locking key clips, receipt forms, 3-way visible card index, temporary markers, permanent markers, and standard metal cabinet, all as recommended by system manufacturer, with capacity for 150% of number of locks required for Project. Provide complete cross index system set up by hardware supplier, and place keys on markers and hooks in cabinet as determined by final key schedule.

2.9 SURFACE CLOSERS: LCN 4010/4110/4020 SERIES

1. Provide cast iron door closers conforming to ANSI/BHMA A156.4 Grade 1 requirements by BHMA certified independent testing laboratory. Certify surface mounted mechanical closers to meet fifteen million (15,000,000) full load cycles.

2.10 ELECTRO-HYDRAULIC AUTOMATIC OPERATORS: LCN 4600 SERIES

1. Provide low energy automatic operator units that are electro-mechanical design complying with ANSI/BHMA A156.19. Locate actuators and other controls as directed by Architect. Hydraulic Fluid: Fireproof, passing requirements of UL10C, and requiring no seasonal closer adjustment for temperatures ranging from 120 degrees F to -30 degrees F.

2.11 **DOOR TRIM: IVES**

1. Provide push plates, push bars, pull plates, pulls, and hands-free reversible door pulls with diameter and length as scheduled.

2.12 PROTECTION PLATES: IVES

1. Provide protection plates with beveled four edges as scheduled. Size plates 2 inches (51 mm) less width of door on single doors, pairs of doors with a mullion, and doors with edge guards. Size plates 1 inch (25 mm) less width of door on pairs without a mullion or edge guards. At fire rated doors, provide protection plates over 16 inches high with UL label.

2.13 DOOR STOPS AND HOLDERS: IVES

1. Provide door stops at each door leaf. Provide wall stops wherever possible. Provide concave type where lockset has a push button of thumbturn. Where a wall stop cannot be used, provide universal floor stops. Where wall or floor stop cannot be used, provide overhead stop. Provide roller bumper where doors open into each other and overhead stop cannot be used.

2.14 THRESHOLDS, WEATHERSTRIPPING, AND GASKETING: ZERO INTERNATIONAL

1. Provide thresholds, weather-stripping, and gasketing systems as specified and per architectural details. Match finish of other items. Where smoke- and draft-control door assemblies are required, provide door hardware that meets requirements of assemblies tested according to UL 1784 and installed in compliance with NFPA 105.

2.15 SILENCERS: IVES

1. Provide "push-in" type silencers for hollow metal or wood frames. Provide one silencer per 30 inches (762 mm) of height on each single frame, and two for each pair frame. Omit where gasketing is specified.

2.16 LATCH PROTECTORS: IVES

1. Provide stainless steel latch protectors of type required to function with specified lock.

2.17 FINISHES

1. Provide hardware with finishes as indicated in hardware sets.

PART 3 - EXECUTION

3.1 EXAMINATION

1. Prior to installation of hardware, examine doors and frames, with Installer present, for compliance with requirements for installation tolerances, labeled fire-rated door assembly construction, wall and floor construction, and other conditions affecting performance. Verify doors, frames, and walls have been properly reinforced for hardware installation. Examine roughing-in for electrical power systems to verify actual locations of wiring connections before electrified door hardware installation. Submit a list of deficiencies in writing and proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

1. Where on-site modification of doors and frames is required, prepare hardware locations and reinstall in accordance with installation requirements for new door hardware and with:

    1. Steel Doors and Frames: For surface applied door hardware, drill and tap doors and frames according to ANSI/SDI A250.6.
    2. Wood Doors: DHI WDHS.5 "Recommended Hardware Reinforcement Locations for Mineral Core Wood Flush Doors."
    3. Doors in rated assemblies: NFPA 80 for restrictions on on-site door hardware preparation.

3.3 INSTALLATION

1. Mount door hardware units at heights to comply with the following, unless otherwise indicated or required to comply with governing regulations.

    1. Standard Steel Doors and Frames: ANSI/SDI A250.8.
    2. Custom Steel Doors and Frames: HMMA 831.
    3. Interior Architectural Wood Flush Doors: ANSI/WDMA I.S. 1A
    4. Installation Guide for Doors and Hardware: DHI TDH-007-20

2. Install hardware in compliance with manufacturer's instructions and recommendations, using only fasteners provided by manufacturer. Set units level, plumb and true to line and location. Adjust and reinforce attachment substrate as necessary for proper installation and operation.

3. Lock Cylinders: Install construction cores to secure building and areas during construction period. Replace construction cores with permanent cores as indicated in keying section. Furnish permanent cores to Owner for installation.

4. Key Control System: Tag keys and place them on markers and hooks in key control system cabinet, as determined by final keying schedule.

5. Door Closers: Mount closers on room side of corridor doors, inside of exterior doors, and stair side of stairway doors from corridors. Mount closers so they are not visible in corridors, lobbies and other public spaces unless approved by Architect.

6. Stops: Do not mount floor stops where they may impede traffic or present tripping hazard.

3.4 FIELD QUALITY CONTROL

1. Provide functional testing and inspection of fire door assemblies and required egress door assemblies by a qualified person in accordance with NFPA 80 and NFPA 101.

2. Adjust and check each operating item of door hardware and each door to ensure proper operation or function of every unit. Replace units that cannot be adjusted to operate as intended. Adjust door control devices to compensate for final operation of heating and ventilating equipment and to comply with referenced accessibility requirements.

3. Clean adjacent surfaces soiled by door hardware installation. Clean operating items per manufacturer's instructions to restore proper function and finish. Provide final protection and maintain conditions that ensure door hardware is without damage or deterioration at time of Substantial Completion.

3.5 DOOR HARDWARE SCHEDULE

1. The intent of the hardware specification is to specify the hardware for interior and exterior doors, and to establish a type, continuity, and standard of quality. However, it is the door hardware supplier's responsibility to thoroughly review existing conditions, schedules, specifications, drawings, and other Contract Documents to verify the suitability of the hardware specified.

2. Hardware items are referenced in the following hardware schedule. Refer to the above specifications for special features, options, cylinders/keying, and other requirements.

3.6 Hardware Sets:

↯ = Hardware Item Requiring Electrical Coordination

A. Hardware Set Index: ↯ = Door Requiring Electrical Coordination

Door Numbers	HwSet#		Requires Elec. Coord.
FS01A	01		
FS01B	01		
FS01C	02		
FS01D	02		
FS01E	02		
FS01F	02		
FS01G	02		
FS01H	02		
FS03	03		
FS04	04		
FS06	05		
FS07	06		
FS08	07		
SC01A	08		↯
SC01B	09		
SC04	10		
SC05	04		
SC06B	11		
SC06C	02		
SC08	06		
SC09	06		
SC10	12		
SC11	12		
SC12	12		
SC13	07		
SC14	13		
SC15	09		
SC16	14		

Abbreviation	Name
BES	Best Locking Systems
GLY	Glynn-Johnson Corp
IVE	H.B. Ives
LCN	LCN Commercial Division
SCH	Schlage Lock Company
VON	Von Duprin
ZER	Zero International Inc

HARDWARE SET: 01

DOOR NUMBER:

FS01A FS01B

EACH TO HAVE:

3	EA	HINGE	5BB1 4.5 X 4.5		652	IVE
1	EA	ENTRANCE LOCK	ND92HD RHO		626	SCH
1	EA	PERMANENT CORE	1C-7		626	BES
1	EA	SURFACE CLOSER	4011		689	LCN
1	EA	WALL STOP	WS406/407CCV		630	IVE
1	SET	SEALS	8303AA X D.S.		AA	ZER
1	EA	DOOR BOTTOM	111AA X D.W.		AA	ZER
1	EA	THRESHOLD	548A X D.W.		A	ZER

HARDWARE SET: 02

DOOR NUMBER:

FS01C FS01D FS01E FS01F FS01G FS01H

SC06C

EACH TO HAVE:

ALL HARDWARE BY DOOR MANUFACTURER

HARDWARE SET: 03

DOOR NUMBER:

FS03

EACH TO HAVE:

3	EA	HINGE	5BB1 4.5 X 4.5		652	IVE
1	EA	PASSAGE SET	ND10S RHO		626	SCH
1	EA	WALL STOP	WS406/407CVX		630	IVE
3	EA	SILENCER	SR64		GRY	IVE

HARDWARE SET: 04

DOOR NUMBER:

FS04 SC05

EACH TO HAVE:

3	EA	HINGE	5BB1 4.5 X 4.5		652	IVE
1	EA	ENTRANCE LOCK	ND92HD RHO		626	SCH
1	EA	PERMANENT CORE	1C-7		626	BES
1	EA	WALL STOP	WS406/407CCV		630	IVE
3	EA	SILENCER	SR64		GRY	IVE

HARDWARE SET: 05

DOOR NUMBER:

FS06

EACH TO HAVE:

3	EA	HINGE	5BB1 4.5 X 4.5 NRP		652	IVE
1	EA	STOREROOM LOCK	ND96HD RHO		626	SCH
1	EA	PERMANENT CORE	1C-7		626	BES
1	EA	SURFACE CLOSER	4111 CUSH		689	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS		630	IVE
1	SET	SEALS	188S X D.S.		BLK	ZER

HARDWARE SET: 06

DOOR NUMBER:

FS07 SC08 SC09

EACH TO HAVE:

3	EA	HINGE	5BB1HW 4.5 X 4.5		652	IVE
1	EA	PUSH PLATE	8200 4" X 16"		630	IVE
1	EA	PULL PLATE	8302 6" 4" X 16"		630	IVE
1	EA	SURFACE CLOSER	4011		689	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS		630	IVE
1	EA	WALL STOP	WS406/407CVX		630	IVE
3	EA	SILENCER	SR64		GRY	IVE

HARDWARE SET: 07

DOOR NUMBER:

FS08 SC13

EACH TO HAVE:

3	EA	HINGE	5BB1 4.5 X 4.5		652	IVE
1	EA	STOREROOM LOCK	ND96HD RHO		626	SCH
1	EA	PERMANENT CORE	1C-7		626	BES
1	EA	WALL STOP	WS406/407CVX		630	IVE
3	EA	SILENCER	SR64		GRY	IVE

HARDWARE SET: 08

DOOR NUMBER:

SC01A

EACH TO HAVE:

1	EA	CONT. HINGE	112XY			628	IVE
1	EA	CONT. HINGE	112XY EPT			628	IVE
1	EA	POWER TRANSFER	EPT2			689	VON
1	EA	REMOVABLE MULLION	KR4954-STAB-ANGLE PLATE			689	VON
1	EA	PANIC HARDWARE	99-EO			626	VON
1	EA	ELEC PANIC HARDWARE	LX-99-NL-OP-110MD			626	VON
2	EA	PERMANENT CORE	1C-7			626	BES
1	EA	SFIC MORTISE CYL.	80-132			626	SCH
1	EA	SFIC RIM CYLINDER	80-159			626	SCH
2	EA	OFFSET PULL	8190EZHD-10"			630	IVE
2	EA	OH STOP	100S			630	GLY
1	EA	SURFACE CLOSER	4021			689	LCN
1	EA	SURF. AUTO OPERATOR	4642 WMS 120 VAC			689	LCN
1	EA	MOUNTING PLATE	4020-18G			689	LCN
1	EA	ACTUATOR KIT	8310-3853WB @ BOLLARD			630	LCN
1	EA	ACTUATOR KIT	8310-3853WS			630	LCN
1	EA	RECEIVER	8310-865				LCN
1	EA	BOLLARD	8310-866				LCN
1	EA	MULLION SEAL	8780N X D.H.			BK	ZER
2	EA	DOOR SWEEP	39A X D.W.			A	ZER
1	EA	THRESHOLD	8655A X D.W.			A	ZER
1	SET	SEALS	BY ALUM DOOR/FRAME MFG				
1	EA	WIRING DIAGRAM	POINT TO POINT / RISER				

NOTE: WALL PLATE SWITCHES SHALL BE WIRED IN SERIES WITH THE "LX" SWITCH IN THE EXIT DEVICE. SUCH THAT WHEN THE EXIT DEVICE IS "DOGGED" (UNLOCKED) THE WALL PLATE SWITCHES ARE ACTIVE AND THE OPERATOR WILL OPEN THE DOOR. WHEN THE EXIT DEVICE IN NOT "DOGGED" (LOCKED) THE WALL PLATE SWITCHES ARE NOT ACTIVE AND THE OPERATOR WILL NOT OPEN THE DOOR.

HARDWARE SET: 09

DOOR NUMBER:

SC01B SC15

EACH TO HAVE:

3	EA	HINGE	5BB1HW 4.5 X 4.5 NRP		652	IVE
1	EA	PANIC HARDWARE	99-L-06		626	VON
1	EA	PERMANENT CORE	1C-7		626	BES
1	EA	SFIC RIM CYLINDER	80-159		626	SCH
1	EA	SURFACE CLOSER	4111 EDA		689	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS		630	IVE
1	EA	WALL STOP	WS406/407CVX		630	IVE
1	EA	RAIN DRIP	142A X D.W. +4"		AA	ZER
1	SET	SEALS	8303AA X D.S.		AA	ZER
1	EA	DOOR SWEEP	39A X D.W.		A	ZER
1	EA	THRESHOLD	8655A X D.W.		A	ZER

HARDWARE SET: 10

DOOR NUMBER:

SC04

EACH TO HAVE:

1	EA	CONT. HINGE	112XY		628	IVE
1	EA	CLASSROOM LOCK	ND94HD RHO		626	SCH
1	EA	PERMANENT CORE	1C-7		626	BES
1	EA	WALL STOP	WS406/407CVX		630	IVE
1	SET	SEALS	BY ALUM DOOR/FRAME MFG			

HARDWARE SET: 11

DOOR NUMBER:

SC06B

EACH TO HAVE:

3	EA	HINGE	5BB1 4.5 X 4.5 NRP		652	IVE
1	EA	ENTRANCE LOCK	ND92HD RHO		626	SCH
1	EA	PERMANENT CORE	1C-7		626	BES
1	EA	SURFACE CLOSER	4111 SCUSH		689	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS		630	IVE
3	EA	SILENCER	SR64		GRY	IVE

HARDWARE SET: 12

DOOR NUMBER:

SC10 SC11 SC12

EACH TO HAVE:

3	EA	HINGE	5BB1 4.5 X 4.5		652	IVE
1	EA	STOREROOM LOCK	ND96HD RHO		626	SCH
1	EA	PERMANENT CORE	1C-7		626	BES
1	EA	SURFACE CLOSER	4011		689	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS		630	IVE
1	EA	WALL STOP	WS406/407CVX		630	IVE
1	SET	SEALS	188S X D.S.		BLK	ZER

HARDWARE SET: 13

DOOR NUMBER:

SC14

EACH TO HAVE:

3	EA	HINGE	5BB1HW 5 X 4.5		652	IVE
1	EA	STOREROOM LOCK	ND96HD RHO		626	SCH
1	EA	PERMANENT CORE	1C-7		626	BES
1	EA	WALL STOP	WS406/407CVX		630	IVE
3	EA	SILENCER	SR64		GRY	IVE

HARDWARE SET: 14

DOOR NUMBER:

SC16

EACH TO HAVE:

3	EA	HINGE	5BB1HW 5 X 4.5 NRP		652	IVE
1	EA	ENTRANCE LOCK	ND92HD RHO		626	SCH
1	EA	PERMANENT CORE	1C-7		626	BES
1	EA	LOCK GUARD	LG13		630	IVE
1	EA	SURFACE CLOSER	4111 SCUSH		689	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS		630	IVE
1	EA	RAIN DRIP	142A X D.W. +4"		AA	ZER
1	SET	SEALS	8303AA X D.S.		AA	ZER
1	EA	DOOR SWEEP	39A X D.W.		A	ZER
1	EA	THRESHOLD	8655A X D.W.		A	ZER

END OF SECTION 08 7100

SECTION 09 0561

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.
3. Thin-set ceramic tile and stone tile.

B. Removal of existing floor coverings.

C. Preparation of new and existing concrete floor slabs for installation of floor coverings.

D. Testing of concrete floor slabs for moisture and alkalinity (pH).

E. 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.

F. Patching compound.

G. Remedial floor coatings.

H. Preparation of new and existing wood-based floors and subfloors for installation of new floor coverings.

1.02 RELATED REQUIREMENTS

A. Section 01 7419 - Construction Waste Management and Disposal: Handling of existing floor coverings removed.

B. Section 03 3000 - Cast-in-Place Concrete: Limitations on curing requirements for new concrete floor slabs.

1.03 REFERENCE STANDARDS

A. ASTM C109/C109M - Standard Test Method for Compressive Strength of Hydraulic Cement Mortars (Using 2-in. or (50-mm) Cube Specimens); 2016a.

B. ASTM C472 - Standard Test Methods for Physical Testing of Gypsum, Gypsum Plasters and Gypsum Concrete; 1999 (Reapproved 2014).

C. ASTM F710 - Standard Practice for Preparing Concrete Floors to Receive Resilient Flooring; 2017.

D. ASTM F1869 - Standard Test Method for Measuring Moisture Vapor Emission Rate of Concrete Subfloor Using Anhydrous Calcium Chloride; 2016a.

E. RFCI (RWP) - Recommended Work Practices for Removal of Resilient Floor Coverings; 2011.

1.04 SUBMITTALS

A. Visual Observation Report: For existing floor coverings to be removed.

B. 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.

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.

4. Copies of specified test methods.

5. Recommendations for remediation of unsatisfactory surfaces.

6. Product data for recommended remedial coating.

7. Submit report to Architect.

8. Submit report not more than two business days after conclusion of testing.

D. Adhesive Bond and Compatibility Test Report.

E. Copy of RFCI (RWP).

1.05 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. 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.

1.06 DELIVERY, STORAGE, ANDHANDLING

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.

1.07 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. 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. Existing concrete slabs (on-grade and elevated) with existing floor coverings:

a. Visual observation of existing floor covering, for adhesion, water damage, alkaline deposits, and other defects.

b. Removal of existing floor covering.

2. Preliminary cleaning.

3. 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.

4. Internal relative humidity tests; in same locations as moisture vapor emission tests, unless otherwise indicated.

5. Alkalinity (pH) tests; in same locations as moisture vapor emission tests, unless otherwise indicated.

6. Specified remediation, if required.
7. Patching, smoothing, and leveling, as required.
8. Other preparation specified.
9. Adhesive bond and compatibility test.
10. 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 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.

C. Use a wide range alkalinity (pH) test paper, its associated chart, and distilled or deionized water.

D. 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.

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 alkalinity (pH) test value is over 10.

3.05 PREPARATION

A. See individual floor covering section(s) for additional requirements.

B. Comply with requirements and recommendations of floor covering manufacturer.

C. Fill and smooth surface cracks, grooves, depressions, control joints and other non-moving joints, and other irregularities with patching compound.

D. Do not fill expansion joints, isolation joints, or other moving joints.

3.06 ADHESIVE BOND AND COMPATIBILITY TESTING

A. Comply with requirements and recommendations of floor covering manufacturer.

3.07 APPLICATION OF REMEDIAL FLOOR COATING

A. Comply with requirements and recommendations of coating manufacturer.

3.08 PROTECTION

A. Cover prepared floors with building paper or other durable covering.

END OF SECTION 09 0561

SECTION 09 2116

GYPSUM BOARD ASSEMBLIES

PART 1 GENERAL

1.01 SECTION INCLUDES

1. Performance criteria for gypsum board assemblies.
2. Acoustic insulation.
3. Gypsum sheathing.
4. Cementitious backing board.
5. Gypsum wallboard.
6. Joint treatment and accessories.
7. Acoustic (sound-dampening) wall and ceiling board.

1.02 RELATED REQUIREMENTS

A. Section 05 4000 - Cold-Formed Metal Framing: Exterior wind-load-bearing metal stud framing.

B. Section 06 1643 – Gypsum Sheathing: Exterior wall sheathing.

C. Section 07 2100 - Thermal Insulation: Exterior wall thermal insulation.

D. Section 07 8400 - Firestopping: Top-of-wall assemblies at fire rated walls.

E. Section 07 9200 - Joint Sealants: Sealing acoustical gaps in construction other than gypsum board or plaster work.

F. Section 09 2216 - Non-Structural Metal Framing: Interior framing.

G. Section: 13 120 – Pre-Engineered Structures

1.03 REFERENCE STANDARDS

A. ANSI A108.11 - American National Standard Specifications for Interior Installation of Cementitious Backer Units; 2010 (Reaffirmed 2016).

B. ANSI A118.9 - American National Standard Specifications for Test Methods and Specifications for Cementitious Backer Units; 1999 (Reaffirmed 2016).

C. ASTM C475/C475M - Standard Specification for Joint Compound and Joint Tape for Finishing Gypsum Board; 2015.

D. ASTM C665 - Standard Specification for Mineral-Fiber Blanket Thermal Insulation for Light Frame Construction and Manufactured Housing; 2017.

E. ASTM C840 - Standard Specification for Application and Finishing of Gypsum Board; 2017a.

F. 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; 2015.

G. ASTM C1002 - Standard Specification for Steel Self-Piercing Tapping Screws for Application of Gypsum Panel Products or Metal Plaster Bases to Wood Studs or Steel Studs; 2016.

H. ASTM C1047 - Standard Specification for Accessories For Gypsum Wallboard and Gypsum Veneer Base; 2014a.

I. ASTM C1288 - Standard Specification for Discrete Non-Asbestos Fiber-Cement Interior Substrate Sheets; 2017.

J. ASTM C1325 - Standard Specification for Non-Asbestos Fiber-Mat Reinforced Cementitious Backer Units; 2017a.

K. ASTM C1396/C1396M - Standard Specification for Gypsum Board; 2017.

L. ASTM D3273 - Standard Test Method for Resistance to Growth of Mold on the Surface of Interior Coatings in an Environmental Chamber; 2016.

M. ASTM E90 - Standard Test Method for Laboratory Measurement of Airborne Sound Transmission Loss of Building Partitions and Elements; 2009 (Reapproved 2016).

N. ASTM E413 - Classification for Rating Sound Insulation; 2016.

O. GA-216 - Application and Finishing of Gypsum Panel Products; 2016.

P. GA-226 - Application of Gypsum Board to Form Curved Surfaces; Gypsum Association; 2016.

Q. ICC (IBC) - International Building Code; 2018.

1.04 SUBMITTALS

A. See Section 01 3000 - 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 5 years of experience.

B. Copies of Documents at Site: Maintain at the project site a copy of each referenced document that prescribes execution requirements.

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. Fire Rated Assemblies: Provide completed assemblies complying with applicable code.

1. ICC IBC Item Numbers: Comply with applicable requirements of ICC IBC for the particular assembly.

2.02 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. Thickness:
    a. Vertical Surfaces: 5/8 inch.
    b. Ceilings: 1/2 inch.

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. 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.
3. ASTM Cement-Based Board: Non-gypsum-based, cementitious board complying with ASTM C1288.
    a. Thickness: 1/2 inch.

C. Backing Board For Non-Wet Areas: Water-resistant gypsum backing board as defined in ASTM C1396/C1396M; sizes to minimum joints in place; ends square cut.

1. Application: Vertical surfaces behind thinset tile, except in wet areas.
2. At Assemblies Indicated with Fire-Rating: Use type required by indicated tested assembly; if no tested assembly is indicated, use Type X board, UL or WH listed.
3. Regular Board Thickness: 1/2 inch.
4. Edges: Tapered.

D. 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.
3. Edges: Tapered.

E. Acoustical Sound Dampening Wall and Ceiling Board: Two layers of heavy paper faced, high density gypsum board separated by a viscoelastic polymer layer and capable of achieving STC rating of 50 or more in typical stud wall assemblies as calculated in accordance with ASTM E413 and when tested in accordance with ASTM E90.

1. Thickness: 1/2 inch.
2. Long Edges: Tapered.
3. Mold Resistance: Score of 10, when tested in accordance with ASTM D3273.

2.03 ACCESSORIES

A. Acoustic Insulation: ASTM C665; preformed mineral wool, friction fit type, unfaced. Thickness: 3-1/2 and 5-1/2 inch to fill stud cavity.

1. Basis of design: Johns Manville Mineral Wool Sound Attenuation Fire Batts (SAFB).

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, galvanized steel or rolled zinc, unless notedotherwise.

1. Types: As detailed or required for finished appearance.

D. Joint Materials: ASTM C475/C475M and as recommended by gypsum board manufacturer for project conditions.

E. High Build Drywall Surfacer: Vinyl acrylic latex-based coating for spray application, designed to take the place of skim coating and separate paint primer in achieving Level 5finish.

F. Screws for Fastening of Gypsum Panel Products to Cold-Formed Steel Studs Less than 0.033 inch in Thickness and Wood Members: ASTM C1002; self-piercing tapping screws, corrosion resistant.

G. 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.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that project conditions are appropriate for work of this section tocommence.

3.02 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.

1. Place one bead continuously on substrate before installation of perimeter framing members.

2. Place continuous bead at perimeter of each layer of gypsum board.

3. Seal around all penetrations by conduit, pipe, ducts, and rough-in boxes, except where firestopping is provided.

3.03 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 Non-Rated: Install gypsum board in most economical direction, with ends and edges occurring over firm bearing.

C. Double-Layer Non-Rated: Use gypsum board for first layer, placed parallel to framing or furring members, with ends and edges occurring over firm bearing. Place second layer perpendicular to framing or furring members. Offset joints of second layer from joints of first layer.

D. Fire-Rated Construction: Install gypsum board in strict compliance with requirements of assembly listing.

E. Exposed Gypsum Board in Interior Wet Areas: Seal joints, cut edges, and holes with water-resistant sealant.

F. Cementitious Backing Board: Install over steel framing members and plywood substrate where indicated, in accordance with ANSI A108.11 and manufacturer's instructions.

G. Installation on Metal Framing: Use screws for attachment of gypsum board except face layer of non-rated double-layer assemblies, which may be installed by means of adhesive lamination.

H. Curved Surfaces: Apply gypsum board to curved substrates in accordance with GA-226.

3.04 INSTALLATION OF TRIM AND ACCESSORIES

A. Control Joints: Place control joints consistent with lines of building spaces and as indicated.

B. Corner Beads: Install at external corners, using longest practical lengths.

C. Edge Trim: Install at locations where gypsum board abuts dissimilar materials.

3.05 JOINT TREATMENT

A. Finish gypsum board in accordance with levels defined in ASTM C840, as follows:

1. Level 5: Walls and ceilings to receive semi-gloss or gloss paint finish and other areas specifically indicated on the drawings.

2. Level 4: Walls and ceilings to receive paint finish or wall coverings, unless otherwise indicated.

3. Level 2: In utility areas, behind cabinetry, and on backing board to receive tile finish.

4. Level 1: Fire rated wall areas above finished ceilings, whether or not accessible in the completed construction.

B. 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 is not required at surfaces behind adhesive applied ceramic tile and fixed cabinetry.

3. Taping, filling and sanding is not required at base layer of double layer applications.

C. 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-freefinish.

D. Fill and finish joints and corners of cementitious backing board as recommended by manufacturer.

END OF SECTION 09 2116

SECTION 09 2216

NON-STRUCTURAL METAL FRAMING

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Metal partition, ceiling, and soffit framing.

B. Stud Liners at Pre-Engineered Metal Building Structures

C. Support for wall board wrap for Columns of Pre-Engineered Metal Building Structures.

D. Framing accessories.

1.02 RELATED REQUIREMENTS

A. Section 05 4000 - Cold-Formed Metal Framing: Exterior wall stud framing.

B. Section 06 1000 - Rough Carpentry: Wood blocking within stud framing.

C. Section 07 8400 - Firestopping: Sealing top-of-wall assemblies at fire rated walls.

D. Section 07 9200 - Joint Sealants: Sealing acoustical gaps in construction other than gypsum board or plaster work.

E. Section 08 3100 - Access Doors and Panels.

F. Section 09 2116 - Gypsum Board Assemblies: Gypsum board installation.

G. Section: 13 120 – Pre-Engineered Structures

1.03 REFERENCE STANDARDS

A. ASTM C645 - Standard Specification for Nonstructural Steel Framing Members; 2014, with Editorial Revision (2015).

B. ASTM C754 - Standard Specification for Installation of Steel Framing Members to Receive Screw-Attached Gypsum Panel Products; 2017.

C. ASTM C1002 - Standard Specification for Steel Self-Piercing Tapping Screws for Application of Gypsum Panel Products or Metal Plaster Bases to Wood Studs or Steel Studs;2016.

D. ASTM E90 - Standard Test Method for Laboratory Measurement of Airborne Sound Transmission Loss of Building Partitions and Elements; 2009 (Reapproved 2016).

E. ASTM E413 - Classification for Rating Sound Insulation; 2016.

1.04 SUBMITTALS

A. See Section 01 3000 - Administrative Requirements, for submittal procedures.

B. Product Data: Provide data describing framing member materials and finish, product criteria, load charts, and limitations.

C. Manufacturer's Installation Instructions: Indicate special procedures and perimeter conditions requiring special attention.

1.05 QUALITY ASSURANCE

A. Installer Qualifications: Company specializing in performing the work of this section with minimum five years documented experience and approved by manufacturer.

PART 2 PRODUCTS

2.01 MANUFACTURERS

2.02 FRAMING MATERIALS

A. Non-Loadbearing 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/240 at 5 psf.

1. Studs: C shaped with flat or formed webs with knurled faces.

2. Tracks: U shaped, sized to match studs.

3. Ceiling Channels: C shaped.

4. Furring: Hat-shaped sections, minimum depth of 7/8 inch.

B. Ceiling and Soffit Framing: Basis of Design : Armstrong QUIKSTIX Drywall Grid System for Soffits.

1. Depth: As indicated on Drawings.

C. Partition Head to Structure Connections: Provide track fastened to structure with legs of sufficient length to accommodate deflection, for friction fit of studs cut short and braced with continuous bridging on both sides.

D. Deflection and Firestop Track: Intumescent strip factory-applied to track flanges expands when exposed to heat or flames to provide a perimeter joint seal.

1. Basis of Design Products:

a. ClarkDietrich Building Systems; BlazeFrame Firestop Deflection Track: www.clarkdietrich.com.

b. Substitutions: See Section 01 6000 - Product Requirements.

E. Tracks and Runners: Same material and thickness as studs, bent leg retainer notched to receive studs with provision for crimp locking to stud.

F. Furring and Bracing Members: Of same material as studs; thickness to suit purpose; complying with applicable requirements of ASTM C754.

G. Fasteners: ASTM C1002 self-piercing tapping screws.

2.03 FABRICATION

A. Fabricate assemblies of framed sections to sizes and profiles required.

B. Fit, reinforce, and brace framing members to suit designrequirements.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify existing conditions before starting work.

B. Verify that rough-in utilities are in proper location.

3.02 INSTALLATION OF STUD FRAMING

A. Extend partition framing to structure where indicated and to ceiling in otherlocations.

B. Partitions Terminating at Ceiling: Attach ceiling runner securely to ceiling track in accordance with manufacturer's instructions.

C. Partitions Terminating at Structure: Attach top runner to structure, maintain clearance between top of studs and structure, and connect studs to track using specified mechanical devices in accordance with manufacturer's instructions; verify free movement of top of stud connections; do not leave studs unattached to track.

D. Curved Partitions:

1. Bend track to uniform curve and locate straight lengths so they are tangent to arcs.

2. Begin and end each arc with a stud, and space intermediate studs equally along arcs. On straight lengths of no fewer than two studs at ends of arcs, place studs 6 inches o.c.

E. Align and secure top and bottom runners at 24 inches on center.

F. At partitions indicated with an acoustic rating:

1. Provide components and install as required to produce STC ratings as indicated, based on published tests by manufacturer conducted in accordance with ASTM E90 with STC rating calculated in accordance with ASTM E413.

2. Place one bead of acoustic sealant between runners and substrate, studs and adjacent construction.

3. Place one bead of acoustic sealant between studs and adjacent vertical surfaces.

G. Fit runners under and above openings; secure intermediate studs to same spacing as wall studs.

H. Install studs vertically at spacing indicated on drawings.

I. Align stud web openings horizontally.

J. Secure studs to tracks using crimping method. Do not weld.

K. Stud splicing is not permissible.

L. Fabricate corners using a minimum of three studs.

M. Double stud at wall openings, door and window jambs, not more than 2 inches from each side of openings.

N. Coordinate erection of studs with requirements of door frames; install supports and attachments.

O. Coordinate installation of bucks, anchors, and blocking with electrical, mechanical, and other work to be placed within or behind stud framing.

P. Blocking: Use wood blocking secured to studs. Provide blocking for support of plumbing fixtures, toilet partitions, wall cabinets, toilet accessories, hardware, and opening frames.

Q. Furring: Coordinate with sound isolation clip spacing and locations. Lap splices a minimum of 6 inches.

3.03 CEILING AND SOFFIT FRAMING

A. Install furring after work above ceiling or soffit is complete. Coordinate the location of hangers with other work.

B. Install furring independent of walls, columns, and above-ceiling work.

C. Securely anchor hangers to structural members or embed in structural slab. Space hangers as required to limit deflection to criteria indicated. Use rigid hangers at exterior soffits.

D. Space main carrying channels at maximum 72 inch on center, and not more than 6 inches from wall surfaces. Lap splice securely.

E. Securely fix carrying channels to hangers to prevent turning or twisting and to transmit full load to hangers.

F. Place furring channels perpendicular to carrying channels, not more than 2 inches from perimeter walls, and rigidly secure. Lap splices securely.

END OF SECTION 09 2216

SECTION 09 2236

LATH

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Metal lath for cement plaster.

1.02 RELATED REQUIREMENTS

A. Section 06 1600 - Sheathing: Sheathing on exterior walls.

B. Section 07 2500 - Weather Barriers: Weather barrier under exterior plaster and stucco.

C. Section 09 2400 - Cement Plastering.

1.03 REFERENCE STANDARDS

A. ASTM C847 - Standard Specification for Metal Lath; 2014a.

B. 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; 2015.

C. ASTM C1063 - Standard Specification for Installation of Lathing and Furring to Receive Interior and Exterior Portland Cement-Based Plaster; 2017a.

1.04 SUBMITTALS

A. See Section 01 3000 - Administrative Requirements, for submittal procedures.

B. Product Data: Provide data on furring and lathing components, structural characteristics, material limitations, and finish.

1.05 QUALITY ASSURANCE

A. Maintain one copy of each installation standard referenced on site throughout the duration of lathing and plastering work.

B. Installer Qualifications: Company specializing in performing the work of this section with at least three years of documented experience.

PART 2 PRODUCTS

2.01 LATH

A. Diamond Mesh Metal Lath: ASTM C847, galvanized; self-furring.

1. Weight: To suit application and as specified in ASTM C841 or ASTM C1063 for framing spacing.

2. Weight: 2.5 lb/sq yd.

B. Fiber mesh reinforcing.

1. Weight: To suit application

2. Embedded in brown coat at parapets, corns and at openings.

C. Corner Mesh: Formed sheet steel, minimum 0.018 inch thick, perforated flanges shaped to permit complete embedding in plaster, minimum 2 inch size; same finish as lath.

D. Beads, Screeds, Joint Accessories, and Other Trim: Depth governed by plaster thickness, and maximum possible lengths.

1. Material: Formed sheet steel with rust inhibitive primer, expanded metal flanges.

E. Expansion Joint between rated wall separating the Senior Center and Fire Station.

2.02 ACCESSORIES

A. Access Panels - Non-Fire Rated: Formed steel shop primed.

B. Fasteners: Self-piercing tapping screws; ASTM C1002 or ASTM C954.

C. Tie Wire: Annealed galvanized steel.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify existing conditions before starting work.

B. Verify that substrates are ready to receive work and conditions are suitable for application.

C. For exterior plaster and stucco on stud walls, verify that water-resistive barrier has been installed over sheathing substrate completely and correctly.

D. Do not begin until unacceptable conditions have been corrected.

E. If substrate preparation is the responsibility of another installer, notify Architect of unsatisfactory preparation before proceeding.

3.02 INSTALLATION - GENERAL

A. Install metal lath and furring for Portland cement plaster in accordance with ASTM C1063.

3.03 CONTROL AND EXPANSION JOINT INSTALLATION

A. Locate joints as indicated on drawings and comply with ASTM C1063.

B. Install expansion joints where an expansion joint occurs in base exterior wall.

C. Construct expansion joints of back-to-back casing beads with a backer rod and sealant, set 1/4 inch apart.

3.04 ACCESS PANELS INSTALLATION

A. Install access panels and rigidly secure in place.

B. Install frames plumb and level in opening. Secure rigidly in place.

C. Position to provide convenient access to concealed work requiring access.

3.05 LATH INSTALLATION

A. Apply lath taut, with long dimension perpendicular to supports.

B. Lap or nest ends of metal lath in accordance with ASTM C841.

C. Secure end laps with tie wire where they occur between supports.

D. Continuously reinforce internal angles with corner mesh, except where the metal lath returns 3 inches from corner to form the angle reinforcement; fasten at perimeter edges only.

E. Place corner bead at external wall corners; fasten at outer edges of lath only.

F. Place base screeds at termination of plaster areas; secure rigidly in place.

G. Place lath vertically above each top corner and each side of door frames to 6 inches above ceiling line.

H. Place casing beads at terminations of plaster finish. Butt and align ends. Secure rigidly in place.

I. Place additional strip mesh diagonally at corners of lathed openings. Secure rigidly in place.

END OF SECTION 09 2236

SECTION 09 2400

CEMENT PLASTERING

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Stucco - exterior cement plastering.

1.02 RELATED REQUIREMENTS

A. Division 00 8100 Bidding Requirements & Instructions

B. Section 05 4000 - Cold-Formed Metal Framing: Structural metal framing for plaster.

C. Section 06 1600 - Sheathing

D. Section 07 2500 - Weather Barriers.

E. Division 07 Section "Sheet Metal Flashing and Trim" for formed sheet metal copings, flashings, reglets, and roof drainage items in addition to items specified in this Section.

F. Division 07 Section "Manufactured Roof Specialties" for manufactured copings, reglets, and roof drainage items in addition to items specified in this Section.

G. Division 07 Section "Joint Sealants" for field-applied Joint Sealants.

H. Section 08 3100 - Access Doors and Panels: Access panels.

I. Section 09 2236 - Lath: Lath, furring, beads, screeds, and joint accessories for plaster base.

J. Division 13 Section 120 Pre-Engineered Buildings.

1.03 REFERENCE STANDARDS

A. ASTM C91/C91M - Standard Specification for Masonry Cement; 2012.

B. ASTM C150/C150M - Standard Specification for Portland Cement; 2017.

C. ASTM C847 Standard Specification for Metal Lath

D. ASTM C897 Standard Specification for Aggregate for Job-Mixed Portland Cement-Based Plaster

E. ASTM C926 Standard Specification for Application of Portland Cement-Based Plaster; 2017.

F. ASTM C933 Standard Specification for Welded Wire Lath

G. ASTM C1032 Standard Specification for Woven Wire Plaster Base

H. ASTM C1063 Standard Specification for Installation of Lathing and Furring for Portland Cement Based Plaster

I. ASTM C1177 Specification for Glass Mat Gypsum for Use as Sheathing

J. ASTM C1278 Specification for Fiber-Reinforced Gypsum Panel

K. ASTM C1396 Standard Specification for Gypsum Board

L. ASTM E84 Test Method for Surface Burning Characteristics of Building Materials

M. ICC AC 219 Acceptance Criteria for Exterior Insulation And Finish Systems

1.04 SUBMITTALS

A. See Section 01 3000 - Administrative Requirements, for submittals procedures.

B. Product Data: Provide data on plaster materials and trim accessories.

C. Samples:

1. Submit two samples, 6 by 6 inch in size illustrating finish color andtexture.

2. Submit two samples of each type trim accessory.

1.05 QUALITY ASSURANCE

A. Installer Qualifications: Company specializing in performing the work of this section with minimum three years documented experience.

1.06 FIELD CONDITIONS

A. Exterior Plaster Work: Do not apply plaster when substrate or ambient air temperature is 40 degrees F or lower, or when temperature is expected to drop below 40 degrees F within 48 hours of application.

B. Prior to installation, the substrate shall be inspected for surface contamination, or other conditions that may adversely affect the performance of the stucco system materials, and shall be free of residual moisture.

C. Substrate shall be dry and free of any residual moisture. Inclement Weather: Do not apply stucco system materials during inclement weather, unless appropriate protection is employed.

D. Sunlight Exposure: Avoid, when possible, installation of the stucco system materials in direct sunlight. Application of finishes in direct sunlight in hot weather may adversely affect aesthetics.

1.07 DELIVERY, STORAGE, AND HANDLING

A. Delivery: Deliver stucco system materials in original packaging with manufacturer's identification.

B. Storage: Store stucco system materials in a dry location, out of direct sunlight, off the ground, and protected from moisture.

1.08 COORDINATION AND SCHEDULING:

A. Coordination: Coordinate stucco system installation with other construction operations.

1.09 WARRANTY

A. Provide manufacturer’s Standard Limited Warranty.

PART 2 PRODUCTS

2.01 THREE COAT CEMENT PLASTER APPLICATION

A. Lath Plaster Base: Metal lath.

1. Plaster Type: Factory prepared plaster mix.
2. Number of Coats: Three.
3. First Coat: Apply to a nominal thickness of 3/8 inch.
4. Second Coat: Apply to a nominal thickness of 3/8 inch.
5. Finish Coat: Apply to a nominal thickness of 1/8 inch.

2.02 FACTORY PREPARED CEMENT PLASTER

A. Exterior Portland cement plaster system made of scratch and brown base coat and cementitious finish coat; install in accordance with ASTM C926.

1. Provide weather resistive barrier as part of the system.
2. Manufacturer -
   a. El. Rey Stucco
3. Other Acceptable Manufacturers:
   a. LaHabra; FastWall 300: www.lahabrastucco.com/sle.
   b. Parex USA, Inc; Armourwall 300: www.parexusa.com/sle.

2.03 ACCESSORIES

A. Expansion and Control Joints: Continuous expansion and control joints shall be installed at locations in accordance with ASTM C1063 and ASTM C926.

B. Substrate movement, and expansion and contraction of stucco and adjacent materials shall be taken into account in design of expansion joints, with proper consideration given to sealant properties, installation conditions, temperature range, coefficients of expansion of materials, joint width to depth ratios, and other material factors. Minimum width of expansion joints shall be as specified by the designer or shown on the project drawings.

C. In accordance with ASTM C1063, expansion or control joints shall be installed in walls not more than 144 ft² (13.4 m²) in area, and not more than 100 ft² (9.3 m²) in area for all non-vertical applications. The distance between joints shall not exceed 18 ft (5.5 m) in either direction or a length-to-width ratio of 2-½ to 1.

D. Lath: As specified in Section 09 2236.

E. Beads, Screeds, and Joint Accessories: As specified in Section 09 2236.

F. Water Resistive Barrier: As specified in Section 07 2500.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify existing conditions are acceptable prior to starting this work. See **Section 1.06 FIELD CONDITIONS**.

B. Verify lath is flat, secured to substrate, and joint and surface perimeter accessories are properly in place.

C. Verify mechanical and electrical equipment and services located within areas to receive this work have been properly tested and approved.

D. Verify Substrate Condition meets manufacturers requirements including

1. Substrate materials and construction shall conform to the building code having jurisdiction.
2. Substrates shall be sound, dry and free of dust, dirt, laitance, efflorescence and other harmful contaminants.
3. Substrate Dimensional Tolerances: Flat with 1/4 in (6.4 mm) within any 10 ft (3 m) radius.
4. Maximum deflection of substrate system under positive or negative design loads shall not exceed L/360 of span.

3.02 MIXING

A. Mix only as much plaster as can be used prior to initial set.

B. Mix materials dry, to uniform color and consistency, before adding water.

C. Protect mixtures from frost or freezing temperatures, contamination, and excessive evaporation.

3.03 APPLICATION

A. Apply plaster in accordance with manufacturer's written instructions and comply with ASTM C926.

B. All plaster coats shall extend a minimum of 6” below finished grade.

C. Where adjacent to paving plaster stop shall be used.

D. At parapets stucco shall extend over parapet and terminate with stucco stop above Reglet cap flashing.

A. Stucco Base:

1. Scratch Coat:
   a. Follow Parex USA’s current Stucco Application Guide.
   b. Apply scratch coat to a minimum thickness of 3/8 in (9.5 mm), using sufficient trowel pressure to key stucco into lath or to create bond to substrates as applicable.
   c. Prior to initial set, scratch horizontally to provide key for bond of brown coat.
   d. Moist cure scratch coat with clean potable water for at least 48 hours in accordance with ASTM C926 and the building codes following initial application (unless brown coat is applied as soon as the scratch coat has achieved sufficient rigidity to support the brown coat).
   e. Follow guidelines in ASTM C926 and manufacturer's written installation instructions for moist curing base coats and application of subsequent coats.
   f. Apply base coat(s) to fully embed lath and to specified thickness

2. Brown Coat:
   a. Apply brown coat to a minimum thickness of 3/8 in (9.5 mm), using sufficient trowel pressure to key stucco into scratch coat.
   b. Rod surface to true plane and float to densify.
   c. Moist cure brown coat with clean potable water for at least 48 hours, in accordance with ASTM C926 and the building codes.
   d. Brown coat shall have fiberglass lath embedded at parapets and openings.

E. Cement based Finish Coats:
   a. Apply with sufficient material and pressure to ensure complete coverage of base to specified thickness.
   b. Apply desired surface texture while mix is still workable.
   c. Float to a consistent finish.

3.04 TOLERANCES

A. Maximum Variation from True Flatness: 1/8 inch in 10 feet.

3.05 REPAIR

A. Patching: Remove loose, damaged or defective plaster and replace with plaster of same composition; finish to match surrounding area.

3.06 CLEAN-UP

A. Removal: Remove and legally dispose of stucco component debris material from job site.

3.06 PROTECTION

A. Provide protection of installed materials from water infiltration into or behind them.

B. Provide protection of installed stucco from dust, dirt, precipitation, and freezing during installation.

C. Provide protection of installed finish from dust, dirt, precipitation, freezing, and continuous high humidity until fully dry.

D. Clean exposed surfaces using materials and methods recommended by the manufacturer of the material or product being cleaned. Remove and replace work that cannot be cleaned to the satisfaction of the Designer/Owner.

END OF SECTION 09 2400

SECTION 09 3000

TILING

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Tile for floor applications.

B. Tile for wall applications.

C. Tile for shower receptors. Cementitious backer board as tile substrate.

D. Stone thresholds.

E. Ceramic trim.

1.02 SUBMITTALS

A. See Section 01 3000 - 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. 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.

D. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.

1. See Section 01 6000 - Product Requirements, for additional provisions.

2. Extra Tile: 10 square feet of each size, color, and surface finish combination.

1.03 QUALITY ASSURANCE

A. Installer Qualifications: Company specializing in performing tile installation, with minimum of five years of documented experience.

1.04 DELIVERY, STORAGE, AND HANDLING

A. Protect adhesives from freezing or overheating in accordance with manufacturer's instructions.

1.05 FIELD CONDITIONS

A. Do not install solvent-based products in an unventilated environment.

PART 2 PRODUCTS

2.01 TILE

A. Manufacturers: All products by the same manufacturer.

a. Arizona Tile www.arizonatile.com

b. Daltile www.daltile.com

B. Ceramic Tile: ANSI A137.1, standard grade.

1. Products:

a. Bathroom 5’-0” high wainscotting. subway tile 6" x 12" Ceramic Tile Color TBD, Semi-gloss Finish.

b. Bathroom Floors; 12x12Ceramic tile color TBD, semi-gloss Finish.

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. Manufacturers: Same as for tile.

B. Thresholds: Marble, white or gray, honed finish; 2 inches wide by full width of wall or frame opening; 1/2 inch thick; beveled one long edge with radiused corners on top side; without holes, cracks, or open seams.

1. Applications:

a. At doorways where tile terminates.

b. At open edges of floor tile where adjacent finish is a different height.

C. Base to match floor tile where no tile wainscotting is shown on drawings.

D. Wall Tile Edge Protection.

1. Product

a. Schluter JOLLY or equal anodized aluminum tile edge protection.

2.03 SETTING MATERIALS

A. Manufacturers:

1. ARDEX Engineered Cements; TBD: www.ardexamericas.com/#sle.

2. Bostik Inc; TBD: www.bostik-us.com.

3. Custom Building Products; TBD: www.custombuildingproducts.com.

4. LATICRETE International, Inc; TBD: www.laticrete.com/sle.

5. Merkrete, by Parex USA, Inc; TBD: www.merkrete.com/sle.

6. TEC, an H.B. Fuller Construction Products Brand; TBD: www.tecspecialty.com/#sle.

B. Products: To be selected by contractor/subcontractor from the manufacturer's recommended product and install method for the tile types and locations.

2.04 GROUTS

A. Manufacturers:

1. ARDEX Engineered Cements; TBD: www.ardexamericas.com/#sle.
2. Bostik Inc; TBD: www.bostik-us.com.
3. Custom Building Products; TBD: www.custombuildingproducts.com.
4. LATICRETE International, Inc; TBD: www.laticrete.com/#sle.
5. Merkrete, by Parex USA, Inc; TBD: www.merkrete.com/sle.
6. TEC, an H.B. Fuller Construction Products Brand; TBD: www.tecspecialty.com/#sle.

B. Products: To be selected by contractor/subcontractor from the manufacturer's recommended product and install method for the tile types and locations.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that sub-floor 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 sub-floor surfaces are dust-free and free of substances that could impair bonding of setting materials to sub-floor surfaces.

D. Verify that concrete sub-floor surfaces are ready for tile installation by testing for moisture emission rate and alkalinity; obtain instructions if test results are not within limits recommended by tile manufacturer and setting materials 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.

3.03 INSTALLATION - GENERAL

A. Install tile, thresholds, and stair treads and grout in accordance with applicable requirements of ANSI A108.1a through ANSI A108.13, 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 thresholds where indicated.

G. Sound tile after setting. Replace hollow sounding units.

H. Keep control and expansion joints free of mortar, grout, and adhesive.

I. Prior to grouting, allow installation to completely cure; minimum of 48 hours.

J. Grout tile joints unless otherwise indicated. Use standard grout unless otherwise indicated.

K. 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. Where waterproofing membrane is indicated, install in accordance with TCNA (HB) Method F122, with latex-Portland cement grout.

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 3000

SECTION 09 5100

ACOUSTICAL CEILINGS

PART 1 GENERAL

SECTION INCLUDES

A- Suspended metal grid ceiling system.

B. Acoustical units.

C. Supplementary acoustical insulation above ceiling.

1.01 REFERENCE STANDARDS

A. ASTM C635/C635M - Standard Specification for the Manufacture, Performance, and Testing of Metal Suspension Systems for Acoustical Tile and Lay-in Panel Ceilings; 2017.

B. ASTM E1264 - Standard Classification for Acoustical Ceiling Products; 2014.

1.02 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.

1.03 SUBMITTALS

A. See Section 01 3000 - Administrative Requirements, for submittal procedures.

B. Shop Drawings: Indicate grid layout and related dimensioning.

C. Product Data: Provide data on suspension system components.

D. Samples: Submit two full size samples illustrating material and finish of acoustical units.

E. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.

1. See Section 01 6000 - Product Requirements, for additional provisions.

2. Extra Acoustical Units: Quantity equal to 5 percent of total installed.

1.04 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.

1.05 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 BASIS OF DESIGN MANUFACTURER

A. Acoustic Tiles/Panels:

1. Armstrong World Industries, Inc; Tectum: www.armstrong.com.
2. Rockfon

B. Suspension Systems:

1. Same as for acoustical units.

2.02 ACOUSTICAL UNITS

A. Acoustical Units - General: ASTM E1264, Class A.

B. Acoustical Panels Type Basis of Design: Armstrong Cirrus 584 or Rockfon Arctic painted Mineral Fiber, ASTM E1264 Type III, Form 1, Pattern EI

1. Size: 24 by 24inches.
2. Panel Edge: Beveled Tegular.
3. Surface Pattern: Coarse texture.
4. Surface Color: To be selected by Architect from manufacturer's standard line.
5. Products:
   a. Armstrong Cirrus 584 or Rockfon Artic
   b. Substitutions: See Section 01 6000 - Product Requirements.

2.03 SUSPENSION SYSTEM(S)

A. Metal Suspension Systems - General: Complying with ASTM C635/C635M; die cut and interlocking components, with stabilizer bars, clips, splices, perimeter moldings, and hold down clips as required.

B. Exposed Steel Suspension System: Formed steel, commercial quality cold rolled; intermediate-duty.

1. Profile: Tee; 15/16 inch wide face.
2. Construction: Double web.
3. Finish:
   a. White painted. Typical
   b. Arch Selected 360 Standard Color at Open Celling's.
4. Products:
   a. Prelude ® XL ® Suspension System. Or Chicago Metallic 730 typical.
   b. 360 Painted Grid at Open Ceiling's.
   c. Substitutions: See Section 01 6000 - Product Requirements.

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. Perimeter Moldings: Same material and finish as grid.

1. At Exposed Grid: Provide L-shaped molding for mounting at same elevation as face of grid.

C. Acoustical Insulation: Specified in Section 07 2100.

1. Thickness: 2 inch.

D. Acoustical Sealant For Perimeter Moldings: Non-hardening, non-skinning, for use in conjunction with suspended ceiling system.

E. Transition Moldings:

1. Location: Edge of hung grid in exposed ceilings

2. Product:

a. Basis of Design Armstrong Axiom Classic

1) Product # AX8STR

2) Material: Extruded Aluminum.

3) Color: shall match rest of grid system

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 INSTALLATION - SUSPENSION SYSTEM

A. Install suspension system in accordance with 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. Install after major above-ceiling work is complete. Coordinate the location of hangers with other work.

D. 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.

E. 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.

F. Do not support components on main runners or cross runners if weight causes total dead load to exceed deflection capability.

G. Support fixture loads using supplementary hangers located within 6 inches of each corner, or support components independently.

H. Do not eccentrically load system or induce rotation of runners.

I. Perimeter Molding: Install at intersection of ceiling and vertical surfaces and at junctions with other interruptions.

1. Use longest practical lengths.

2. Overlap and rivet corners.

3.03 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 units after above-ceiling work is complete.

E. Install acoustical units level, in uniform plane, and free from twist, warp, and dents.

F. Cutting Acoustical Units:

1. Make field cut edges of same profile as factory edges.

G. Lay acoustical insulation for a distance of 48 inches either side of acoustical partitions as indicated.

H. Install hold-down clips on panels within 20 ft of an exterior door.

3.04 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 5100

SECTION 09 6500

RESILIENT FLOORING

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Resilient tile flooring.

B. Resilient base.

C. Installation accessories.

1.02 RELATED REQUIREMENTS

1.03 SECTION 09 6500 RESILIENT FLOORING

A. Section 09 0561 - Common Work Results for Flooring Preparation: Independent agency testing of concrete slabs, removal of existing floor coverings, cleaning, and preparation.

1.04 REFERENCE STANDARDS

A. ASTM F1700 - Standard Specification for Solid Vinyl Floor Tile; 2013a.

B. ASTM F1861 - Standard Specification for Resilient Wall Base; 2016.

2.01 TILE FLOORING

A. Vinyl Tile: Solid vinyl with color and pattern throughout thickness.

1. Basis of Design Manufacturers:

a. EF Contract Mineral BLVEL LVT.

b. Color TBD

2. Minimum Requirements: Comply with ASTM F1700, of Class corresponding to type specified.

3. Total Thickness: 2.5 mm

2.02 RESILIENT BASE

A. Resilient Base: ASTM F1861, Type TS rubber, vulcanized thermoset; top set Style B, Cove.

1. Basis of Design Manufacturers:

a. Johnsonite, a Tarkett Company; Millwork Wall Base System: www.johnsonite.com.

2. Length: 8 foot sections.

3. Profile: TBD.

4. Color: Black

2.03 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.

C. Adhesive for Rubber and Linoleum Flooring:

1. As recommended by contractor/supplier.

D. Transitions:

1. Carpet to LVT:

a. Schluter Scheine (finish shall be submitted to architect for selection).

E. Filler for Coved Base: Plastic.

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. Cementitious Sub-floor Surfaces: Verify that substrates are dry enough and ready for resilient flooring installation by testing for moisture and pH.

1. Obtain instructions if test results are not within limits recommended by resilient flooring manufacturer and adhesive materials manufacturer.

3.02 PREPARATION

A. Prepare floor substrates as recommended by flooring and adhesive manufacturers.

B. Prohibit traffic until filler is fully cured.

C. Clean substrate.

3.03 INSTALLATION - GENERAL

A. Starting installation constitutes acceptance of sub-floor conditions.

B. Install in accordance with manufacturer's written instructions.

C. Spread only enough adhesive to permit installation of materials before initial set.

D. Fit joints and butt seams tightly.

E. Set flooring in place, press with heavy roller to attain full adhesion.

F. Where type of floor finish, pattern, or color are different on opposite sides of door, terminate flooring under centerline of door.

G. Install edge strips at unprotected or exposed edges, where flooring terminates, and where indicated.

H. Scribe flooring to walls, columns, cabinets, floor outlets, and other appurtenances to produce tight joints.

I. Install flooring in recessed floor access covers, maintaining floor pattern.

J. 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.

3.05 INSTALLATION - RESILIENT BASE

A. Fit joints tightly and make vertical. Maintain minimum dimension of 18 inches between joints.

B. Miter internal corners. At external corners, 'V' cut back of base strip to 2/3 of its thickness and fold. At exposed ends, use premolded units.

C. Install base on solid backing. Bond tightly to wall and floor surfaces.

D. Scribe and fit to door frames and other interruptions.

3.06 CLEANING

A. Remove excess adhesive from floor, base, and wall surfaces without damage.

B. Clean in accordance with manufacturer's written instructions.

3.07 PROTECTION

A. Prohibit traffic on resilient flooring for 48 hours after installation.

END OF SECTION 09 6500

SECTION 09 6510

RESILIENT LINOLEUM MODULAR FLOORING

PART 1 GENERAL

1.01 SUMMARY

A. Section Includes: Resilient Linoleum Sheet Flooring
   1. Marmoleum® [Fresco] Flooring, Adhesive Installation, Topshield2™ Finish
   2. Forbo Flooring Systems Resilient Base
   3. Forbo Flooring Systems Resilient Transition Accessories

B. Related Sections: Section(s) related to this section include:
   1. Concrete: Refer to Division 3 Concrete Sections for cast-in-place concrete, concrete toppings, and cementitious underlayments.
   2. Resilient Flooring Accessories: Refer to Division 9 Finishes Sections for resilient wall bases, reducer strips, metal edge strips and other resilient flooring accessories.
   3. Expansion Joint Covers: Refer to Division 10 Specialties Section for expansion joint covers to be used with resilient flooring.

1.02 REFERENCES

A. Forbo Installation Guide

B. Forbo Floor Care Guide

C. American Society for Testing and Materials (ASTM):

   1. ASTM F 2034 Standard Specification for Linoleum Sheet Floor Covering
   2. ASTM F 1869 Standard Test Method for Measuring Vapor Emission Rate of Concrete Subfloor Using Anhydrous Calcium Chloride
   3. ASTM F 2170 Standard Test Method for Determining Relative Humidity in Concrete Floor Slabs Using in situ Probes
   4. ASTM F 1861 Standard Specification for Resilient Wall Base
   5. ASTM F 710 Standard Practice for Preparing Concrete Floors to Receive Resilient Flooring
   6. ASTM F 1482 Standard Practice for Installation and Preparation of Panel Type Underlayments to Receive Resilient Flooring
   7. ASTM E 648 Standard Test Method for Critical Radiant Flux of Floor-Covering Systems Using a Radiant Heat Energy Source
   8. ASTM E 662 Standard Test Method for Specific Optical Density of Smoke Generated by Solid Materials
   9. ASTM E 84 Standard Test Method for Surface Burning Characteristics of Building Materials
   10. ASTM E 492 Standard Test Method for Laboratory Measurement of lmpact Sound Transmission through Floor-Ceiling Assemblies Using the Tapping Machine
   11. ASTM E 989 Standard Classification for Determination of lmpact lnsulation Class (llC)

D. National Fire Protection Association (NFPA):
   1. NFPA 253 Test Method for Critical Radiant Flux of Floor-Covering Systems Using a Radiant Heat Energy Source
   2. NFPA 258 Test Method for Specific Optical Density of Smoke Generated by Solid Materials

E. Standards Council of Canada
   1. CAN/ULC S102 Standard Method of Test for Surface Burning Characteristics of Building Materials and Assemblies

1.03 SYSTEM DESCRIPTION

A. Performance Requirements: Provide flooring which has been manufactured, fabricated and installed to performance criteria certified by manufacturer without defects, damage, or failure.

1.04 SUBMITTALS

A. General: Submit listed submittals in accordance with "Conditions of the Contract" and Division 1 Submittal Procedures Section.

B. Product Data: Submit product data, including manufacturer's SPEC-DATA product sheet, for specified products.

C. Shop Drawings: Submit shop drawings showing layout, profiles, and product components, including anchorage, accessories, finish colors, patterns and textures.

D. Samples: Submit selection and verification samples for finishes, colors, and textures.

E. Quality Assurance Submittals: Submit the following:
   1. Manufacturers Technical Data: Manufacturers document specifying performance characteristics and criteria, and physical requirements.
   2. Manufacturer's Instructions: Manufacturer's installation instructions.
   3. Manufacturer's Field Reports: Manufacturer's field reports specified herein.

F. Closeout Submittals: Submit the following:
   1. Operation and Maintenance Data: Operation and maintenance data for installed products in accordance with Division 1 Closeout Submittals (Maintenance Data and Operation Data) Section. Include methods for maintaining installed products, and precautions against cleaning materials and methods detrimental to finishes and performance.
   2. Warranty: Warranty documents specified herein.

1.05 QUALITY ASSURANCE

A. Installer Qualifications: Installer experienced in performing work of this section who has specialized in installation of work similar to that required for this project.

B. Regulatory Requirements:
   1. Fire Performance Characteristics: Provide resilient linoleum sheet flooring with the following fire performance characteristics as determined by testing products in accordance with the latest version of ASTM method indicated below by a certified testing laboratory or another testing and inspecting agency acceptable to authorities having jurisdiction:
      a. Critical Radiant Flux: Class 1 Rating per NFPA 253 (ASTM E 648) (0.45 watts/cm² or greater).
      b. Smoke Density: Less than 450 per NFPA 258 (ASTM E 662).

C. Pre-Installation Meetings: Conduct pre-installation meeting to verify project requirements, substrate conditions, manufacturer's installation instructions, and manufacturer's warranty requirements. Comply with Division 1 Project Management and Coordination (Project Meetings) Section.

D. Pre-Installation Testing: Conduct pre-installation testing as follows: [Specify testing (bond testing, pH testing, calcium chloride testing, relative humidity testing, etc.)]

1.06 DELIVERY, STORAGE, AND HANDLING

A. General: Comply with Division 1 Product Requirements Sections.

B. Ordering: Comply with manufacturer's ordering instructions and lead time requirements to avoid construction delays.

C. Delivery: Deliver materials in manufacturer's original, unopened, undamaged containers with identification labels intact.

D. Storage and Protection: Store materials protected from exposure to harmful weather conditions and at temperature and humidity conditions recommended by manufacturer.
   1. Material should be stored in areas that are fully enclosed and weathertight. The permanent HVAC should be fully operational, controlled and set at a minimum of 68º F (20º C) for at least 48 hours prior to the installation.

1.07 PROJECT CONDITIONS

A. Environmental Requirements/Conditions: In accordance with manufacturer's recommendations, areas to receive flooring should be clean, fully enclosed and weathertight. The permanent HVAC must be fully operational, controlled and set at a minimum of 68° F (20° C) for a minimum of seven days prior to, during, and seven days after the installation. The flooring material should be conditioned in the same manner for at least 48 hours prior to the installation. Areas to receive flooring shall be adequately lighted to allow for proper inspection of the substrate, installation and seaming of the flooring, and for final inspection.

B. Temperature Requirements: Maintain air temperature in spaces where products will be installed for time period before, during, and after installation as recommended by manufacturer.

1. Temperature Conditions: 68° F (20° C) for a minimum of seven days prior to, during, and seven days after the installation.

C. Existing Conditions: [Specify existing conditions affecting product use and installation.]

D. Field Measurements: Verify actual measurements/openings by field measurements before fabrication; show recorded measurements on shop drawings. Coordinate field measurements and fabrication schedule with construction progress to avoid construction delays.

1.08 SEQUENCING AND SCHEDULING

A. Finishing Operations: Install flooring after finishing operations, including painting and ceiling operations, have been completed.

B. Concrete Curing: Do not install flooring over concrete substrates until substrates have cured and are dry to bond with adhesive as determined by resilient flooring manufacturer's recommended bond testing, moisture testing, and pH testing.

1. Flooring Contractor assigned to report responsibility

1.09 WARRANTY

A. Project Warranty: Refer to "Conditions of the Contract" for project warranty provisions.

B. Manufacturer's Warranty: Submit, for Owner's acceptance, manufacturer's standard warranty document executed by authorized company official. Manufacturer's warranty is in addition to, and not a limitation of, other rights Owner may have under Contract Documents.

1. Warranty Period: Five (5) year limited warranty commencing on Date of Substantial Completion.

2.

1.10 MAINTENANCE

A. Extra Materials: Deliver to Owner extra materials from same production run as products installed. Package products with protective covering and identify with descriptive labels. Comply with Division 1 Closeout Submittals (Maintenance Materials) Section.

1. Quantity: Furnish quantity of flooring units equal to 5% of amount installed.
2. Delivery, Storage and Protection: Comply with Owner's requirements for delivery, storage and protection of extra materials.

PART 2 PRODUCTS

Specifier Note: Retain article below for proprietary method specification. Add product attributes performance characteristics, material standards, and descriptions as applicable. Use of such phrases as "Equal" or "Approved Equal," or similar phrases may cause ambiguity in specifications. Such phrases require verification (procedural, legal, and regulatory) and assignment of responsibility for determining "Equal" products.

2.01 RESILIENT LINOLEUM SHEET FLOORING

A. Manufacturer: Forbo Flooring, Inc.

1. Contact: Forbo Flooring, Inc.
   P.O. Box 667
   Hazleton, PA 18202
   Telephone +800 842 7839 or +570 459 0771
   Fax + 570 450 0258

B. Marmoleum Modular Tiles® .

1. Description: Heterogeneous linoleum sheet made primarily of natural materials consisting of linseed oil, wood flour, and rosin binders, mixed and calendared onto natural jute backing. Pattern and color shall extend throughout total thickness of material.
2. Size: 19.7”x19.7”
3. Thickness: .1”
4. Backing: Jute
5. Pattern and Color:
   a. Field Color: 60% T2621 Dove Grey.
   b. Highlight Color 1: 20%
6. Adhesive: [Forbo L 885 Adhesive] [Forbo Sustain 885m Adhesive] [Forbo Sustain 1195 Adhesive]
7. Net Fit Seams: All Marmoleum sheet products shall be installed utilizing net fit seams.
   a. [Welding Rod: Forbo Marmoweld® color-matched [solid color] [multi-color] welding rod as selected by Architect from manufacturer’s standard patterns and colors.]
8. Topshield 2™ Finish: Applied during the manufacturing process.

2.02 RELATED MATERIALS

A. Related Materials: Refer to other sections for related materials as follows:
   1. Underlayment and Patching Compound: Refer to Division 3 Concrete Sections for Portland cement based underlayments and patching compounds.
   2. Resilient Flooring Accessories: Refer to Division 9 Finishes Sections for resilient flooring accessories.
   3. Expansion Joint Covers: Refer to other specification section for expansion joint covers to be used with resilient flooring.

2.03 SOURCE QUALITY

A. Source Quality: Obtain flooring product materials from a single manufacturer.

PART 3 EXECUTION

3.01 MANUFACTURER'S INSTRUCTIONS

A. Compliance: Comply with manufacturer's product data, including product technical bulletins, product catalog installation instructions, and product carton instructions for installation.

3.02 EXAMINATION

A. Site Verification of Conditions: Verify substrate conditions (which have been previously installed under other sections) are acceptable for product installation in accordance with manufacturer's instructions (bond testing, pH testing, calcium chloride testing, relative humidity testing, etc.).

B. Material Inspection: In accordance with manufacturer's installation requirements, visually inspect materials prior to installation. Material with visual defects shall not be installed and shall not be considered as a legitimate claim.

3.03 PREPARATION

A. Adjacent Surfaces Protection: Protect adjacent work areas and finish surfaces from damage during product installation.

B. Surface Preparation:
   1. General: Prepare floor substrate in accordance with manufacturer's instructions.
   2. Floor Substrate: Floors shall be sound, smooth, flat, permanently dry, clean, and free of all foreign materials including, but not limited to, dust, paint, grease, oils, solvents, curing and hardening compounds, sealers, asphalt and old adhesive residue.
   3. Concrete Floor Substrate: Concrete floor substrate shall have a minimum compressive strength of 3,000 psi. Refer to Division 3 Concrete sections for patching and repairing crack materials and leveling compounds with Portland cement based compounds.
      a. Reference Standard: Comply with the latest version of ASTM F 710 Standard Practice for Preparing Concrete Floors to Receive Resilient Flooring.

C. Concrete Moisture Testing: Conduct moisture tests on all concrete floors regardless of the age, grade level or the presence of existing flooring. Conduct calcium chloride tests in accordance with the latest version of ASTM F 1869. Measure the internal relative humidity of the concrete slab in accordance with the latest version of ASTM F 2170. One test of each type should be conducted for every 1,000 square feet of flooring (minimum of 3). The tests should be conducted around the perimeter of the room, at columns, and anywhere moisture may be evident. Concrete moisture vapor emissions must not exceed 8.0 lbs. per 1,000 square feet in 24 hours when using Forbo V 885 adhesive. Concrete internal relative humidity must not exceed 85% when using Forbo V 885 adhesive. A diagram of the area showing the location and results of each test should be submitted to the Architect, General Contractor or End User. If the test results exceed these limitations, the installation must not proceed until the problem has been corrected.

D. Concrete pH Test: Perform pH tests on concrete floors regardless of the age or grade level. The surface pH of concrete slabs must not exceed a pH of 10 for Forbo L 885 or Sustain 885m adhesives. The surface pH of concrete slabs must not exceed a pH of 11 for Forbo Sustain 1195 adhesive. Concrete substrates with pH readings less than 7.0 or above 10.0 will require remediation prior to installation.

3.04 INSTALLATION

A. Material Installation: Measure the area to be installed and determine the direction in which the material will be installed and seam placement. Seams must be a minimum of 6" away from underlayment and concrete joints, saw cuts, etc. Cut the required length for the first sheet, adding 3" - 6" for trimming. Fit the first sheet along the main wall and at the ends using standard fitting methods. The factory edge must be trimmed in order to produce a clean edge suitable for seaming. Immediately after installation, roll the tile with a 100 pound three-section roller in both directions and repeat as necessary to ensure adequate transfer of adhesive to the backing. Repeat the same procedure on the other half of the sheet. DO NOT REVERSE THE SHEETS. INSTALL ALL MARMOLEUM® AND LINOLEUM SHEETS IN THE SAME DIRECTION.

B. Adhesive Flooring Installation: Use trowel recommended by flooring manufacturer for specific adhesive (1/16" x 1/16" x 1/16" Square notch trowel). Spread rate is approximately 125 ft^2/gallon.

C. Seaming: After the material has been laid into the adhesive, the material should be trimmed to produce a net fit at the seam. The seam edges should just meet, with no pressure or fullness and should be cut with a slight bevel. This will compensate for any slight expansion that may occur.

D. [Heat Welded Seamless Flooring Installation: Groove out seams and heat weld together with complementary colored heat welding rod of complimentary composition in accordance with resilient flooring manufacturer's recommendations.]

E. [Flash Cove Installation: Extend the flooring up the wall in a flash-coved method to a height of [4] [6] inches ([102] [152] mm), as indicated.]

F. Installation Techniques:
   1. Where demountable partitions and other items are indicated for installation on top of finished flooring, install flooring before these items are installed.
   2. Scribe, cut, fit flooring to butt tightly to vertical surfaces, permanent fixtures and built-in furniture, including pipes, outlets, edgings, thresholds, nosings, and cabinets.
   3. Extend flooring into toe spaces, door reveals, closets, and similar openings.
   4. Install flooring on covers for telephone and electrical ducts, and similar items occurring within finish floor areas. Maintain overall continuity of color and pattern with pieces of flooring installed on these covers.
   5. Do not install resilient flooring over expansion joints. Use expansion joint covers manufactured for use with resilient flooring. Refer to other specification sections for expansion joint covers.
   6. Adhere resilient flooring to substrate without producing open cracks, voids, raising and puckering at joints, telegraphing of adhesive spreader marks, or other surface imperfections in completed installation.
      a. Use adhesive applied to substrate in compliance with manufacturer's recommendations, including those for mixing, trowel notch, and adhesive open and working times.
   7. Roll resilient flooring as required by resilient flooring manufacturer.

G. Finish Flooring Patterns: [As selected by Architect.]

3.06 CLEANING

A. Cleaning: Remove temporary coverings and protection of adjacent work areas. Repair or replace damaged installed products. Clean installed products in accordance with manufacturer's instructions prior to owner's acceptance. Remove construction debris from project site and legally dispose of debris.
   1. Remove visible adhesive and other surface blemishes using cleaning methods recommended by floor manufacturer.
   2. Sweep and vacuum floor after installation.
   3. Do not wash floor until after time period recommended by flooring manufacturer.
   4. Damp mop flooring to remove black marks and soil.
   5. Marmoleum® with Topshield 2 ™ is pre-sealed and pre-finished. It is occupancy ready- no additional finish is required at the time of installation. See manufacturers' recommendations for further information.

3.07 PROTECTION

A. Protection: Protect installed product and finish surfaces from damage during construction. Remove and legally dispose of protective covering at time of Substantial Completion.

3.08 INITIAL MAINTENANCE PROCEDURES

A. General: Include in Contract Sum Amount cost for initial maintenance procedures, and execute procedures after flooring installation as recommended by flooring manufacturer.

B. Initial maintenance to be conducted by awarded Flooring Contractor using a Certified Forbo Floor Care Technician.

C. Drying Room Yellowing/Ambering: While Marmoleum® and linoleum products are maturing in the drying stoves, a yellow cast, called "drying room yellowing" or "ambering" may appear on the surface. This yellow cast is caused by the oxidation of linseed oil and is TEMPORARY. It occurs intermittently and with varying intensity. It is most noticeable on blue and grey shades of material. When the material is exposed to light, the drying room yellowing will disappear. The process may take as little as a few hours in bright sunlight or longer with artificial light. Because this is a natural occurrence in the product, there is no set time frame for the yellowing to disappear. This is not a material defect. In regards to floor care, applying finish to the material before the drying room yellowing disappears will make no difference; it will still disappear with exposure to light.

END OF SECTION 09 6510

SECTION 09 6813

TILE CARPETING

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Carpet tile, fully adhered.

B. **QUALITY ASSURANCE** Manufacturer Qualifications: Company specializing in manufacturing specified carpet tile with minimum three years documented experience.

C. Installer Qualifications: Company specializing in installing carpet tile with minimum three years documented experience and approved by carpet tile manufacturer.

PART 2 PRODUCTS

2.01 MANUFACTURERS - BASIS OF DESIGN

A. Tile Carpeting:

1. Basis Of Design EF Contract : www.efcontractflooring.com
2. Substitutions: See Section 01 6000 - Product Requirements.

2.02 MATERIALS

A. Tile Carpeting: Tufted, manufactured in one color dye lot.

1. Product Basis of Design: Vestige – VES14
2. Tile Size: 24 by 24 inch, nominal.
3. Color: TBD
4. Primary Backing Material: Polyester Felt Cushion.

2.03 ACCESSORIES

A. Transitions

1. Exposed concrete to Carpet:
   a. Schluter-Reno (finish shall be submitted to architect for selection)
2. Carpet to LVT and VCT
   a. Schluter Schiene

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that sub-floor surfaces are smooth and flat within tolerances specified for that type of work and are ready to receive carpet tile.

B. Cementitious Sub-floor Surfaces: Verify that substrates are dry enough and ready for flooring installation by testing for moisture and pH.

1. Obtain instructions if test results are not within limits recommended by flooring material manufacturer and adhesive materials manufacturer.

3.02 PREPARATION

A. Prepare floor substrates as recommended by flooring and adhesive manufacturers.

B. Remove sub-floor ridges and bumps. Fill minor or local low spots, cracks, joints, holes, and other defects with sub-floor filler.

C. Apply, trowel, and float filler to achieve smooth, flat, hard surface. Prohibit traffic until filler is cured.

D. Vacuum clean substrate.

3.03 INSTALLATION

A. Starting installation constitutes acceptance of sub-floor conditions.

B. Install carpet tile in accordance with manufacturer's instructions.

C. Blend carpet from different cartons to ensure minimal variation in color match.

D. Cut carpet tile clean. Fit carpet tight to intersection with vertical surfaces withoutgaps.

E. Lay carpet tile in square pattern, with pile direction parallel to next unit, set parallel to building lines.

F. Fully adhere carpet tile to substrate.

G. Trim carpet tile neatly at walls and around interruptions.

H. Complete installation of edge strips, concealing exposed edges.

END OF SECTION 09 681

SECTION 09 9113

EXTERIOR PAINTING

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Surface preparation. Field application of paints, stains, and varnishes.

B. Scope: Finish exterior surfaces exposed to view, unless fully factory-finished and unless otherwise indicated, including the following:

1. Both sides and edges of plywood backboards for electrical and telecom equipment before installing equipment.
2. Exposed surfaces of steel lintels and ledge angles.
3. Mechanical and Electrical:
   a. On the roof and outdoors, paint equipment that is exposed to weather or to view, including factory-finished materials.

C. Do Not Paint or Finish the Following Items:

1. Items factory-finished unless otherwise indicated; materials and products having factory-applied primers are not considered factory finished.
2. Items indicated to receive other finishes.
3. Items indicated to remain unfinished.
4. Fire rating labels, equipment serial number and capacity labels, and operating parts of equipment.
5. Floors, unless specifically indicated.
6. Glass.
7. Concealed pipes, ducts, and conduits.

1.02 REFERENCE STANDARDS

A. MPI (APSM) - Master Painters Institute Architectural Painting Specification Manual; Current Edition.

B. SSPC-SP 1 - Solvent Cleaning; 2015, with Editorial Revision (2016).

C. SSPC-SP 6 - Commercial Blast Cleaning; 2007.

1.03 SUBMITTALS

A. See Section 01 3000 - Administrative Requirements, for submittal procedures.

B. Product Data: Provide complete list of products to be used, with the following information for each:

1. Manufacturer's name, product name and/or catalog number, and general product category (e.g. "alkyd enamel").
2. MPI product number (e.g. MPI #47).
3. Cross-reference to specified paint system(s) product is to be used in; include description of each system.

C. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.

1. See Section 01 6000 - Product Requirements, for additional provisions.

2. Extra Paint and Finish Materials: 1 gallon of each color; from the same product run, store where directed.

3. Label each container with color in addition to the manufacturer's label.

1.04 DELIVERY, STORAGE, AND HANDLING

A. Deliver products to site in sealed and labeled containers; inspect to verifyacceptability.

B. Container Label: Include manufacturer's name, type of paint, brand name, lot number, brand code, coverage, surface preparation, drying time, cleanup requirements, color designation, and instructions for mixing and reducing.

C. Paint Materials: Store at minimum ambient temperature of 45 degrees F and a maximum of 90 degrees F, in ventilated area, and as required by manufacturer'sinstructions.

1.05 FIELD CONDITIONS

A. Do not apply materials when surface and ambient temperatures are outside the temperature ranges required by the paint product manufacturer.

B. Follow manufacturer's recommended procedures for producing best results, including testing of substrates, moisture in substrates, and humidity and temperature limitations.

C. Provide lighting level of 80 ft candles measured mid-height at substrate surface.

PART 2 PRODUCTS

2.01 PAINTS AND FINISHES - GENERAL

A. Paints and Finishes: Ready mixed, unless required to be a field-catalyzedpaint.

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.

2.02 PAINT SYSTEMS - EXTERIOR

A. Paint E-OP - Exterior Surfaces to be Painted, Unless Otherwise Indicated: Including primed wood and primed metal.

1. Two top coats and one coat primer.

2. Top Coat(s): Exterior Latex; MPI #10, 11, 15, 119, or 214.

B. Paint WE-OP-3A - Wood, Opaque, Alkyd, 3 Coat:

1. One coat of alkyd primer sealer.

2. Semi-gloss: Two coats of alkyd enamel; TBD .

C. Paint ME-OP-2A - Ferrous Metals, Primed, Alkyd, 2 Coat:

1. Touch-up with rust-inhibitive primer recommended by top coat manufacturer.

2. Semi-gloss: Two coats of alkyd enamel; TBD .

2.03 PRIMERS

A. Primers: Provide the following unless other primer is required or recommended by manufacturer of top coats.

1. Alkali Resistant Water Based Primer; MPI #3.

2.04 ACCESSORY MATERIALS

A. Accessory Materials: Provide primers, sealers, cleaning agents, cleaning cloths, sanding materials, and clean-up materials as required for final completion of painted surfaces.

B. Patching Material: Latex filler.

C. Fastener Head Cover Material: Latex filler.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that surfaces are ready to receive work as instructed by the product manufacturer.

B. Examine surfaces scheduled to be finished prior to commencement of work. Report any condition that may potentially effect proper application.

C. Test shop-applied primer for compatibility with subsequent cover materials.

3.02 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.

F. Ferrous Metal:

1. Solvent clean according to SSPC-SP 1.

2. Shop-Primed Surfaces: Sand and scrape to remove loose primer and rust. Feather edges to make touch-up patches inconspicuous. Clean surfaces with solvent. Prime bare steel surfaces. Re-prime entire shop-primed item.

3. Remove rust, loose mill scale, and other foreign substances using using methods recommended in writing by paint manufacturer and blast cleaning according to SSPC-SP 6 "Commercial Blast Cleaning". Protect from corrosion until coated.

G. Exterior Wood Surfaces to Receive Opaque Finish: Remove dust, grit, and foreign matter. Seal knots, pitch streaks, and sappy sections. Fill nail holes with tinted exterior calking compound after prime coat has been applied. Back prime concealed surfaces before installation.

3.03 APPLICATION

A. Remove unfinished louvers, grilles, covers, and access panels on mechanical and electrical components and paint separately.

B. Exterior Wood to Receive Opaque Finish: If final painting must be delayed more than 2 weeks after installation of woodwork, apply primer within 2 weeks and final coating within 4 weeks.

C. Apply products in accordance with manufacturer's written instructions and recommendations in "MPI Architectural Painting Specification Manual".

D. Do not apply finishes to surfaces that are not dry. Allow applied coats to dry before next coat is applied.

E. Apply each coat to uniform appearance.

F. Vacuum clean surfaces of loose particles. Use tack cloth to remove dust and particles just prior to applying next coat.

G. Reinstall electrical cover plates, hardware, light fixture trim, escutcheons, and fittings removed prior to finishing.

3.04 CLEANING

A. Collect waste material that could constitute a fire hazard, place in closed metal containers, and remove daily from site.

END OF SECTION 09 9113

SECTION 09 9123

INTERIOR PAINTING

PART 1 - GENERAL

1.01 SUMMARY

A. Section includes surface preparation and the application of paint systems on interior substrates.

1.02 RELATED REQUIREMENTS:

A. Section 051200 "Structural Steel Framing" for shop priming of metal substrates with primers specified in this Section.

B. Section 099300 "Staining and Transparent Finishing" for surface preparation and the application of wood stains and transparent finishes on interior wood substrates.

1.03 DEFINITIONS

A. Gloss Level 1: Not more than 5 units at 60 degrees and 1 to 2 units at 85 degrees.

B. Gloss Level 2: 5 to 9 units at 60 degrees and 10 to 15 units at 85 degrees.

C. Gloss Level 3: 10 to 15 units at 60 degrees and 15 to 30 units at 85 degrees.

D. Gloss Level 4: 20 to 35 units at 60 degrees and 35 to 50 units at 85 degrees.

E. Gloss Level 5: 40 to 50 units at 60 degrees.

F. Gloss Level 6: 70 to 80 units at 60 degrees.

G. Gloss Level 7: More than 80 units at 60 degrees.

H. Blocking: Two painted surfaces sticking together such as a painted door sticking to a painted jamb.

I. Bio-Pruf: Biostabilizing additive, to protect products from premature microbial degradation.

J. CHPS: Collaborative for High Performance Schools. A national movement to improve student performance and the entire educational experience by building the best possible schools. www.chps.net.

K. EG: Ethylene Glycol. Ethylene glycol is listed as a hazardous air pollutant (HAP) by the U.S. EPA.

L. EPR: Environmental Performance Rating. Master Painters Institute (MPI) formula that relates to VOC, Performance of Category, Gloss and Appropriate specified use. Higher values equate to greater eco-efficiency.

M. MPI: Master Painters Institute. Organization that establishes architectural paint standards and quality assurance programs in North America. www.paintinfo.com.

N. PDCA: Painting & Decorating Contractors of America. www.pdca.org.

O. RAVOC: Reactivity adjusted VOC. "Reactivity" means the ability of a VOC to promote ozone formation

P. SSPC: The Society for Protective Coatings publishes Scopes of SSPC Surface Preparation Standards and Specifications. www.sspc.org.

1.04 ACTION SUBMITTALS

A. Product Data: For each type of product. Include preparation requirements and application instructions.

1.05 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials, from the same product run, that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Paint: 5 percent, but not less than 1 gal. of each material and colorapplied.

1.06 QUALITY ASSURANCE

A. Mockups: Apply mockups of each paint system indicated and each color and finish selected to verify preliminary selections made under Sample submittals and to demonstrate aesthetic effects and set quality standards for materials and execution.

1. Architect will select one surface to represent surfaces and conditions for application of each paint system specified in Part 3.

a. Vertical and Horizontal Surfaces: Provide samples of at least 100 sq. ft. (9 sq. m).

b. Other Items: Architect will designate items or areas required.

2. Final approval of color selections will be based on mockups.

a. If preliminary color selections are not approved, apply additional mockups of additional colors selected by Architect at no added cost to Owner.

3. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.

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

1.07 DELIVERY, STORAGE, AND HANDLING

A. Store materials not in use in tightly covered containers in well-ventilated areas with ambient temperatures continuously maintained at not less than 45 deg F (7 deg C).

1. Maintain containers in clean condition, free of foreign materials and residue.

2. Remove rags and waste from storage areas daily.

1.08 FIELD CONDITIONS

A. Apply paints only when temperature of surfaces to be painted and ambient air temperatures are between 50 and 105 deg F (10 and 41 deg C).

B. Do not apply paints when relative humidity exceeds 85 percent; at temperatures less than 5 deg F (3 deg C) above the dew point; or to damp or wet surfaces.

C. Painting contractor should follow proper painting practices and exercise judgment based on his or her experience and project specific conditions as to when to proceed.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

A. Basis-of-Design Product: Subject to compliance with requirements, provide products listed from Dunn-Edwards Corp. for the paint category indicated, or comparable products by one of the following:

1. Pratt & Lambert.

2.02 PAINT, GENERAL

A. Material Compatibility:

1. Provide materials for use within each paint system that are compatible with one another and substrates indicated, under conditions of service and application as demonstrated by manufacturer, based on testing and field experience.

2. For each coat in a paint system, provide products recommended in writing by manufacturers of topcoat for use in paint system and on substrate indicated.

B. VOC Content: Products shall comply with VOC limits of authorities having jurisdiction and, for interior paints and coatings applied at Project site, the following VOC limits, exclusive of colorants added to a tint base, when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

1. Flat Paints and Coatings: 0 g/L.

2. Nonflat Paints and Coatings: 0 g/L.

3. Dry-Fog Coatings: 0 g/L.

4. Primers, Sealers, and Undercoaters: 0 g/L.

5. Anticorrosive and Antirust Paints Applied to Ferrous Metals:0 g/L.

6. Zinc-Rich Industrial Maintenance Primers: 0 g/L.

7. Pretreatment Wash Primers: 0 g/L.

8. Floor Coatings: 0 g/L.

9. Shellacs, Clear: 0g/L.

10. Shellacs, Pigmented:0 g/L.

C. Low-Emitting Materials: Interior paints and coatings shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

D. Colorants: The use of colorants containing hazardous chemicals, such as ethylene glycol, is prohibited & Zero VOC colorants should be used whenever possible.

E. Colors: As selected by Architect from manufacturer's full range, Match Architect's samples, As indicated in a color schedule.

1. Indicate a percentage of surface area which will be painted with deep tones.

2.03 SOURCE QUALITY CONTROL

A. Testing of Paint Materials: Owner reserves the right to invoke the following procedure:

1. Owner may engage the services of a qualified testing agency to sample paint materials. Contractor will be notified in advance and may be present when samples are taken. If paint materials have already been delivered to Project site, samples may be taken at Project site. Samples will be identified, sealed, and certified by testing agency.

2. Testing agency will perform tests for compliance with product requirements.

3. Owner may direct Contractor to stop applying coatings if test results show materials being used do not comply with product requirements. Contractor shall remove noncomplying paint materials from Project site, pay for testing, and repaint surfaces painted with rejected materials. Contractor will comply with requirements to use compatible products and systems as described in Article

2.2. Contractor will be required to remove rejected materials from previously painted surfaces if, on repainting with complying materials, the two paints are incompatible.

PART 3 - EXECUTION

3.01 EXAMINATION

A. Examine substrates and conditions, with Applicator present, for compliance with requirements for maximum moisture content and other conditions affecting performance of the Work.

B. Maximum Moisture Content of Substrates: When measured with an electronic moisture meter as follows:

1. Concrete: 12 percent.
2. Masonry (Clay and CMU): 12 percent.
3. Wood: 15 percent.
4. Gypsum Board: 12 percent.
5. Plaster: 12 percent.

C. Gypsum Board Substrates: Verify that finishing compound is sanded smooth.

D. Plaster Substrates: Verify that plaster is fully cured, including pH testing to determine that alkalinity is within limits established by the manufacturer.

E. Spray-Textured Ceiling Substrates: Verify that surfaces are dry.

F. Verify suitability of substrates, including surface conditions and compatibility with existing finishes and primers.

G. Proceed with coating application only after unsatisfactory conditions have been corrected.

H. Application of coating indicates acceptance of surfaces and conditions.

3.02 PREPARATION

A. Comply with manufacturer's written instructions and recommendations in "MPI Manual" applicable to substrates indicated.

B. Remove hardware, covers, plates, and similar items already in place that are removable and are not to be painted. If removal is impractical or impossible because of size or weight of item, provide surface-applied protection before surface preparation and painting.

1. After completing painting operations, use workers skilled in the trades involved to reinstall items that were removed. Remove surface-applied protection if any.

C. Clean substrates of substances that could impair bond of paints, including dust, dirt, oil, grease, and incompatible paints and encapsulants.

1. Remove incompatible primers and reprime substrate with compatible primers or apply tie coat as required to produce paint systems indicated.

D. Concrete Substrates: Remove release agents, curing compounds, efflorescence, and chalk. Do not paint surfaces if moisture content or alkalinity of surfaces to be painted exceeds that permitted in manufacturer's written instructions, including pH testing to determine that alkalinity is within limits established by the manufacturer.

E. Masonry Substrates: Remove efflorescence and chalk. Do not paint surfaces if moisture content or alkalinity of surfaces or mortar joints exceed that permitted in manufacturer's written instructions.

F. Steel Substrates: Remove rust, loose mill scale, and shop primer, if any. Clean using methods recommended in writing by paint manufacturer[.] [but not less than the following:]

1. SSPC-SP 1, "Solvent Cleaning."
2. SSPC-SP 2, "Hand Tool Cleaning."
3. SSPC-SP 3, "Power Tool Cleaning."
4. SSPC-SP 7/NACE No. 4, "Brush-off Blast Cleaning."
5. SSPC-SP 11, "Power Tool Cleaning to Bare Metal."

G. Shop-Primed Steel Substrates: Clean field welds, bolted connections, and abraded areas of shop paint, and paint exposed areas with the same material as used for shop priming to comply with SSPC-PA 1 for touching up shop-primed surfaces.

H. Galvanized-Metal Substrates: Remove grease and oil residue from galvanized sheet metal fabricated from coil stock to produce clean, lightly etched surfaces that promote adhesion of subsequently applied paints.

I. Wood Substrates:

1. Scrape and clean knots, and apply coat of knot sealer before applying primer.
2. Sand surfaces that will be exposed to view, and dust off.
3. Prime edges, ends, faces, undersides, and backsides of wood.
4. After priming, fill holes and imperfections in the finish surfaces with putty or plastic wood filler. Sand smooth when dried.

3.03 APPLICATION

A. Apply paints according to manufacturer's written instructions and to recommendations in "MPI Manual."

1. Use applicators and techniques suited for paint and substrate indicated.
2. Paint surfaces behind movable equipment and furniture same as similar exposed surfaces. Before final installation, paint surfaces behind permanently fixed equipment or furniture with prime coat only.
3. Paint front and backsides of access panels, removable or hinged covers, and similar hinged items to match exposed surfaces.
4. Do not paint over labels of independent testing agencies or equipment name, identification, performance rating, or nomenclature plates.
5. Primers specified in painting schedules may be omitted on items that are factory primed or factory finished if acceptable to topcoat manufacturers.

B. Tint each undercoat a lighter shade to facilitate identification of each coat if multiple coats of same material are to be applied. Tint undercoats to match color of topcoat, but provide sufficient difference in shade of undercoats to distinguish each separate coat.

C. If undercoats or other conditions show through topcoat, apply additional coats until cured film has a uniform paint finish, color, and appearance.

D. Apply paints to produce surface films without cloudiness, spotting, holidays, laps, brush marks, roller tracking, runs, sags, ropiness, or other surface imperfections. Cut in sharp lines and color breaks.

E. Block Fillers: Provide block fill as scheduled to conform to the following PDCA Standard P12- 05:

1. Level 3 - Premium Fill: One or multiple coats of high performance block filler manufactured to be applied at a high dry film build. Block filler shall be back-rolled to eliminate voids and reduce the majority of the masonry profile depth.

F. Painting Fire Suppression, Plumbing, HVAC, Electrical, Communication, and Electronic Safety and Security Work:

1. Paint the following work where exposed in equipment rooms:

a. Equipment, including panelboards[and switch gear].

b. Uninsulated metal piping.

c. Uninsulated plastic piping.

d. Pipe hangers and supports.

e. Metal conduit.

f. Plastic conduit.

g. Tanks that do not have factory-applied final finishes.

h. Duct, equipment, and pipe insulation having cotton or canvas insulation covering or other paintable jacket material.

2. Paint the following work where exposed in occupied spaces:

a. Equipment, including panelboards.

b. Uninsulated metal piping.

c. Uninsulated plastic piping.

d. Pipe hangers and supports.

e. Metal conduit.

f. Plastic conduit.

g. Duct, equipment, and pipe insulation having cotton or canvas insulation covering or other paintable jacket material.

h. Other items as directed by Architect.

3. Paint portions of internal surfaces of metal ducts, without liner, behind air inlets and outlets that are visible from occupied spaces.

3.04 FIELD QUALITY CONTROL

A. Dry Film Thickness Testing: Owner may engage the services of a qualified testing and inspecting agency to inspect and test paint for dry film thickness.

1. Contractor shall touch up and restore painted surfaces damaged by testing.

2. If test results show that dry film thickness of applied paint does not comply with paint manufacturer's written recommendations, Contractor shall pay for testing and apply additional coats as needed to provide dry film thickness that complies with paint manufacturer's written recommendations.

3.05 CLEANING AND PROTECTION

A. At end of each workday, remove rubbish, empty cans, rags, and other discarded materials from Project site.

B. After completing paint application, clean spattered surfaces. Remove spattered paints by washing, scraping, or other methods. Do not scratch or damage adjacent finished surfaces.

C. Protect work of other trades against damage from paint application. Correct damage to work of other trades by cleaning, repairing, replacing, and refinishing, as approved by Architect, and leave in an undamaged condition.

D. At completion of construction activities of other trades, touch up and restore damaged or defaced painted surfaces.

END OF SECTION 09 9123

SECTION 09 9723

CONCRETE SEALERS

PART 1 GENERAL

1.1 SUMMARY

A. This Section specifies an applied sealer for horizontal cast-in-place concrete surfaces.

B. Related Sections: Refer to the following specification sections for coordination.

1. Section 033000 - Cast-In-Place Concrete.

1.2 SUBMITTALS

A. Product Data: Submit manufacturer's product data and installation instructions.

B Mock-Up: Prepare a test area minimum 2 by 2 feet in size to verify suitability of the sealer and final appearance.

1.3 QUALITY ASSURANCE

A. Manufacturer: Minimum 10 years experience producing concrete coatings.

B. Installer: Licensed installers experienced and trained in the use of specified products.

C. Suitability of Substrate: Concrete surface must be clean and dry with all stains, oil, grease, dust and dirt removed prior to application. A thorough pressure washing is highly recommended.

D. Regulatory Requirements: Comply with requirements of authorities having jurisdiction and applicable codes at the location of the project.

1.4 DELIVERY, STORAGE AND HANDLING

A. Deliver materials and products in unopened factory labeled packages. Protect from damage.

B. Store in a safe place, out of direct sunlight. Keep containers tightly sealed. Do not allow product to freeze. Use within manufacturer’s recommended shelf life, approximately 12 months.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Concrete Sealer: High-performance, non-yellowing, clear acrylic-based sealer

1. Sealer with Gloss Finish with max.200 g/L VOC.

2. . Performance: Concrete sealers shall meet or exceed the following:

a. Coverage: As recommended by manufacturer.

b. Moisture Retention, Test ASTM C 309: 0.21 kg/m² at 200 ft² per gallon and 0.32 kg/m² at 300 ft² per gallon.

c. Gasoline Resistance: Slight dulling after15-minute exposure (ponding).

d. Tg: 50°C.

e. Tukon Hardness: 30 minutes at 180°F, 9.3; 30 minutes at 300°F, 13.7.

f. Pencil Hardness: 30 minutes at 180°F, F; 30 minutes at 300°F, H.

g. Spray Conditions, Viscosity: 19 seconds, No. 2 Zhan cup.

h. Abrasion Resistance: 160 mg lost, CS-17 wheel, 1000 g load, 1000 cycles

PART 3 - EXECUTION

3.1 PREPARATION

A. Inspection: Prior to start of application, inspect existing conditions to ensure surfaces are suitable for installation including the following:

1. Concrete has cured for a minimum of 28 days prior to application of sealer.
2. Surface is completely free of sealers, oils, dirt, paint, alkali, penetrating sealers and foreign materials that would prevent the sealer from penetrating the concrete surface.
3. Concrete has been swept clean.
4. Test area has been approved.

3.2 APPLICATION

A. Concrete Sealer: Strictly comply with manufacturer's installation recommendations including the following.

1. Apply after stain has dried at rate recommended by manufacturer.
2. Clean surface as recommended by manufacturer.
3. All concrete flatwork designated as being sealed in the plans and specifications shall be sealed with 2-3 even coats of sealer, at the rate of approximately 150 to 200 square feet per gallon.

3.3 CLEANING AND PROTECTION

A. Protection: Do not cover, but protect floor area from paint and other contaminates that could inhibit the sealer.

END OF SECTION 09 9723

SECTION 10 1400

SIGNAGE

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Interior directional and informational signs.

B. Emergency evacuation maps.

C. Building identification signs.

D. Plaque.

E. Traffic signs.

1.02 REFERENCE STANDARDS

A. 36 CFR 1191 - Americans with Disabilities Act (ADA) Accessibility Guidelines for Buildings and Facilities; Architectural Barriers Act (ABA) Accessibility Guidelines; current edition.

B. ADA Standards - Americans with Disabilities Act (ADA) Standards for Accessible Design; 2010.

C. ICC A117.1 - Accessible and Usable Buildings and Facilities; 2017.

1.03 SUBMITTALS

A. See Section 01 3000 - Administrative Requirements, for submittal procedures.

B. Product Data: Manufacturer's printed product literature for each type of sign, indicating sign styles, font, foreground and background colors, locations, overall dimensions of each sign.

C. Signage Schedule: Provide information sufficient to completely define each sign for fabrication, including room number, room name, other text to be applied, sign and letter sizes, fonts, and colors.

1. When room numbers to appear on signs differ from those on drawings, include the drawing room number on schedule.

2. When content of signs is indicated to be determined later, request such information from Owner through Architect at least 2 months prior to start of fabrication; upon request, submit preliminary schedule.

3. Submit for approval by Owner through Architect prior to fabrication.

D. Samples: Submit two samples of each type of sign, of size similar to that required for project, illustrating sign style, font, and method of attachment.

E. Selection Samples: Where colors are not specified, submit two sets of color selection charts or chips.

1.04 DELIVERY, STORAGE, AND HANDLING

A. Package signs as required to prevent damage before installation.

B. Package room and door signs in sequential order of installation, labeled by floor or building.

C. Store tape adhesive at normal room temperature.

1.05 FIELD CONDITIONS

A. Do not install tape adhesive when ambient temperature is lower than recommended by manufacturer.

B. Maintain this minimum temperature during and after installation of signs.

PART 2 PRODUCTS

2.01 SIGNAGE APPLICATIONS

A. Accessibility Compliance: Signs are required to comply with ADA Standards and ICC A117.1

_____, unless otherwise indicated; in the event of conflicting requirements, comply with the most comprehensive and specific requirements.

B. Room and Door Signs: Provide a sign for every doorway, whether it has a door or not,not including corridors, lobbies, and similar open areas.

1. Sign Type: Flat signs with engraved panel media as specified.
2. Provide "tactile" signage, with letters raised minimum 1/32 inch and Grade II braille.
3. Character Height: 1 inch.
4. Sign Height: 2 inches, unless otherwise indicated.
5. Office Doors: Identify with room numbers to be determined later, not the numbers indicated on drawings; in addition, provide "window" section for replaceable occupant name.
6. Conference and Meeting Rooms: Identify with room numbers to be determined later, not the numbers indicated on drawings;
7. Service Rooms: Identify with room names and numbers to be determined later, not those indicated on drawings.
8. Rest Rooms: Identify with pictograms, the names "MEN" and "WOMEN", room numbers to be determined later, and braille.

C. Interior Directional and Informational Signs:

1. Sign Type: Same as room and door signs.

D. Assembly Signage:

1. Map content to be provided by Owner.
2. Use clear plastic panel silk-screened on reverse, in brushed aluminum frame, screw-mounted.

E. Building Identification Signs:

1. Use individual metal letters.
2. Mount on outside wall in location indicated on drawings.

F. Plaque:

1. 12x16 Steel plaque, exterior grade.

2.02 SIGN TYPES

A. Flat Signs: Signage media without frame.

1. Edges: Square.
2. Corners: Square.
3. Wall Mounting of One-Sided Signs: Tape adhesive.

B. Color and Font: Unless otherwise indicated:

1. Character Font: Helvetica, Arial, or other sans serif font.
2. Character Case: Upper case only.
3. Background Color: Clear.
4. Character Color: Contrasting color.

2.03 TACTILE SIGNAGE MEDIA

A. Engraved Panels: Laminated colored plastic; engraved through face to expose core as background color:

1. Total Thickness: 1/16 inch.

2.04 NON-TACTILE SIGNAGE MEDIA

A. Silk Screened Plastic Panels: Letters and graphics silk screened onto reverse side of plastic surface:

1. Sign Color: Clear.
2. Total Thickness: 1/8 inch.

2.05 PLAQUES

2.06 DIMENSIONAL LETTERS

A. Metal Letters:

1. Metal: Aluminum casting.
2. Finish: As selected by Architect.
3. Mounting: appropriate adhesive or fasteners

2.07 ACCESSORIES

A. Concealed Screws: Stainless steel, galvanized steel, chrome plated, or other non-corroding metal.

B. Tape Adhesive: Double sided tape, permanent adhesive.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that substrate surfaces are ready to receive work.

3.02 INSTALLATION

A. Install in accordance with manufacturer's instructions.

B. Install neatly, with horizontal edges level.

C. Locate signs and mount at heights indicated on drawings and in accordance with ADA Standards and ICC A117.1.

D. Protect from damage until Substantial Completion; repair or replace damaged items.

END OF SECTION 10 1400

SECTION 10 2113.13

METAL TOILET COMPARTMENTS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Metal toilet compartments.

B. Urinal screens.

1.02 REFERENCE STANDARDS

A. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process; 2017.

B. ASTM A666 - Standard Specification for Annealed or Cold-Worked Austenitic Stainless Steel Sheet, Strip, Plate, and Flat Bar; 2015.

1.03 ADMINISTRATIVE REQUIREMENTS

A. Coordination: Coordinate the work with placement of support framing and anchors in walls and ceilings.

1.04 SUBMITTALS

A. See Section 01 3000 - Administrative Requirements, for submittal procedures.

B. Shop Drawings: Indicate partition plan, elevation views, dimensions, details of wall, floor, and ceiling supports, door swings.

C. Product Data: Provide data on panel construction, hardware, and accessories.

PART 2 PRODUCTS

2.01 MATERIALS

A. Steel Sheet: Hot-dipped galvanized steel sheet, ASTM A653/A653M, with G90/Z275coating.

2.02 COMPONENTS

A. Toilet Compartments: Powder coated steel, floor-mounted headrail-braced.

B. Doors, Panels, and Pilasters: Sheet steel faces, pressure bonded to sound deadening core, formed and closed edges; corners made with corner clips or mitered, welded, and ground smooth.

1. Panel Faces: 22 gage, 0.0299 inch.

2. Door Faces: 22 gage, 0.0299 inch.

3. Pilaster Faces: 18 gage, 0.0478 inch.

4. Internal Reinforcement: Provide in areas of attached hardware and fittings. Mark locations of reinforcement for partition mounted washroom accessories.

C. Door and Panel Dimensions:

1. Thickness: 1 inch.

2. Door Width: 24 inch.

3. Door Width for Handicapped Use: 36 inch, out-swinging.

4. Height: 58 inch.

D. Pilasters: 1-1/4 inch thick, of sizes required to suit compartment width and spacing.

E. Urinal Screens: Wall mounted with two panel brackets, and floor-to-ceiling vertical upright consisting of pilaster anchored to floor and ceiling.

2.03 ACCESSORIES

A. Pilaster Shoes: Formed ASTM A666, Type 304 stainless steel with No. 4 finish, 3 inch high, concealing floor fastenings.

1. Provide ceiling attachment using two adjustable hanging studs, attached to above-ceiling framing.

B. Brackets: Polished stainless steel.

C. Attachments, Screws, and Bolts: Stainless steel, tamper proof type.

D. Hardware: Polished chrome plated non-ferrous cast metal:

1. Pivot hinges, gravity type, adjustable for door close positioning; two per door.

2. Thumb turn or sliding door latch with exterior emergency access feature.

3. Door strike and keeper with rubber bumper; mounted on pilaster in alignment with door latch.

4. Coat hook with rubber bumper; one per compartment, mounted on door.

5. Provide door pull for outswinging doors.

2.04 FINISHING

A. Powder Coated Steel Compartments: Clean, degrease, and neutralize. Follow immediately with a phosphatizing treatment, prime coat and two finish coats powder coat enamel.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify existing conditions before starting work.

B. Verify that field measurements are as indicated.

C. Verify correct spacing of and between plumbing fixtures.

D. Verify correct location of built-in framing, anchorage, and bracing.

3.02 INSTALLATION

A. Install partitions secure, rigid, plumb, and level in accordance with manufacturer's instructions.

B. Maintain 3/8 to 1/2 inch space between wall and panels and between wall and end pilasters.

C. Attach panel brackets securely to walls using anchor devices.

D. Attach panels and pilasters to brackets. Locate head rail joints at pilaster center lines.

3.03 ADJUSTING

A. Adjust and align hardware to uniform clearance at vertical edge of doors, not exceeding 3/16 inch.

B. Adjust hinges to position doors in partial opening position when unlatched. Return out swinging doors to closed position.

C. Adjust adjacent components for consistency of line or plane.

END OF SECTION 10 2113.13

SECTION 10 2800

TOILET, BATH, AND LAUNDRY ACCESSORIES

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Commercial toilet accessories.

B. Commercial shower and bath accessories.

C. Under-lavatory pipe supply covers.

D. Diaper changing stations.

E. Utility room accessories.

1.02 RELATED REQUIREMENTS

A. Section 10 2113.13 - Metal Toilet Compartments.

B. Section 22 4000 - Plumbing Fixtures: Under-lavatory pipe and supply covers.

1.03 REFERENCE STANDARDS

A. ADA Standards - Americans with Disabilities Act (ADA) Standards for Accessible Design; 2010.

B. ASTM C1036 - Standard Specification for Flat Glass; 2016.

C. ASTM C1048 - Standard Specification for Heat-Strengthened and Fully Tempered Flat Glass; 2012.

D. ASTM F2285 - Standard Consumer Safety Performance Specification for Diaper Changing Tables for Commercial Use; 2004, with Editorial Revision (2016).

1.04 ADMINISTRATIVE REQUIREMENTS

A. Coordinate the work with the placement of internal wall reinforcement, concealed ceiling supports, and reinforcement of toilet partitions to receive anchor attachments.

1.05 SUBMITTALS

A. See Section 01 3000 - Administrative Requirements, for submittal procedures.

B. Product Data: Submit data on accessories describing size, finish, details of function, and attachment methods.

C. Manufacturer's Installation Instructions: Indicate special procedures and conditions requiring special attention.

PART 2 PRODUCTS

2.01 MANUFACTURERS - BASIS OF DESIGN

A. Commercial Toilet, Shower, and Bath Accessories:

1. Bobrick Washroom Equipment, Inc.; http://www.bobrick.com.

2. Substitutions: Section 01 6000 - Product Requirements.

B. Under-Lavatory Pipe Supply Covers:

1. Plumberex Specialty Products, Inc: www.plumberex.com/#sle.

2. Substitutions: Section 01 6000 - Product Requirements.

C. Diaper Changing Stations:

1. Koala Kare Products: www.koalabear.com.

2. Substitutions: 01 6000 - Product Requirements.

D. Provide products of each category type by single manufacturer.

2.02 MATERIALS

A. Accessories - General: Shop assembled, free of dents and scratches and packaged complete with anchors and fittings, steel anchor plates, adapters, and anchor components for installation.

1. Grind welded joints smooth.

2. Fabricate units made of metal sheet of seamless sheets, with flat surfaces.

B. Keys: Provide two keys for each accessory to Owner; master key lockable accessories.

C. Mirror Glass: Tempered safety glass, ASTM C1048; and ASTM C1036 Type I, Class 1, Quality Q2, with silvering as required.

D. Adhesive: Two component epoxy type, waterproof.

E. Fasteners, Screws, and Bolts: Hot dip galvanized; tamper-proof; security type.

F. Expansion Shields: Fiber, lead, or rubber as recommended by accessory manufacturer for component and substrate.

2.03 FINISHES

A. Stainless Steel: Satin finish, unless otherwise noted.

2.04 COMMERCIAL TOILET ACCESSORIES

A. Toilet Paper Dispenser: Single roll with storage space for extra roll, , stainless steel unit with theft resistant spindle.

1. Products:

a. Bobrick B-4388.

B. Paper Towel Dispenser: Folded paper type, stainless steel

1. Capacity: 300 C-fold minimum.

2. Products:

a. Bobrick B-35903.

C. Waste Receptacle: Recessed, stainless steel, seamless lower door for access to container, with tumbler lock, reinforced panel full height of door, push-in self-closing top door, continuously welded bottom pan and seamless exposed flanges.

1. Liner: Removable seamless stainless steel receptacle.

2. Minimum capacity: 12 gallons.

3. Products:

a. Bobrick B-3644 (confirm selection with Architect before ordering)..

4. Soap Dispenser: Liquid soap dispenser, wall-mounted, surface, with stainless steel Products:

a. Bobrick B-2111.

D. Mirrors: Stainless steel framed, 1/4 inch thick annealed float glass; ASTM C1036.

1. Sizes: As shown on drawings.

2. Frame: 0.05 inch channel shapes, with mitered and welded and ground corners, and tamperproof hanging system; satin finish.

3. Backing: Full-mirror sized, minimum 0.03 inch galvanized steel sheet and nonabsorptive filler material.

4. Products:

a. Bobrick B-290 2436

E. Seat Cover Dispenser: Stainless steel, surface-mounted, reloading by concealed opening at base, tumbler lock.

1. Minimum capacity: 500 seat covers.

2. Products:

a. Bobrick B-301.

F. Grab Bars: Stainless steel, smooth surface.

1. Standard Duty Grab Bars:

a. Push/Pull Point Load: 250 pound-force, minimum.

b. Dimensions: 1-1/4 inch outside diameter, minimum 0.05 inch wall thickness, exposed flange mounting, 1-1/2 inch clearance between wall and inside of grabbar.

c. Finish: Satin.

d. Length and Configuration: As indicated on drawings.

e. Products:

1) Bobrick B-6806 series

2.05 COMMERCIAL SHOWER AND BATH ACCESSORIES

A. Shower Curtain Rod: Stainless steel tube, 1 inch outside diameter, 0.04 inch wall thickness, satin-finished, with 3 inch outside diameter, minimum 0.04 inch thick satin-finished stainless steel flanges, for installation with exposed fasteners.

B. Shower Curtain:

1. Product: Bobrick matching shower size.

C. Wall-Mounted Soap Dish: Heavy duty, seamless stainless steel, surface-mounted with drain holes, without grab bar, satin finish; with concealed mechanical fastening suitable for substrate and backplate.

D. Robe Hook: Heavy-duty stainless steel, single-prong, rectangular-shaped bracket and backplate for concealed attachment, satin finish.

2.06 UNDER-LAVATORY PIPE AND SUPPLY COVERS

A. Under-Lavatory Pipe and Supply Covers:

1. Insulate exposed drainage piping including hot, cold, and tempered water supplies under lavatories or sinks to comply with ADA Standards.

2. Exterior Surfaces: Smooth non-absorbent, non-abrasive surfaces.

3. Color: White.

4. Products:

a. Plumberex Specialty Products, Inc; Plumberex Handy-Shield Maxx: www.plumberex.com/#sle.

2.07 DIAPER CHANGING STATIONS

A. Diaper Changing Station: Recess-mounted folding diaper changing station for use in commercial toilet facilities, meeting or exceeding ASTM F2285.

1. Material: Polyethethlene with stainless steel finish flange..

2. Mounting: Recessed.

3. Color: As selected.

4. Products:

    a. KoalaCare Model KB200-01SS

    b. Substitutions: 01 6000 - Product Requirements.

2.08 UTILITY ROOM ACCESSORIES

A. Combination Utility Shelf/Mop and Broom Holder: 0.05 inch thick stainless steel, Type 304, with 1/2 inch returned edges, 0.06 inch steel wall brackets.

1. Hooks: Two, 0.06 inch stainless steel rag hooks at shelf front.

2. Mop/broom holders: Three spring-loaded rubber cam holders at shelf front.

3. Length: 36 inches.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify existing conditions before starting work.

B. Verify exact location of accessories for installation.

C. See Section 06 1000 for installation of blocking, reinforcing plates, and concealed anchors in walls and ceilings.

3.02 PREPARATION

A. Deliver inserts and rough-in frames to site for timely installation.

B. Provide templates and rough-in measurements as required.

3.03 INSTALLATION

A. Install accessories in accordance with manufacturers' instructions in locations indicated on the drawings.

B. Install plumb and level, securely and rigidly anchored to substrate.

C. Mounting Heights: As required by accessibility regulations, unless otherwise indicated.

1. All Accessories: As indicated on drawings.

3.04 PROTECTION

A. Protect installed accessories from damage due to subsequent construction operations.

END OF SECTION 10 2800

SECTION 10 4400

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 09 2216: Placement of rough-in frame for cabinets.

1.03 REFERENCE STANDARDS

A. ASTM E814 - Standard Test Method for Fire Tests of Penetration Firestop Systems; 2013a (Reapproved 2017).

B. NFPA 10 - Standard for Portable Fire Extinguishers; 2017.

1.04 SUBMITTALS

A. See Section 01 3000 - Administrative Requirements, for submittal procedures.

B. Product Data: Provide extinguisher operational features.

C. Manufacturer's Certificate: Certify that products meet or exceed specified requirements.

D. Maintenance Data: Include test, refill or recharge schedules and re-certification requirements.

1.05 FIELD CONDITIONS

A. Do not install extinguishers when ambient temperature may cause freezing of extinguisher ingredients.

PART 2 PRODUCTS

2.01 FIRE EXTINGUISHERS

A. Fire Extinguishers - General: Comply with product requirements of NFPA 10 and applicable codes, whichever is more stringent.

2.02 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: Recessed type.

1. Size to accommodate accessories.

2. Projected Trim: Returned to wall surface, with 1 inch projection, and 1 inch wideface.

3. Provide cabinet enclosure with right angle inside corners and seams, and with formed perimeter trim and door stiles.

E. Door: 0.036 inch metal thickness, reinforced for flatness and rigidity with nylon catch. Hinge doors for 180 degree opening with two butt hinge.

F. Door Glazing: Acrylic plastic, clear, 1/8 inch thick, flat shape and set in resilient channel glazing gasket.

G. Cabinet Mounting Hardware: Appropriate to cabinet, with pre-drilled holes for placement of anchors.

H. Weld, fill, and grind components smooth.

I. Finish of Cabinet Exterior Trim and Door: No. 4 - Brushed stainless steel.

J. Finish of Cabinet Interior: White colored enamel.

2.03 ACCESSORIES

A. Extinguisher Brackets: Formed steel, chrome-plated.

B. Cabinet Signage:_____.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify rough openings for cabinet are correctly sized andlocated.

3.02 INSTALLATION

A. Install in accordance with manufacturer's instructions.

B. Secure rigidly in place.

C. Place extinguishers in cabinets.

END OF SECTION 10 4400

SECTION 10 5113

METAL LOCKERS

PART 1 GENERAL

1.01 REFERENCE STARDARDS

A. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process; 2017.

1.02 SUBMITTALS

A. See Section 01 3000 - Administrative Requirements, for submittal procedures.

B. Product Data: Manufacturer's published data on locker construction, sizes and accessories.

C. Shop Drawings: Indicate locker plan layout, numbering plan.

1.03 DELIVERY, STORAGE, AND HANDLING

A. Protect locker finish and adjacent surfaces from damage.

PART 2 PRODUCTS

2.01 LOCKER APPLICATIONS

A. Metal lockers, wall mounted with matching closed base. B.

1. Width: 12 inches.
2. Depth: 15 inches.
3. Height: 72 inches.
4. Configuration: Two tier.
5. Fittings: Size and configuration as indicated on drawings.
    a. Hat shelf.
    b. Hooks: Two double prong.
6. Ventilation: Louvers at top and bottom of door panel.
7. Locking: Padlock hasps, for padlocks provided by Owner.
8. Locker Benches: Stationary type; bench top of laminated birch; painted steel pedestals.
    a. Accessibility: Comply with ICC A117.1 and ADA Standards.

2.02 METAL LOCKERS

A. Lockers: Factory assembled, made of formed sheet steel, ASTM A653/A653M SS Grade 33/230, with G60/Z180 coating, stretcher leveled; metal edges finished smooth without burrs; baked enamel finished inside and out.

1. Where ends or sides are exposed, provide flush panel closures.
2. Provide filler strips and inside corners where indicated, securely attached to lockers.
3. Color: To be selected by Architect.
4. Locker Body: Formed and flanged; with steel stiffener ribs; electric spot welded.
5. Body and Shelves: 24 gage, 0.0239 inch.
6. Base: 20 gage, 0.036 inch.
7. Metal Base Height: 4 inch.

B. Frames: Formed channel shape, welded and ground flush, welded to body, resilient gaskets and latching for quiet operation.

1. Door Frame: 16 gage, 0.0598 inch, minimum.

C. Doors: Hollow channel edge construction, 1-3/16 inch thick; welded construction, channel reinforced top and bottom with intermediate stiffener ribs, grind and finish edges smooth.

1. Door Outer Face: 18 gage, 0.0478 inch, minimum.
2. Form recess for operating handle and locking device.

D. Hinges: Continuous piano hinge with powder coat finish to match locker color.

E. Trim: 20 gage, 0.0359 inch.

F. Coat Hooks: Stainless steel or zinc-plated steel.

G. Number Plates: Provide oval shaped aluminum plates. Form numbers_____inch high of block font style with ADA designation, in contrasting color.

H. Locks: Locker manufacturer's standard type indicated above.

PART 3 EXECUTION

3.01 INSTALLATION

A. Install in accordance with manufacturer's instructions.

B. Install lockers plumb and square.

C. Secure lockers and benches with anchor devices to suit substrate materials. Minimum Pullout Force: 100 pounds.

D. Bolt adjoining locker units together to provide rigid installation.

E. Install end panels, filler panels, and miscellaneous panels.

F. Install fittings if not factory installed.

G. Replace components that do not operate smoothly.

3.02 CLEANING

A. Clean locker interiors and exterior surfaces.

END OF SECTION 10 5113

SECTION 10 7500

FLAGPOLES

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Aluminum Flagpoles.

1.02 RELATED REQUIREMENTS

A. Section 03 3000 - Cast-in-Place Concrete: Concrete base and foundation construction.

1.03 REFERENCE STANDARDS

A. AASHTO M 36 - Standard Specification for Corrugated Steel Pipe, Metallic-Coated, for Sewers and Drains; 2016.

B. ASTM B241/B241M - Standard Specification for Aluminum and Aluminum-Alloy Seamless Pipe and Seamless Extruded Tube; 2016.

C. NAAMM FP 1001 - Guide Specifications for Design Loads of Metal Flagpoles; 2007.

1.04 SUBMITTALS

A. See Section 01 3000 - Administrative Requirements, for submittal procedures.

B. Product Data: Provide data on pole, accessories, and configurations.

C. Shop Drawings: Indicate detailed dimensions, base details, anchor requirements, and imposed loads.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Flagpoles:

1. Basis of Design: American Flagpole; Vangard series: www.americanflagpole.com.
2. Substitutions: See Section 01 6000 - Product Requirements.

2.02 FLAGPOLES

A. Flagpoles: Designed in accordance with NAAMM FP 1001.

1. Material: Aluminum.
2. Design: Cone tapered.
3. Mounting: Ground mounted type.
4. Outside Butt Diameter: 7 inches.
5. Outside Tip Diameter: 3.5 inches.
6. Nominal Wall Thickness: 0.156 inches.
7. Nominal Height: 40 ft; measured from nominal ground elevation.

8. Halyard: Interior type.

B. Performance Requirements:

1. Wind Pressure Loading on Flagpole with Flag: Resistant without permanent deformation to 90 miles/hr wind speed, in accordance with NAAMM FP 1001; the factor of safety used is 2.5.

2.03 POLE MATERIALS

A. Aluminum: ASTM B241/B241M, 6063 alloy, T6 temper.

2.04 ACCESSORIES

A. Finial Ball: Aluminum, 6 inch diameter.

B. Truck Assembly: Cast aluminum; revolving, stainless steel ball bearings, non-fouling.

C. Halyard: 5/16 inch diameter polypropylene, braided, white.

2.05 OPERATORS

A. Hand Crank: Removable type.

2.06 MOUNTING COMPONENTS

A. Foundation Tube Sleeve: AASHTO M 36, corrugated 16 gage, 0.0598 inch steel, galvanized,

B. Pole Base Attachment: Flush; steel base with base cover.

2.07 FINISHING

A. Aluminum: Clear anodized.

B. Finial: Spun finish.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that concrete foundation is ready to receive work and dimensions are as indicated on shop drawings.

3.02 INSTALLATION

A. Install flagpole, base assembly, and fittings in accordance with manufacturer's instructions.

B. Install foundation plate and centering wedges for flagpoles base set in concrete base and fasten.

3.03 ADJUSTING

A. Adjust operating devices so that halyard and flag function smoothly.

END OF SECTION 10 7500

SECTION 10 82 00 –
LOUVERED ROOF TOP EQUIPMENT SCREENS

PART 1 GENERAL

1.1 SUMMARY

a. Section Includes:

1) Fixed, extruded-aluminum louvered roof top equipment screens

b. See Division 5 Section "Structural Metal Framing" for structural framing supporting louver sections.

1.2 PERFORMANCE REQUIREMENTS

A. Design: Design louvers, including comprehensive engineering analysis by a qualified engineer, using structural performance requirements and design criteria indicated.

B. Structural Performance: Louvers shall withstand the effects of gravity loads and the following loads and stresses within limits and under conditions indicated without permanent deformation of louver components, noise or metal fatigue caused by louver blade rattle or flutter, or permanent damage to fasteners and anchors.

1) Wind Loads: Determine loads based on a uniform pressure of 30 lb./sq. ft. (1435 Pa), acting inward or outward.

1.3 SUBMITTALS

A. Product Data: For each type of product indicated.Shop Drawings: For equipment screens and accessories. Include plans, elevations, sections, details, and attachments to other work. Show frame profiles and blade profiles, angles, and spacing.

B. Samples: For each type of metal finish required.

C. Submittal: For louvers indicated to comply with structural performance requirements and design criteria indicated.

PART 2 PRODUCTS

2.01 MATERIALS

A. Aluminum Extrusions: ASTM B 221M, Alloy 6063-T5.

B. Aluminum Sheet: ASTM B 209M, Alloy 3003 with temper as required for forming.

C. Fasteners: Use types and sizes to suit unit installation conditions.

1) For fastening aluminum, use aluminum or 300 series stainless-steel fasteners.

2.02 FABRICATION, GENERAL

A. Join concealed frame members to each other and to fixed louver blades with fillet welds concealed from view welds, threaded fasteners, or both, as standard with louver manufacturer unless otherwise indicated or size of louver assembly makes bolted connections between frame members necessary.

2.03 EXTRUDED-ALUMINUM ROOF TOP EQUIPMENT SCREEN

A. Horizontal Blade Louvered Roof Top Equipment Screen

1. Basis-of-Design Product: Architectural Louvers Co. (Harray, LLC); Model V4JS. Subject to compliance with requirements, provide the specified product or comparable product by one of the following:

a) Manufacturers of equivalent products submitted and approved in accordance with Section 01630 - Product Substitution Procedures.

2) Louver Blade Depth: 4 inches (100 mm)

3) Blade Profile: Plain blade without center baffle.

4) Framing Support Nominal Thickness: Not less than 0.125 inch (3.2 mm)

5) Louver Performance Requirements:

a) Free Area: Not less than 8.0 sq. ft. (0.74 sq. m) for 48-inch- (1220-mm-) wide by 48-inch- (1220-mm-) high louver assembly.

b) Horizontal Drag Coefficient: Not greater than 0.63 on a cross sectional profile, allowing for a 37% reduction in wind load imposed horizontally upon supporting structural framing.

2.04 ALUMINUM FINISHES

A. High-Performance Organic Finish: 3-coat fluoropolymer finish complying with AAMA 2605 and containing not less than 70 percent PVDF resin by weight in color coat. Prepare, pre-treat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.

6) Color and Gloss: As selected by Architect from manufacturer's full range.

PART 3 EXECUTION

3.01 INSTALLATION

a. Locate and place equipment screens level, plumb, and at indicated alignment with adjacent work.

b. Use concealed anchorages where possible. Provide brass or lead washers fitted to screws where required to protect metal surfaces and to make a weather-tight connection.

c. Provide perimeter reveals and openings of uniform width to allow for thermal expansion, as indicated.

d. Repair damaged finishes so no evidence remains of corrective work. Return items that cannot be refinished in the field to the factory and refinish entire unit or provide new units.

END OF SECTION 10 82 00

SECTION 11 40 00
FOODSERVICE EQUIPMENT

PART 1 - GENERAL

1.01 SECTION INCULDES

A. Foodservice Equipment.

1.02 Scope of Work:

A. Furnish all labor, materials and services necessary for the procurement and installation of the equipment included in this section.
B. Supervise and provide required instructions for work to be performed by other contractors in connection with requirements for all equipment included this section.
C. Specifications and drawings have been prepared to form the basis for coordination with the other trades on this Project, procurement, erection, start-up and adjustment of all equipment in this section. Plans and specifications are to be considered as mutually explanatory and work required by one, but not by the other, is to be performed as though required by both. Items required by one, but not by the other are to be provided as though required by both. Work to be accomplished as called for in specifications and shown on drawings, so that all items of equipment are completely functional for purpose for which they were designed. When/if there is any discrepancy between drawings and specifications, bidders should seek clarification of any discrepancies from the Consultant prior to bidding.
D. Should the drawings disagree between themselves or the specifications with the drawings, the better quality more stringent, and/or greater quantity of the work or materials to be completed without additional costs to the Owner.
E. Secure and pay fees for all permits and licenses as required by all authorities having jurisdiction. Give all notices and comply with all laws, ordinances, rules, regulations and contract requirements bearing on the work.

1.03 RELATED DIVISIONS / SECTIONS:

A. Refer to General Conditions, Supplementary Conditions, and applicable provisions of Division 1 for additional instructions.
B. Refer to Interior Design Divisions for applicable provisions and sections regarding décor finishes, applications, details, and special instructions relating to items specified in this Section. Applicable to Projects with items specified in this Section, with décor finishes and/or construction.
C. Refer to Mechanical/Plumbing Divisions for applicable provisions and sections regarding mechanical services, including, but not limited to exhaust ductwork and fans, floor sinks and floor drains, water gas and steam rough-ins, grease traps, steam traps, drain traps, atmospheric vents, valves, pipes and pipe fittings, ductwork, and other materials necessary to complete final connections to individual items as specified in this Section. Not work of this Section. Also includes:
    1. Piping and insulation for fryer oil systems.
    2. Piping for remote pulping systems.
    3. All exhaust hood or ventilator duct work and fans upstream from the connection position.
D. Refer to Electrical Divisions for applicable provisions and sections regarding electrical services, including, but not limited to, rough-ins, standard voltage and low-voltage wiring, conduit, drop-cords, ceiling-mounted cord reel assemblies, disconnects and other materials necessary to complete final connections to individual items as specified in this Section. Not work of this Section. Also includes:
    1. Installation of light fixtures furnished loose at cold storage rooms.
    2. Connection of cold storage room temperature alarm system to the building security system.
    3. Connection of hood fire suppression system to the building security system.

E. Work included in other Divisions - Provision of all wall, floor, and/or ceiling/roof openings, and sealing thereof, as necessary for installation of items included in this section. Not work of this Section. Also includes:
   1. Slab depressions reinforced concrete wearing bed and interior finished floor with coved base at prefabricated cold storage assemblies.
   2. Concrete or masonry platforms with finished top and coved base at perimeter, for raised setting of foodservice equipment: Divisions 03/09.
   3. Slab depressions to receive stainless-steel drain trench liner/grate assemblies provided under this Section.
   4. Wall backing to support all wall-mounted equipment.
   5. Conduit and piping sleeves for soda, beer/liquor, refrigeration, CO2 and drain lines through building ceilings and floors.

1.04 DEFINITIONS:

A. Furnish - Supply and deliver to Project Site, ready for unloading, unpacking, assembly, installation, and similar operations.

B. Install (set in place) - Operations at Project Site including actual unloading, unpacking, assembly, erecting, placing, anchoring, applying, finishing, curing, protecting, cleaning and similar operations; ready for final utility connections by other Divisions as appropriate.

C. Provide - Furnish and install complete, ready for intended use, including any necessary initial training.

D. Contractor - Refers to the Kitchen Equipment (Sub) Contractor in this Section. References to any other Contractor or Division will be specific; such as General Contractor, Plumbing (Sub) Contractor / Division, Electrical (Sub) Contractor / Division, Architect designated, etc.

1.05 LAWS, ORDINANCES, REGULATIONS AND STANDARDS:

A. Comply with the following in their current published form:
   1. Air Conditioning and Refrigeration Institute (A.R.I): applicable regulations and references of the latest edition of standards for remote refrigeration system(s), components and installation.
   2. American Gas Association (A.G.A.): standards for gas heated equipment and provide equipment with the A.G.A. seal. Automatic safety pilots to be provided on all equipment, where available. (Canadian Gas Association or alternate testing lab's seals accepted if acceptable to local code jurisdictions.)
   3. American National Standards Institute (A.N.S.I.): Z21-Series for gas-burning equipment. Provide labels indicating name of testing agency.
   4. American National Standards Institute (A.N.S.I.): B57.1 for compressed gas cylinder connections, and with applicable standards of the Compressed Gas Association for compressed gas piping.
   5. American National Standards Institute (A.N.S.I.): A40.4 and A40.6 for water connection air gaps and vacuum breakers.
   6. American Society of Heating, Refrigeration and Air Conditioning Engineers (A.S.H.R.A.E.): applicable regulations and references of the latest edition of standards for exhaust system planning including A.S.H.R.A.E. 90.1 Section 5,6,7, and remote refrigeration system(s), components and installation.
   7. American Society of Mechanical Engineers (A.S.M.E.): Boiler Code requirements for steam generating and steam heated equipment and provide A.S.M.E. inspection stamp and registration with National Board.
   8. American Society for Testing and Materials (A.S.T.M.): C1036 for flat glass.
   9. American Society for Testing and Materials (A.S.T.M.): C1048 for heat-treated fla glass - Kind HS, Kind FT coated and uncoated glass.

10. American Society for Testing and Materials (A.S.T.M.): F232-03 for pre-rinse spray units, and in compliance with Energy Policy Act of 2005 (EPAct).
11. American Welding Society (A.W.S.): D1.1 structural welding code.
12. Energy Policy Act of 2005 (EPAct 2005): water savings pre-rinse spray valves.
13. National Electric Code (N.E.C.): N.F.P.A. Volume 5 for electrical wiring and devices included with foodservice equipment, A.N.S.I. C2 and C73, and applicable N.E.M.A. and N.E.C.A. standards.
14. National Electrical Manufacturers Association (N.E.M.A.): LD3 for high-pressure decorative laminates.
15. National Fire Protection Association (N.F.P.A.): applicable sections for exhaust hoods, ventilators, duct and fan materials, hoods fire suppression systems, whee placement systems, construction and installation; in addition to local codes and standards.
16. National Sanitation Foundation (NSF): latest Standards and Revisions, and as accredited by ANSI, IAS, NELAC, ISO, OSHA and SCC. Provide NSF Seal of Approval on all standard manufactured items included in this Project and listed in any NSF Certified Food Equipment Products Category, and on all items of custom fabricated work included in this Project. (UL Sanitation approval and seal accepted if acceptable to local code jurisdictions.)
17. Sheet Metal and Air Conditioning Contractor's National Association (S.M.A.C.N.A.): latest edition of guidelines for seismic restraint of kitchen equipment, as applicable to project location. All seismic requirements shall be shown on all submittals. Submit requested information to the agencies and authorities having jurisdiction.
18. Underwriters Laboratories (U.L.): as applicable for electrical components and assemblies. Provide either U.L. labeled products or, where no labeling service is available, “recognized markings” to indicate listing in the U.L. “Recognized Component Index”. (Canadian Standards Association or alternate testing lab's seals accepted if acceptable to local code jurisdictions.)
19. UL 300 Standard: for wet chemical fire suppression systems for exhaust hoods/ventilators.
20. American with Disabilities Act (ADA): as applicable to this Project.
21. Refrigeration Service Engineers Society (R.S.E.S.): applicable regulations and references of the latest edition of standards for remote refrigeration system(s), components and installation.
22. All refrigerants used for any purpose is to comply with the 1995 and 2010 requirements of the Montreal Protocol Agreement, and subsequent revisions and amendments. No CFC or HCFC refrigerants will be permitted on this Project.
23. All refrigeration components installation, repairs, and/or associated work on any refrigeration system, is to be performed by a Certified Refrigeration Mechanic thoroughly familiar with this type commercial foodservice installation. ETL and other national and international recognized Testing and Listing Agency labels and certifications are acceptable in lieu of Listing Agencies indicated in these documents, if acceptable to the local code jurisdictions.
24. All applicable local codes, standards and regulations.
25. All special local codes, standard, and regulations; such as (examples only)
26. California Energy Commissions Regulations, Dade County requirements for walk-in cooler(s) and/or freezer(s).

B. The Contract Documents shall prevail whenever they require larger sizes or higher standards than are required by regulations.
C. The above regulations shall govern whenever the Contract Documents require something that is deemed to violate the above regulations.

D. No extra charge will be paid by Owner for furnishing items required by the regulations, but not specified and/or shown on the drawings.
E. Rulings and interpretations of the enforcing agencies shall be considered part of the regulations.

1.06 AS-BUILT/ RECORD DOCUMENTS:

A. Maintain one record set of Foodservice Equipment Plans with any related corrections, revisions, additions, deletions, changes, etc. noted during construction and installation. Provide an "as-built" set on a computer disk or electronically in PDF format.
B. Provide one (1) final set of Product Data Submittal Manual with any related corrections, revisions, additions, deletions, changes, etc. noted during construction and installation as a specifications' record set electronically in PDF format.
C. These documents are to be provided at the same time as the O & M Data Manuals. Submit the O & M Data Manuals electronically in PDF format.

1.07 SCHEDULE:

A. Time is of the essence and acceptance constitutes assurance that the Contractor can and will obtain materials, equipment and manpower, to permit installation of the items included in this Section, on schedule. Contractor is to coordinate their work with the progress schedule, as prepared and updated periodically by the General Contractor or Construction Manager.
B. Anticipated delays, not within the control of the Contractor, are to be noted in a written notification to the Architect, immediately upon the Contractor's realization that delays are imminent.
C. Failure of manufacturers to meet promised delivery dates will not grant relief to the Contractor for failure to meet schedules; unless the Contractor can establish, in writing, that orders were received by the manufacturer, with reasonable lead times.
D. Extra charges resulting from special handling or air shipment in-order-to meet the schedule will be paid by the Contractor, if insufficient time was allowed in placing factory orders.

1.08 WARRANTY:

A. Unless otherwise noted in Related Divisions / Sections 1.3.A, items furnished are to be fully guaranteed against defects in workmanship, materials, and functionality for one full year from the date of the first event to occur of the following: date of issue of Certificate of Occupancy (or the equivalent), start-up for intended use by the Owner/Operator, completion of installation of kitchen equipment contract package, or final acceptance of installation by Owner. Should a Temporary Certificate of Occupancy be issued for partial completion of work, the items furnished within that designated area are to be under warranty from the date of issue of that Certificate. Contractor or their service agent will make necessary repairs and replacements without charge to the Owner, and within a reasonable time.
B. Additional Refrigeration Warranty: in addition to the one-year warranty requirements as stated above, provide start-up and parts and labor for the first year, plus additional four-year extended warranty on compressors. Extended warranty is for provision of replacement compressor, determined to be defective by a certified refrigeration mechanic. However, verification of defective compressor, installation of replacement compressor, recharging and repairs of system will be the responsibility of the Owner. This includes all items with built-in or remote refrigeration system.
C. Periodic routine maintenance, servicing, adjustments, cleaning, etc., as required by the manufacturers included in this Project, are the responsibility of the Owner.

D. Any-and-all parts or requirements for manufacturer's warranties to be in effect, whether, or not noted in the itemized specifications, are to be provided or complied with by the Contractor. This is to include, but not be limited to, particular-parts, accessories, or installation; installation supervision, start-up, and/or follow-up inspections required by factory trained, Certified, and/or authorized personnel. Factory training, Certification, and/or authorization is to be in effect at the time of bidding, installation, start-up, and warranty period of this Project.
E. Unless otherwise noted in Related Divisions manufacturer's warranties which comply with the requirements of this Warranty Article 1.14, are to be provided in lieu of Contractor's own warranties, where available. Copies of the written warranties are to be included in the
    1) & M Manuals.

PART 2 - 2.1 EQUIPMENT:

A. Equipment Schedule:

EQUIPMENT SCHEDULE						
EQUIPMENT TYPE	QNTY	MANUFACTORER	MODEL #	Fuel	POWER	OPTIONS
Dishwashing Machine	1	Champion	DL2000	Elec.	115v/16/ 1ph	Low Temp with side table
Three Compartment Sink	1	Eagle Group	412-16-3-24L	-	None	-
Ice Machine	1	Koolair	KT-0420	Elec.	-	K-420 Bin
Convection Oven	1	Duke Manufactoring	E102-E	Elec.	3-ph	Casters
36" 6 Burner Range	1	Vulcan	SX36-6BN	Gas		1- (ELVSX36-NAT Elevation Kit, Natural Gas, elevation up to 8,000 feet, for SX36) 2- (OVNRACK-SX Oven Rack) 3- (CASTERS-RR4 Casters, 5" ; set of 4; 2 with locks)
Reach-In Freezer	1	Turbo Air	M3F72-3-N	Elec.	115v/60/1ph	1- (Caster Set, swivel, locking front wheels) 2- (Self-cleaning condenser device equipped)
Reach-In Freezer	1	Turbo Air	M3R72-3-N	Elec.	115v/60/1ph	1- (Caster Set, swivel, locking front wheels) 2- (Self-cleaning condenser device equipped)
Hot Server Counter	1	Duke Manufactoring	Aerohot E304SW	Elec.	208v/60/1ph	1- E304-208-1 208v/60/1-ph, 3000 watts, 14.4 amps, NEMA 6-20
Convection Steamer	2	Vulcan	C24EO5AF	Electric	208v/60/3ph	1- (STCKKIT 24EA Stacking kit) 2- (STCKKIT-FLG6 6" legs stacking kit, floor mount) 3- (HOSEWTR 3/4BBV Flex stainless steel water hose 72", 3/4" female NSHT) 4- (CORDPLG5PAN3P CORD & plug set rated to 208-240v/3-ph - 55.0amps, CABLE 6/4 90C UL SO, SEO, SOW OR SEOW, 7'7": ANGLED PLUG HBL8462C NEMA 15-60P)

2.2 MATERIALS:

A. Metals:
1. Stainless-Steel: AISI Type 201 or 302/304, hardest workable temper, and No.4 directional polish. Unless otherwise noted or specified, or required by the manufacturer, 201 may be used wherever 302/304 is listed.
2. Galvanized Steel Sheet: ASTM A526, except ASTM A527 for extensive forming; ASTM A525, G90 zinc coating, chemical treatment.
   a. Where painted finish is indicated, provide mill phosphatized treatment in lieu of chemical treatment.
3. Steel Sheet: ASTM A569 hot-rolled carbon steel.
4. Galvanized Steel Pipe: ASTM A53 or ASTM A120, welded or seamless, schedule 40, galvanized.
5. Steel-Structural Members: Hot rolled or cold formed, carbon steel unless stainless-steel is indicated.
   a. Galvanized Finish (G.I.): ASTM A123 hot-dipped zinc coating, applied after fabrication.
6. Aluminum: ASTM B209/B221 sheet, plate and extrusions (as indicated); alloy, temper and finish as determined by manufacturer/fabricator, except 0.40-mil natural anodized finish on exposed work unless another finish is indicated.

2.3 FABRICATED PRODUCTS:

A. Hardware (also refer to article 2.4 Fabrication of Metal Work in general, and paragraphs
B. Doors 1-3 and P. Drawer Assemblies 1-6 specifically, for additional requirements):
1. General: Manufacturer's standard, but not less than ANSI 156.9 Type 2 (Institutional), satin finish stainless-steel or dull chrome finish on brass, bronze, or steel.
2. Hinged Door Hardware: Stainless-steel hinged doors to be mounted with heavy duty NSF-approved hinges with Component Hardware Group, Model No. P62-1010 pulls, or equal; or full length pulls as per individual itemized specifications and shown on Standard Detail FSD1-24. Catches to be heavy-duty magnetic type, except as otherwise indicated. Millwork cabinet hinged doors to be mounted with Blum 95º CLIP top thick door all metal hinges, nickel plated, with 3-dimensional adjustment, or equal; or as per individual itemized specifications.
3. Drawer Hardware: Slides to be 200 pounds (90 kilograms) minimum capacity per pair, 201 or 300 series stainless-steel, full extension, side-mounting, self-closing type, with stainless-steel ball-bearings, and positive stops; Component Hardware Group Series S52, or equal. Pulls to be Component Hardware Group, Model No. P62-1012, or equal; or full length pulls as per individual itemized specifications and shown on Standard Detail FSD1-24.
4. Sliding Door Hardware: Sliding doors to be mounted on large, quiet ball bearing rollers in 14-gauge (2 mm) stainless-steel overhead tracks and be removable without the use of tools. Bottom of cabinet to have stainless-steel guide-pins and not channel tracks for doors.
5. All hardware to be identified with manufacturer's name and number, so that broken or worn parts may be replaced.

C. Casters:
1. Type and size as recommended by caster manufacturer, NSF- approved for the type and weight of equipment supported; normally 5” (127 mm) diameter heavy-duty, ball-bearing, solid or disc wheel with non-marking grease proof rubber, neoprene or polyurethane tire; unless otherwise specified. Minimum width of tread to be 1-3/16” (30 mm). Minimum capacity per caster to be 250-pound (113.4kg), unless otherwise noted in itemized specifications.
2. Solid material wheels to be provided with stainless-steel rotating wheel guard.

3. Wheel and swivel bearings shall be sealed and show a polished plated finish per NSF.
4. Unless otherwise indicated, equip each item with two (2) swivel-type casters and two (2) fixed casters, with foot brakes on two (2) casters.
5. Unless item is equipped with another form of all-around protective bumper, provide circular rotating bumper above each caster, 5" (127 mm) diameter tire of light grey synthetic rubber (hollow or closed-cell) on cadmium-plated disc.

D. Plumbing Fittings, Trim and Accessories:
1. Exposed screws or bolt heads, rivets and butt joints made by riveting straps under seams and then filled with solder, will not be accepted. Where fasteners are permitted, provide Phillips head, flat or oval head machine screws. Cap threads with acorn nuts and lock washers, unless fully concealed in inaccessible construction; and provide nuts and lockwashers unless metal for tapping is at least 12-gauge (2.5 mm). Match fastener head finish with finish of metal fastened.
2. Where components of fabricated metal work are indicated to be galvanized and involve welding or machining of metal heavier than 16-gauge (1.6 mm), complete the fabrication and provide hot-dip galvanizing of each component, after fabrication, to the greatest extent possible (depending upon available dip-tank sizes). Comply with ASTM A123.
3. Welding and Soldering:
   a. Materials 18-gauge (1.3 mm), or heavier, to be welded.
   b. Seams and joints to be shop welded or soldered as the nature of the material may require.
   c. Welds to be ground smooth and polished to match original finish.
   d. Where galvanizing has been burned off, the weld is to be cleaned and touched up with high grade aluminum paint.
4. Provide removable panels for access to mechanical and electrical service connections, which are concealed behind or within foodservice equipment, but only where access is not possible and not indicated through other work.
5. Where ends of fixtures, splashbacks, shelves, etc., are open, fill by forming the metal or welding sections, if necessary, to close entire opening flush to walls or adjoining fixtures.
6. Rolled edges are to be as detailed, with corners bullnosed, ground and polished.
7. Equipment to have 1/2" (12.7 mm) or larger radius coves in horizontal and vertical corners, and intersections, per NSF standards.

E. Metal and Gauges:
   1. Except as otherwise indicated, fabricate exposed metalwork of stainless-steel; and fabricate the following components from the gauge of metal indicated, and other components from not less than 20-gauge (1 mm) metal:
      a. Table and counter tops: 14-gauge (2 mm)
      b. Sinks and drainboards: 14-gauge (2 mm)
      c. Shelves: 16-gauge (1.6 mm)
      d. Front drawer and door panels: 18-gauge (1.3 mm)
      (double pan type)
      e. Single pan doors and drawer fronts: 16-gauge (1.6 mm)
      f. Enclosed base cabinets: 18-gauge (1.3 mm)
      g. Enclosed wall cabinets: 16-gauge (1.3 mm)
      h. Exhaust hoods and ventilators: 18-gauge (1.3 mm)
      i. Pan-type insets and trays: 16-gauge (1.6 mm)
      j. Removable covers and panels: 18-gauge (1.3 mm)
      k. Skirts and enclosure panels: 18-gauge (1.3 mm)
      l. Closure/trim strips over 4" (102 mm) wide: 18-gauge (1.3 mm)
      m. Hardware reinforcement: 12-gauge (2.5 mm)
      n. Gusset plates: 10-gauge (3.4 mm)
      o. Removable toe kicks: 14-gauge (3.4 mm)
      p. Wall flashing 18-gauge (.95 mm)

F. Work-Surface Fabrication:
   1. Fabricate metal work surfaces by forming and welding, to provide seamless construction; using welding rods matching sheet metal, grinding and polishing.
   Where necessary for disassembly, provide waterproof gasketed draw-type joints with concealed bolting.
   2. Reinforce work surfaces 30” (762 mm) on center both ways, with galvanized or stainless-steel concealed structural members. Reinforce edges, which are not self-reinforced, by formed edges.

G. Metal Top Construction:
   1. Metal tops to be one-piece welded construction, including field joints. Secure to a full perimeter galvanized steel channel frame cross-braced not farther than 30" (762 mm) on center. Fasten top with stud bolts or tack welds. If hat sections are used in lieu of channels, close ends.
   2. Properly designed draw fastening, trim strip, or commercial joint material to suit requirement is to be used, only if specified.

H. Structural Framing:
   1. Except as otherwise indicated, provide framing of minimum 1” (25 mm) pipe-size round pipe or tube members, with mitered and welded joints and gusset plates, ground smooth. Provide 14-gauge (2 mm) stainless-steel tube for exposed framing, and galvanized steel pipe for concealed framing.
   2. Where indicated, flange rear and end edges up to form splashes integrally with top, with vertical and horizontal corners coved of not less than 1/4” (6 mm) radius, die formed. Turn back splashes 1” (25 mm) to wall across top and ends with rounded edge on break, unless otherwise specified.
   3. For die-crimped edges, use inverted "V" 1/2” (13 mm) deep inside and 2” (50 mm) deep on outside, unless otherwise shown. For straight down flanges, make 1-3/4” (45 mm) deep on outside. For bullnose edges, roll down 1-3/4” (45 mm).
   4. Edges: die-formed, integral with top. For rounded corners, form to 1” (25 mm) radius, weld, and polish to original finish.

I. Field Joints: For any field joint required because of size of fixture; butt-joint, reinforce on underside with angles of same material, bolt together with non-corrosive bolts and nuts, field-weld, grind and polish to a seam not visible to the naked eye.

J. Pipe Bases: Construct pipe bases of 1-5/8" (41 mm) diameter 18-gauge (1.3 mm) stainless-steel tubing. Fit legs with polished stainless-steel sanitary adjustable bullet feet to provide for not less than 2" (50 mm) of vertical adjustment without exposing threads. Space legs to provide ample support for tops, precluding any possibility of buckling or sagging and in no case more than 6' -0" (1829 mm) centers.

K. Legs and Cross rails
   1. Equipment legs and cross rails to be 1-5/8" (41 mm), 16-gauge (1.6 mm) stainless-steel tubing.
   2. Welds at cross rails to be continuous and ground smooth. Tack welds will not be acceptable.
   3. Bottom of legs to be hugged inward and fitted with a stainless-steel bullet-type foot with not less than 2" (50 mm) vertical adjustment without exposing threads.
   4. Free standing legs or legs on island tables/counters with electrical/plumbing connections to be anchored to floor with bolt-down type flanged feet with stainless-steel fasteners.
   5. Components:
      a. Steel Gusset: Stainless-steel exterior to fit 1-5/8" (41 mm) tubing, with Allen screw for fastening and adjustment. Not less than 3" (76 mm) diameter at top and 3-3/4" (95mm) long. Outer shell 16-gauge (1.6 mm) stainless-steel, reinforced with 12-gauge (2.5 mm) mild steel insert welded interior shell, or approved equal.
      b. Stainless-Steel Low Counter Legs: Stainless-steel exterior 5-3/4" (146 mm) minimum, 7" (178 mm) maximum length with stainless-steel 3-1/2" (89 mm) square plate with four countersunk holes, welded to top for fastening.
      c. Stainless-Steel Adjustable Foot: Stainless-steel 1-1/2" (37 mm) diameter tapered at bottom to 1" (25 mm) diameter, fitted with threaded cold rolled rod for minimum 1-1/2" (37 mm) diameter x 3/4" (19 mm) threaded bushing plug welded to legs, or approved equal. Push-in foot not acceptable.
   6. Legs to be fastened to equipment with gussets, as follows:
      a. Sinks: Reinforced with bushings and set screw.
      b. Metal Top Tables and Dish Tables: Welded to galvanized steel channels, 14-gauge (2 mm) or heavier, anchored to top with screws through slotted holes.
      c. Wood Top Tables: Welded to stainless-steel channels, 14-gauge (2 mm) or heavier, anchored to top with screws through slotted holes.

L. Shelves:
   1. Construct solid shelves under pipe base tables of 16-gauge (1.6 mm) stainless-steel, with 1-1/2" (37 mm) turned down and under edges on exposed sides, and 2" (50 mm) turn up against walls or equipment. Fully weld to pipe legs.
   2. In fixtures with enclosed bases, turn up shelves on back and sides with 1/4" (6 mm) (minimum) radius and feather slightly to ensure a tight fit to enclosure panels.

M. Sinks:
   1. Construct sinks of 14-gauge (2 mm) stainless-steel with No.4 finish inside and outside.
   2. Form back, bottom and front of one piece, with ends and partitions welded into place. Partitions: double thickness, 2" (51 mm) minimum space between walls. Multiple compartments to be continuous on the exterior, without applied facing strips or panels.
   3. Cove interior vertical and horizontal corners of each tub not less than 1/4" (6 mm) radius, die formed. Outer ends of drainboards to have roll rim risers not less than 3" (76 mm) high.

4. Drill faucet holes in splashes 2-1/2" (63.5 mm) below top edge. Verify center spacing with faucet specified. Grind and polish.
5. Sink insets to be deep drawn of 16-gauge (1.6 mm), or heavier, polished stainless-steel. Weld into sink drainboards with 1-1/2" (37 mm) x 1-1/2" (37 mm) x 14-gauge (2 mm) stainless-steel angle brackets; securely welded to sinks and galvanized cross angles spot welded to underside of drainboards to form an integral part of the installation.
6. The bottom of each compartment is to be creased such as to ensure complete drainage to waste opening. Slope bottom of sink bowls toward drain outlet.

N. Drains and Wastes and Faucets:
1. Furnish and install Fisher model 28940, or equal, ball valve type rotary drain assembly with flat strainer and connected overflow assembly, with chrome finish, in die-drawn inset type sinks and Bain Marie sinks.
2. Other custom fabricated sinks to be furnished with Fisher model 28932, or equal, ball valve-type rotary drain assembly, with flat strainer and chrome finish. Waste connection to have 2" (50 mm) external thread size, with 1-1/2" (37 mm) internal thread size.
3. Rotary Handle: Of sufficient length to extend to front edge of sink. No riveting, screws or soldering permitted to fit drains to sinks, with all parts of drains easily removable for servicing and replacement.
4. All faucets furnished with equipment included in this Section to be lead-free and comply with NSF Standard #61, Section #9; such as manufactured by Fisher, Chicago, or T&S.
5. Faucets and pre-rinse spray assemblies furnished with equipment included in this Section, are to have a maximum GPM flow rate in compliance with the Energy Policy Act of 2005 (EPAct) and later updates; or local requirements, whichever is lower. EPAct / local requirements are to be applicable to all faucets and pre-rinses; except for pre-rinse type assemblies used at glass icing / fill stations, fill hose / faucet assemblies at high water usage cooking equipment such as kettles, tilt fry pans, etc., and fill faucets at high volume / usage sinks, such as pot wash, mop sink and preparation sinks, etc. are to have flow rates of approximately 5 gpm flow minimum.
6. All flex hose type faucet assemblies, such as pre-rinses, kettle fill hoses, etc., to have an inline pressure type back-flow preventer in the hose assembly, as required by local codes.
7. All equipment provided by this Contractor, which discharges liquid waste exceeding 140º F (60º C), is to be provided with a cold-water drain tempering assembly per local codes.

O. Workmanship:
1. Best quality in the trade. Field-verify dimensions before fabricating; conform all items to dimensions of building; neatly fit around pipes, offsets and other obstructions.
2. Fabricate only in accordance with approved shop drawings, showing pipes, obstructions to be built around, and location of utilities and services.

P. Casework:
1. Enclosure: except as otherwise indicated, provide each unit of casework (base, wall, overhead and free-standing) with a complete-enclosure metal cabinet, including fronts, backs, tops, bottoms, and sides.
2. Bases to be made of 18-gauge (1.3 mm) stainless-steel sheets reinforced by forming the metal and the inclusion of hat-channels.
3. Ends, partitions and shelves to be stainless-steel.
4. Unexposed backs and structural members may be galvanized, unless otherwise noted.
5. Vertical ends and partitions to be single wall, with a 2" (50 mm) face.

6. Sides and through partitions are flush with bottom rail, welded at intersections.
7. Shelves: Provide adjustable standards for positioning and support of shelves in casework; except bottom shelf of cabinet mounted on legs or as specified. Turn back of shelf units up 2" (50 mm) and hem. Turn other edges down to form open channel. Reinforce shelf units and pilasters to support 40 pounds per square foot (195 kgs/sq meter) loading, plus 100 percent impact loading.
8. Bottom front rail of bases set on masonry platform to be continuously closed and sealed to platform.
9. Provide removable access hatchways to all concealed floor sinks under casework directly over floor sinks. Sink locations to conform to local Health Department code requirements.

Q. Doors:
1. Metal doors to be double-cased stainless-steel. Outer pans to be 18-gauge (1.3 mm) stainless-steel with corners welded, ground smooth and polished. Inner pan to be 20-gauge (1 mm) stainless-steel fitted tightly into outer pan with a sound deadening material such as Celotex or Styrofoam used as a core. The two pans to be tack welded together and joints solder-filled. Doors to finish approximately 3/4" (19 mm) thick and be fitted with flush recessed type stainless-steel door pulls; or full-length continuous pulls as per individual itemized specifications and shown on applicable Standard Detail sheet.
2. Wood doors to be fabricated as detailed.
3. Hinged doors to be mounted on heavy-duty NSF-approved hinges, or as noted on plans or specifications.

R. Drawer Assemblies:
1. Assemblies to consist of removable drawer body mounted in a ball bearing slide assembly with fully enclosed housing.
2. Slide assembly consists of one pair of 200-pound (90 kilograms) capacity stainless-steel roller bearing full extension slides, with side and back enclosure panels, front spacer angle, two drawer carrier angles, secured to slides and stainless-steel front.
3. Drawers intended for tools and general non-food products storage are to have 20" x 20" x 6" deep (508 mm x 508 mm x 152 mm), 18-gauge (1.3 mm) minimum stainless-steel drawer pans.
4. Drawers intended to hold food products are to have 12" x 20" x 6" deep (305 mm x 508 mm x 152 mm) stainless-steel food pans.
5. All drawer pans to be easily removable without tools or disassembly of any drawer assembly components.
6. Drawer fronts are double-cased, 3/4" (19 mm) thick, with 18-gauge (1.3 mm) stainless-steel welded and polished front pan. Steel back pan shall be tightly-fitted, and tack-welded. Sound-deaden with rigid insulation material.
7. Provide drawers with replaceable soft neoprene bumpers or for refrigerated drawers - a full perimeter replaceable refrigerator gasket.

S. Closed Base: Where casework is indicated to be located on a raised-floor base, prepare casework for support without legs, and for anchorage and sealant application, as required for a completely enclosed and concealed base.

T. Support from Floor: Equip floor supported mobile units with casters, and equip items indicated as roll-out units, with manufacturer's standard one-directional rollers. Otherwise, and except for closed-base units, provide pipe or tube legs, with adjustable bullet-design feet for floor supported items of fabricated metalwork. Provide 2" (50 mm) vertical adjustment of feet (concealed threading).

U. Shop Painting:
1. Clean and prepare metal surfaces to be painted; remove rust and dirt. Apply treatment to zinc coated surfaces, which have not been mill phosphatized. Coat welded and abraded areas of zinc coated surfaces, with galvanize repair paint.

2. Apply 1.5 mil (dry film thickness) metal primer coating, followed by 2, 1.0 mil (dry film thickness) metal enamel finish coatings.
3. Bake primer and finish coatings in accordance with paint manufacturer's instructions for a baked enamel finish.

V. Sound Deadening:
1. Sound-deaden underside of metal tops, drainboards, undershelves, cabinet interior shelves, etc., above the underbracing/reinforcing/framing only.

2.6 FILTER EXHAUST HOODS AND/OR WATER WASH VENTILATOR FABRICATION:

A. 18-gauge (1.3 mm) type 201 or 304 stainless-steel external welded construction, in accordance with the latest edition of N.F.P.A. No.96 and International Mechanical Code, including all applicable appendices. Exposed welds to be ground and polished. Exhaust hoods to be U.L. Listed as available for length specified.
B. Furnish type of fixture specified. Fixtures to be U.L. listed for cooking equipment exhaust hoods, NSF-approved, and with sealed safety lenses.
C. Furnish welded stainless-steel formed duct collars at ceiling or wall duct connections. Verify size and location of duct connections required in this contract, before fabrication.
D. Pre-piped liquid chemical or water fire suppressant system, as specified; complying with applicable local and N.F.P.A. regulations. Wet chemical fire suppression systems to comply with UL 300 Standards. Water fire suppression systems to comply with U.L. Category Subject 199E. Each pull station is to be clearly identified with a permanent type label, as to which exhaust hood(s) it is for. Each exhaust hood is to have a matching permanent type label, identifying which pull station activates its fire system.
E. All cooking equipment below exhaust hoods/ventilators, on casters, are to be provided with positive wheel placement systems for the rear casters, similar-to Posi-Set units, in compliance with NFPA-17A 5.6.4 and NFPA-96 12.1.2.3.
F. Water wash or ultra-violet control panel to be by the same manufacturer as the ventilator, with time clock control for automatic operation. Provide stainless-steel trim strips for recessed control cabinet applications. Provide stainless-steel chase for surface mounted control panel, from top of panel to ceiling, full width and depth of panel.

2.7 REFRIGERATION EQUIPMENT:

A. General:
1. Furnish either single or multiple compressor units, as specified or recommended by the manufacturer for the sizes and variations between connected evaporator loads as indicated.
2. Furnish units of the capacities indicated, arranged to respond to multiple-evaporator thermostats and defrosting timers. Include coils, receivers, compressors, motors, and motor starters, mounting bases, vibration isolation units, fans, dryers, valves, piping, insulation, gauges, winter control equipment and complete automatic control system.
3. Refrigerant: Pre-charge units with type or types recommended by manufacturer for services indicated, with quick-disconnect type connections only where specified, ready to receive refrigerant piping runs to evaporators and (where remote) to condensers. All refrigerant and associated components to comply with the requirements of the Montreal Protocol Agreement. No CFC or HCFC refrigerants or associated components will be permitted on this Project. HFC refrigerants and components are to be used. Contractor is responsible for coordinating these requirements with manufacturers.

4. Foodservice equipment items included in this Section, with remote refrigerated systems, are to include interconnecting refrigeration lines, sizing, and insulation between components, as per manufacturer's installation instructions, and as determined by this Contractor's Certified Refrigeration Sub-Contractor; and only after a thorough examination of actual site conditions and obstacles which might affect the routing. Routing should be as direct and short as possible and practical. Refer to additional requirements listed in this Section 11 40 00, 1.5 Laws, Ordinances and Standards.
5. The minimum outdoor operating ambient temperature for design of units is -10 degrees Fahrenheit (-23 Centigrade), or lower as applicable for extreme low local conditions. The maximum indoor design temperature for operation of compressor units is 95 degrees Fahrenheit (35 Centigrade). The maximum outdoor ambient design temperature is to be determined by Contractor with prevailing conditions at mounting location of compressor, such as sun exposure, limited ventilation, high fences/walls, roof color and materials, local climatic extremes, etc.; but in no case is it to be less than 100 degrees Fahrenheit (37.8 Centigrade).
6. All refrigeration systems with remote condensing units and job-site installed interconnecting refrigeration lines shall be tested to verify that there are no leaks. Leak testing shall be equal to or better than a professionally recognized 48-hour minimum, pressure holding test. If any leaks are detected, they shall be repaired and another leak test preformed; until there are zero leaks detected. A written report of the type test preformed, and a step-by-step record of the procedure and readings shall be submitted to Contractor for inclusion in the Operations and Maintenance Data Manuals.

B. Components:
1. Coils for fabricated refrigerators to have vinyl plastic coatings, stainless-steel housings; and be installed in such a manner as to be replaceable.
2. Provide guards for all refrigeration/freezer fans, with maximum 1/2" (13 mm) mesh.
3. Remote refrigeration system to be complete with thermostatic expansion valves at the evaporator.
4. Fabricated refrigerated compartments to be fitted with flush dial thermometers, with chrome plated bezels. Thermometers to be adjustable and shall be calibrated after installation. Thermometers to have an accuracy of + 2 degrees Fahrenheit (1 degree Centigrade).
5. Hardware:
   a. Refrigerator hardware for fabricated refrigerator compartments to be heavy-duty components.
   b. Self-closing hinges.
   c. Latches to be magnetic edge mount type, unless specified or detailed otherwise.
6. Doors and drawers for walk-in coolers/freezers, and reach-in refrigerated compartments, both fabricated and standard, to be fitted with cylinder locking type latches, and provided with master keys.
7. Provide and install shut-off valves and service port for each compressor, manifold or header, and refrigerated fixture for multiplex and parallel installations to enable service personnel to service one (1) fixture while other fixture(s) connected to the same compressor can continue to operate. Isolation valves for individual fixtures based upon the sizes of the individual pieces.
8. Drawers for refrigerated fabricated compartments shall be complete with heated surround at closing perimeter.

C. Cold Pans: Ice pans, refrigerated pans and cabinets to be provided with breaker strips, where adjoining top or cabinet face materials, to prevent transfer of cold.

D. All mechanically-cooled custom fabricated or standard buy-out refrigerators with openings in the top for cooling pans, and/or all built-in or drop-in mechanically cooled cold pans are to comply with and be listed by NSF Standard #7. Contractor is to verify that the specified unit complies with this requirement.
E. Ventilation of Refrigerated Equipment:
   1. Adequate ventilation to be provided for custom fabricated equipment with integral refrigeration condensing units, both built-in and drop-in. If flow-through ventilation cannot be provided, provide flow direction partitions and an additional squirrel fan(s) capable of cooling the condensing unit.
   2. If, in the opinion of the Contractor, additional room ventilation is required to ensure correct operating temperatures of standard buy-out, custom fabricated, or remote refrigeration condensing units, or compressor rack assemblies, they are to so state in a letter to the Architect, for evaluation and decision.

2.9 MISCELLANEOUS MATERIALS AND FABRICATION:

A. Nameplates: Whenever possible, locate nameplates and labels on manufactured items, in accessible position, but not within customer's normal view. Do not apply name plates or labels on custom fabricated work, except as required for compliance with governing regulations, insurance requirements, or operator performance.
B. Manufactured Equipment Items: Furnish items as scheduled or herein specified. Verify dimensions, spaces, rough-in and service requirements, and electrical characteristics, before ordering. Provide trim, accessories and miscellaneous items for complete installation.
C. Insert Pans:
   1. General: Cut-outs, openings, drawers, or equipment specified or detailed to hold stainless-steel insert pans to be provided with a full complement of pans as follows:
      a. One (1) stainless-steel, 20-gauge (1 mm) minimum, solid insert pan – in us pan size or gastronorm configuration as specified for each space, sized per plans, details, or specifications.
      b. Where pan sizes are not indicated in plans, details, or specifications, provide one full-size pan for each opening.
      c. Provide maximum depth pan to suit application and space.
   2. Provide 18-gauge (1.3 mm) NSF- approved removable stainless-steel adapter bars where applicable.
   3. All cut-outs and openings, or equipment specified or detailed to hold stainless-steel insert pans, shall be provided with a hinged stainless-steel removable night cover.
D. Tray Slides: Before fabrication of counters with tray slides, verify:
   1. Size and shape of tray with Owner/Operator prior to fabrication. Edge of tray should not overhang outer support/slider by more than 2" (50 mm). If edge of tray exceeds this dimension, notify Architect, in writing, for evaluation and adjustment, if necessary.
   2. Configuration of corners, turns, and shape of tray slides for proper support and safe guidance of trays.
   3. Tray slide to be capable of supporting 200 pounds per linear foot (298 kgs/meter), live load.
E. Self-leveling dispensers: Verify type, make dimensions and weight of ware with Owner/Operator; and submit to the dispenser manufacturer, for proper sizing and calibration of dispensers.

F. Carbon dioxide (CO2) equipment: Where equipment requires connection with compressed CO2 cylinder for operation, provide 2-cylinder manifold and control system (integral with equipment) with proper connectors for Department of Transportation (DOT) approved type cylinders, complete with cylinder safety devices and supports. Applicable to projects with CO2 equipment included in Contractor's specified equipment.
G. Reasonable quietness of operation of equipment is a requirement, and Contractor will be required to replace or repair any equipment producing out-of-the-ordinary intolerable noise. This also includes providing and installing bumpers and gaskets for doors and drawers on fabricated and standard manufactured items and sound insulation where feasible.
H. Gas pressure regulator: All gas fired equipment included with this Section is to be provided with a gas pressure regulating valve with a built-in vent limiting device sized per WC pressure rating of this project. Contractor is responsible for coordinating this requirement with their manufacturers and suppliers.

PART 3 – EXECUTION

3.01 SUPERVISION:

A. A competent supervisor, representing the Contractor, is to be present at-all times during progress of the Contractor's work.
B. Contractor is responsible for coordinating with all applicable Design Team members, Key Ownership Stakeholders Assigned, General Contractor, other Contractors and/or Sub-Contractors and Trades involved in this Project and associated with any items or work provided under this Section; as required for the successful provision, installation, completion, and functioning of these items and/or work, and the Project in general. This is to include, but not be limited to, exchange of shop drawings, details, and manufacturer's information, supplying templates or actual components to be installed in or on items provided by other Sections, for coordination; and coordinating with and between their own internal staff, sub-contractors, trades, manufacturers, fabricators and installers, for compliance with the Contract Documents.
C. Contractor responsible for obtaining any documents referenced in this Section and on any associated drawings, which contain information relative to the performance of this Contract; and disseminating and coordinating the pertinent information contained in them, with the appropriate sub-contractors, manufacturers, fabricators, and/or installers.
D. Contractor is to take every precaution against injuries to persons or damage to property.
E. Contractor is to store his apparatus, materials, supplies and equipment in an orderly fashion at the site of the work so it will not unduly interfere with the progress of his work or the work of any other contractors.

3.02 SITE EXAMINATION:

A. Verify site conditions under the provisions of the General Conditions, Supplementary Conditions and applicable provisions of Division 1 Sections. Notify the Architect, in writing, of unsatisfactory conditions for proper installation of foodservice equipment.
B. Verify wall, column, door, window, and ceiling locations and dimensions. Fabrication and installation should not proceed until dimensions and conditions have been verified and coordinated with fabrication details.
C. Verify that wall reinforcement or backing has been provided and is correct for wall supported equipment. Coordinate placement dimensions with wall construction Section.
D. Verify that ventilation ducts are of the correct characteristics, and in the required locations.
E. Verify that utilities are available, of the correct characteristics, and in the required locations.

3.03 DELIVERY AND INSTALLATION:

F. Delivery:
   1. The equipment shall be delivered and installed on schedule. Coordinate all work with the General Contractor and other divisions as required.
   2. Deliver materials (except bulk materials) in manufacturer's containers, fully identified with manufacturer's name, trade name, type, class, grade, size, color, item number, area, etc.
   3. Contractor is responsible for receiving and warehousing equipment and fixtures, until ready for installation. Store materials, equipment and fixtures in sealed containers, where possible. Store off the ground and under cover, protected from damage.
   4. Contractor to verify and coordinate conditions at the building site, particularly door and/or wall openings, and passages, to assure access for all equipment. Pieces too bulky for existing facilities are to be hoisted or otherwise handled with apparatus as required.
   5. Extra charges resulting from special handling or shipment to be paid by the Kitchen Equipment Contractor if insufficient time was allowed in placing factory orders to ensure normal shipment.

G. The work to be accomplished so as not to delay the project construction schedule, interfere or conflict with the work being performed by other contractors. Work to be coordinated and integrated to prevent conflict of work necessitating changes to work already completed. Sequence installation and erection to ensure correct mechanical and electrical utility connections are achieved.

H. Verify all field dimensions before fabrication.

I. Install items in accordance with manufacturer's instructions.

J. Set each item of non-mobile and non-portable equipment securely in place, leveled and adjusted to correct height. Anchor to supporting substrate where indicated, and where required for sustained operation and use without shifting or dislocation. Conceal anchorages wherever possible. Adjust counter tops and other work surfaces to a level tolerance of 1/16” (1.6 mm) (maximum offset, and plus or minus on dimension, and maximum variation in 24" (610 mm) run from level or indicated slope). Provide anchors, supports, bracing, clips, attachments, etc., as required to comply with the local seismic restraint requirements. The Guidelines for Seismic Restraint of Kitchen Equipment, as prepared for the Sheet Metal Industry Fund of Los Angeles and endorsed by S.M.A.C.N.A., is to be followed.

K. Complete field assembly joints in the work (joints which cannot be completed in the shop) by welding, bolting-and-gasketing, or similar methods as indicated and specified. Grind welds smooth and restore finish. Set or trim flush, except for "T" gaskets as indicated. Field joints shall not be visible to the untrained eye.

L. Provide closure plates and strips where required, with joints coordinated with units of equipment.

M. Provide sealants and gaskets all around equipment to wall, ceiling, floors, masonry pads, and adjoining units not portable and with enclosed bodies to make joints airtight, waterproof, vermin-proof, and sanitary for cleaning purposes. Space between all equipment to wall, ceiling, floors, masonry pads, and adjoining units not portable and with enclosed bodies to be shall be completely sealed against entrance of food particles or vermin by means of trim strips, welding, soldering or mastic. Mastic to be General Electric Silicone Construction Sealant Series SE1200 or equal in appropriate color.

N. Joints up to 3/8” (9.5 mm) wide, to be stuffed with backer rod, to shape sealant bead properly, at 1/4” (6 mm) depth.

O. At internal corner joints, apply sealant or gaskets to form a sanitary cove, of not less than 3/8” (9.5 mm) radius.

P. Shape exposed surfaces of sealant slightly concave, with edges flush with faces of materials at joint.

Q. Provide sealant filled or gasketed joints up to 3/8" (9.5 mm) joint width. Wider than 3/8" (9.5 mm), provide matching metal closure strips, with sealant application each side of strips. Anchor gaskets mechanically, or with adhesives to prevent displacement.
R. Treat enclosed spaces, inaccessible after equipment installation, by covering horizontal surfaces with powdered borax at a rate of 4 ounces per square foot (1.2 kg/m2).
S. Insulate to prevent electrolysis between dissimilar metals.
T. Cut and drill components for service receptacles, fixtures, piping, conduit, fittings, etc. as required. Grind and polish penetrations to safe tolerance. Work to include welded sleeves, collars, ferrules or escutcheons.
U. Verify and coordinate the mounting heights of all wall shelves and equipment, with equipment located below them, for proper clearances.
V. Walk-In Refrigerator/Freezers:
    1. The cold storage rooms shall be delivered and installed on schedule by factory supervised and approved installers. Coordinate the work with the General Contractor and other trades as necessary.
    2. Provide the necessary job site coordination with the various trades to insure job site conditions will meet the requirements of the cold storage rooms.
    3. During curing and cleaning of the wearing floors inside the cold storage rooms, the cold storage room doors shall be left open and the rooms well ventilated to prevent damage to the interior. "Keep Out" signs to be posted at each open door.
    4. After the installation of the cold storage rooms and prior to the installation of the wearing floor has cured, the cold storage room doors are to be closed and locked.
W. Coordinate with the Plumbing and Electrical Divisions and provide penetrations in food service equipment for plumbing and electrical service to and through the fixtures, as required. This includes welded sleeves, collars, ferrules, or escutcheons. These services are to be located so that they do not interfere with intended use and/or servicing of the fixture.
X. All equipment provided by this Section, that requires light bulb(s), are to be provided with heavy-duty, energy efficient, extra long-life bulbs with a minimum life expectancy of 5000 hours, and as required by the local Jurisdictions. All light bulbs in and/or above foodservice equipment and/or areas are to be coated or provided with shields in compliance with local health codes.
Y. All equipment provided by this Section, shall include any-and-all parts, components, options, accessories, etc. necessary to provide a completely functional item for its intended use under normal conditions; and if appropriate, after the final utility connections are completed by other Divisions. This shall generally apply to equipment such as soda systems, beer systems, and remote refrigeration systems, any type remote system or equipment, or ice machines; but shall also apply to any equipment provided by this Section.

3.04 ADJUSTING:

A. Equipment to be tested for leaks, poor connections, inadequate or faulty performance.
    1. Thermostatically controlled equipment and equipment with automatic features shall be operated for 14 days to prove controls are functioning as intended. Walk-in refrigerators and freezers shall be turned on and ran for a minimum of fourteen days.
B. Refrigeration equipment to run a minimum of three days duration before acceptance.
C. Lubricate and adjust drawer slides, hinges, casters.
D. Adjust pressure regulating valves, timed-delay relays, thermostatic controls, temperature sensors, exhaust hood grilles, etc.
E. Clean or replace faucet aerators, line strainers.
F. Repair, adjust or replace equipment which is found to be defective in its operation, including units which are below capacity or operating with excessive noise or vibration.

3.05 CLEANING, RESTORING AND REPAIRING:

A. After completion of installation, and completion of other major work in foodservice areas, remove protective coverings and clean foodservice equipment, internally and externally. Repair all damage as a result-of this installation.

B. Restore exposed and semi-exposed finishes removing abrasions and other damages; polish exposed metal surfaces and touch-up painted surfaces. Replace work, which cannot be successfully restored.

C. Polish glass, plastic, hardware and accessories, fixtures and fittings.

D. Wash and clean equipment and leave in a condition ready for the Owner to sanitize and use.

3.06 TESTING:

A. Delay the start-up of equipment until service lines have been tested, balanced, and adjusted for pressure, voltage and similar considerations; and until water and steam lines have been cleaned and treated for sanitation.

B. Contractor, with assistance from a factory-certified representative from the exhaust hood manufacturer, shall conduct an exhaust hood performance test for each exhaust hood in the Contractor's scope of work at the conclusion-of the project when all hoods and related cooking equipment are in operation. Contractor shall have manufacturer's factory authorized representative test and measure exhaust airflow rates, dampers, switches, demand control ventilation, and sequence of operation, with all appliances at operating temperatures. Contractor shall furnish a written report within ten (10) working days of substantial completion and acceptance of the project by the Owner, indicating the design requirements for each hood and the actual operating parameters as tested and measured.

C. Refrigeration Piping Testing:
   1. Each system shall be pressure tested for leaks. Tests for to be on the high side and on the low side. All valves shall be fully open during last test.

D. Tests are to be accomplished as follows:
   1. Charge the systems with refrigerant through the port of liquid shut-off valves of the receivers to a pressure of 10 to 20 psi
   2. Add dry nitrogen, the supply of which shall be equipped with a pressure regulating valve to provide the specified pressure.
   3. Carefully test all joints for leaks using either a Halide torch or an electronic Halogen leak detector.

E. Precautions to be taken to disconnect the low-pressure controls for protection of the bellows during testing.

F. Refrigeration System Evacuation:
   1. Evacuation shall be with a vacuum pump with an indicating gauge registering pressure in microns. Pump shall be connected to the system with a 5/8" (15 mm) O.D. line or larger.
   2. Evacuate both high and low sides to 500 microns. Break the vacuum with refrigerant to 0 psi evacuate high and low sides to 100 microns; and then break vacuum to 0 psi. with the refrigerant to be used in the system.

3.07 START-UP AND INSTRUCTIONS:

A. Make-arrangements for demonstration of foodservice equipment operation and maintenance, in advance with the Owner/Operator.

B. Demonstrate foodservice equipment, to familiarize the Owner and the Operator on operation and maintenance procedures, including periodic preventative maintenance measures required. Include an explanation of service requirements and simple on-site service procedures, as well as, information concerning the name, address and telephone number of qualified local source of service. The individual(s) performing the demonstration are to be knowledgeable of operating and service aspects of the equipment.
C. Provide a written report of the demonstration, to the Owner, outlining the equipment demonstrated and malfunctions or deficiencies noted. Identify individuals present at demonstration.
D. Final Cleaning: After testing and start-up, clean the foodservice equipment, and leave in a condition ready for the Owner to sanitize and use.
E. All keys for all locks provided with equipment provided under this Section, are to be gathered up, individually tagged with the equipment they belong to, put into a single box, and handed over to the Owner's authorized representative. A list of the keys and their associated equipment Item numbers is to be provided with the O&M Manuals, along with a copy of the list, signed by the Owner's representative, acknowledging receipt of the keys.

3.08 CLEAR AWAY

F. Throughout the progress of their work, Contractor is to keep the working area free from debris and remove rubbish from premises resulting from work being done by them. At the completion of their work, Contractor is to leave the premises in a clean and finished condition.

END OF SECTION 11 40 00

SECTION 12 2116

VERTICAL LOUVER BLINDS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Vertical louver blinds at all locations indicated on drawings.

1.02 LOCATIONS

A. At all windows of offices, conference rooms and the reading room.

1.03 REFERENCE STANDARDS

A. WCMA A100.1 - Safety of Window Covering Products; 2018.

1.04 SUBMITTALS

A. See Section 01 3000 - Administrative Requirements, for submittal procedures.

B. Product Data: Manufacturer's data sheets on each product to be used, including:
   1. Preparation instructions and recommendations.
   2. Storage and handling requirements and recommendations.
   3. Installation methods.

C. Certification: Provide certification that product complies with WCMA A100.1.

D. Shop Drawings: Indicate headrail location and headrail attachment.

E. Selection Samples: For vanes, color chips or material samples representing manufacturer's full range of available colors and patterns.

F. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
   1. See Section 01 6000 - Product Requirements, for additional provisions.

1.05 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing products specified in this section, with not less than three years of documented experience.

B. Installer Qualifications: Company specializing in performing work of this type with minimum three years of documented experience.

1.06 DELIVERY, STORAGE, AND HANDLING

A. If blinds are delivered early and stored at the project, deliver in unopened containers; handle and store in such a manner to protect them from damage.

PART 2 PRODUCTS

2.01 BLINDS AND BLIND COMPONENTS

A. Vertical Louver Blinds: Horizontal travel, vertical vane louver units complete with tracks, pivot and traversing mechanisms, and accessories, as follows:
   1. Vanes: PVC vanes of the size indicated.
   2. Operation: Manual.
   3. Direction of Travel: As indicated on the drawings.
   4. Mounting: Inside (between jambs).
   5. Cord and Chain Operation: Comply with WCMA A100.1.

B. Tracks: Channel tracks as required for type of operation, extruded aluminum with clear anodized finish, with end caps.
   1. Dimensions: Manufacturer's standard, selected for suitability for installation conditions, span, and weight of vanes.
   2. Vane Rotation: Chain driven direct rotation byactivating tilt gear within end cap assembly in turn actuating tilt rod and worm-and-spur gears in carrier trucks.
   3. Operating Components: Internally mounted heavy-duty extruded aluminum tilt rod, vane carriers, and other components required for proper performance and designed for smooth, quiet, trouble free operation.
   4. Pivot Mechanism: Geared for synchronous 180 degrees rotation of vanes and type of operation indicated.
   5. Vane Carriers: Metal carriers with ball-bearing wheels or thermoplastic trucks, equipped with linkages or other devices to ensure positive spacing of vanes.
   6. Tilt Chain: Nickel plated brass beaded ball chain, minimum 1/8 inch diameter; locate at drawback side of units as indicated.

C. Aluminum Vanes: Flat, 2 inches (50mm) wide.
   1. Thickness: 0.008 inch, minimum.
   2. Pattern, Color, and Texture: As selected by Architect from manufacturer’s full range of colors.

D. Brackets and Mounting Hardware: As recommended by manufacturer for the mounting configuration and span indicated; provide manufacturer’s standard L- bracket with clip for outside mounting and clip only for inside mounting.

2.02 FABRICATION

A. Field measure finished openings prior to ordering or fabrication.

B. Fabricate blinds to fit openings within specified tolerances.
   1. Vertical Dimensions: Fill openings from head to sill with 1/2 inch space between bottom of vanes and finish floor.
   2. Horizontal Dimensions - Inside Mounting: Fill openings from jamb to jamb.

C. Dimensional Tolerances: Fabricate blinds to within plus/minus 1/8 inch of intendeddimensions.

D. At openings requiring continuous multiple blind units with separate tracks, locate track joints at window mullion centers; butt tracks end-to-end.

PART 3 EXECUTION

3.01 EXAMINATION

A. Do not start installation before openings are finished and all finishes have been completed; do not install until painting is completed.

B. Field measure finished openings prior to ordering or fabrication.

3.02 INSTALLATION

A. Install in accordance with manufacturer's instructions using mounting style as indicated.

B. Installation Tolerances:
   1. Maximum Offset From Level: 1/16 inch.

C. Adjust blinds for smooth operation.

D. Replace blinds that exceed specified dimensional tolerances at no extra cost to Owner.

3.03 CLEANING

A. Clean installed work to like-new condition.

3.04 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 12 2116

SECTION 12 3600

COUNTERTOPS AND SILLS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Countertops for architectural cabinet work.

B. Wall-hung counters and vanity tops.

C. Solid Surface Window Stills

1.02 RELATED REQUIREMENTS

A. Section 06 4100 - Architectural Wood Casework.

B. Section 22 4000 - Plumbing Fixtures: Sinks.

1.03 REFERENCE STANDARDS

A. ANSI A208.1 - American National Standard for Particleboard; 2009.

B. AWI/AWMAC/WI (AWS) - Architectural Woodwork Standards; 2014, with Errata (2016).

C. AWMAC/WI (NAAWS) - North American Architectural Woodwork Standards, U.S. Version 3.1; 2016, with Errata (2017).

D. ISFA 2-01 - Classification and Standards for Solid Surfacing Material; 2013.

E. NEMA LD 3 - High-Pressure Decorative Laminates; 2005.

F. SEFA 2 - Installations; 2010.

G. SEFA 3 - Laboratory Work Surfaces; 2010.

1.04 SUBMITTALS

A. See Section 01 3000 - Administrative Requirements, for submittal procedures.

B. Product Data: Manufacturer's data sheets on each product to be used, including:

1. Preparation instructions and recommendations.

2. Storage and handling requirements and recommendations.

3. Specimen warranty.

C. Shop Drawings: Complete details of materials and installation; combine with shop drawings of cabinets and casework specified in other sections.

D. Selection Samples: For each finish product specified, color chips representing manufacturer's full range of available colors and patterns.

E. Test Reports: Chemical resistance testing, showing compliance with specified requirements.

F. Installation Instructions: Manufacturer's installation instructions and recommendations.

G. Maintenance Data: Manufacturer's instructions and recommendations for maintenance and repair of countertop surfaces.

1.05 QUALITY ASSURANCE

A. Installer Qualifications: Company specializing in performing work of the type specified in this section, with not less than three years of documented experience.

1.06 DELIVERY, STORAGE, AND HANDLING

A. Store products in manufacturer's unopened packaging until ready for installation.

B. Store and dispose of solvent-based materials, and materials used with solvent-based materials, in accordance with requirements of local authorities having jurisdiction.

1.07 FIELD 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.

PART 2 PRODUCTS

2.01 COUNTERTOPS

A. Quality Standard: SEFA 3 for laboratory worksurfaces.

B. Plastic Laminate Countertops: High-pressure decorative laminate (HPDL) sheet bonded to substrate.

1. Laminate Sheet: NEMA LD 3, Grade HGS, 0.048 inch nominal thickness.

   a. Wear Resistance: In addition to specified grade, comply with NEMA LD 3 High Wear Grade requirements for wear resistance.

   b. Laminate Core Color: Same as decorative surface.

   c. Finish: Matte or suede, gloss rating of 5 to 20.

   d. Surface Color and Pattern: As selected by Architect from the manufacturer's full line.

2. Exposed Edge Treatment where indicated on drawings: Postformed laminate; front edge substrate built up to minimum 1-1/4 inch thick with raised radiused edge, integral coved backsplash with radiused top edge.

3. Exposed Edge Treatment where indicated on drawings: Square, substrate built up to minimum 1-1/4 inch thick; covered with matching laminate.

4. Exposed Edge Treatment where indicated on drawings: Molded rubber edge with T-spline, sized to completely cover edge of panel.

5. Back and End Splashes: Same material, same construction.

6. Fabricate in accordance with AWI/AWMAC/WI (AWS) or AWMAC/WI (NAAWS), Section 11 - Countertops, Custom Grade.

C. Solid Surfacing Countertops: Solid surfacing sheet or plastic resin casting over continuous substrate.

1. Solid Surfacing Sheet and Plastic Resin Castings: Complying with ISFA 2-01 and NEMA LD 3; acrylic or polyester resin, mineral filler, and pigments; homogenous, non-porous and capable of being worked and repaired using standard woodworking tools; no surface coating; color and pattern consistent throughout thickness.

a. Basis of Design Manufacturers:

1) Avonite Surfaces: www.avonitesurfaces.com.

2) Dupont: www.corian.com.

3) Arizona Tile.

b. Color and Pattern: As selected by Architect from manufacturer's full line.

2.02 WINDOWSILLS

A. Solid Surfacing Sills: Solid surfacing sheet or plastic resin casting over continuous substrate.

1. Solid Surfacing Sheet and Plastic Resin Castings: Complying with ISFA 2-01 and NEMA LD 3; acrylic or polyester resin, mineral filler, and pigments; homogenous, non-porous and capable of being worked and repaired using standard woodworking tools; no surface coating; color and pattern consistent throughout thickness.

a. Basis of Design Manufacturers:

1) Avonite Surfaces: www.avonitesurfaces.com.

2) Dupont: www.corian.com.

3) Arizona Tile.

b. Color and Pattern: As selected by Architect from manufacturer's full line.

2. Back and End Splashes: Same sheet material, square top; minimum 4 inches high.

2.03 MATERIALS

A. Particleboard for Supporting Substrate: ANSI A208.1 Grade 2-M-2, 45 pcf minimum density; minimum 3/4 inch thick; join lengths using metal splines.

B. Adhesives: Chemical resistant waterproof adhesive as recommended by manufacturer of materials being joined.

2.04 FABRICATION

A. Fabricate tops and splashes in the largest sections practicable, with top surface of joints flush.

1. Join lengths of tops using best method recommended by manufacturer.

2. Fabricate to overhang fronts and ends of cabinets 1 inch except where top butts against cabinet or wall.

3. Prepare all cutouts accurately to size; replace tops having improperly dimensioned or unnecessary cutouts or fixture holes.

B. Provide back/end splash wherever counter edge abuts vertical surface unless otherwise indicated.

1. Secure to countertop with concealed fasteners and with contact surfaces set in waterproof glue.

2. Height: 4 inches, unless otherwise indicated.

C. Solid Surfacing: Fabricate tops up to 144 inches long in one piece; join pieces with adhesive sealant in accordance with manufacturer's recommendations and instructions.

D. Wall-Mounted Counters: Provide skirts, aprons, brackets, and braces as indicated on drawings, finished to match.

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.

C. Verify that wall surfaces have been finished and mechanical and electrical services and outlets are installed in proper locations.

3.02 PREPARATION

A. Clean surfaces thoroughly prior to installation.

B. Prepare surfaces using the methods recommended by the manufacturer for achieving the best result for the substrate under the project conditions.

3.03 INSTALLATION

A. Install laboratory worksurface countertops in conformance to requirements of SEFA 2.

B. Securely attach countertops to cabinets using concealed fasteners. Make flat surfaces level; shim where required.

C. Attach plastic laminate countertops using screws with minimum penetration into substrate board of 5/8 inch.

D. Seal joint between back/end splashes and vertical surfaces.

3.04 TOLERANCES

A. Variation From Horizontal: 1/8 inch in 10 feet, maximum.

B. Offset From Wall, Countertops: 1/8 inch maximum; 1/16 inch minimum.

C. Field Joints: 1/8 inch wide, maximum.

3.05 CLEANING

A. Clean countertops surfaces thoroughly.

3.06 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 12 3600

SECTION 12 4813

ENTRANCE FLOOR MATS AND FRAMES

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Rubber mat.

B. Recessed mat frames.

PART 2 PRODUCTS

2.01 MANUFACTURERS - BASIS OF DESIGN

A. Entrance Floor Mats:

1. Construction Specialties Pedimat (M1): www.roppe.com
2. Substitutions: See Section 01 6000 - Product Requirements.

2.02 MATS

A. Pedimat, Type M1, insert MonoTuft HD Color 9322 slate.

2.03 FRAME

A. M1 ¾" LEVEL BASE, MILL FINISH

2.04 FABRICATION

A. Construct recessed mat frames square, tight joints at corners, rigid. Coat surfaces with protective coating where in contact with cementitious materials.

B. Fabricate mats in single unit sizes; fabricate multiple mats where indicated.

2.05 LOCATION

A. Main Entry Doors

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that floor opening for mats are ready to receive work.

3.02 PREPARATION

A. Mats: Verify size of floor recess before fabricating mats.

B. Vacuum clean floor recess.

3.03 INSTALLATION

A. Install frames to achieve flush plane with finished floor surface.

B. Install walk-off surface in floor recess flush with finish floor after cleaning of finish flooring.

END OF SECTION 12 4813

SECTION 13 120
PRE-ENGINEERED STRUCTURES

PART 1 GENERAL

1.4 SECTION INCLUDES

A- Pre-engineered building and components including the following:
1- Structural steel frame, secondary framing, and miscellaneous framing.
2- Roof covering system including exterior roof panels, panel attachments, sealants, mastics, trim and flashings.
3- Insulation and insulation support system.

B- Wall accessories including the following:
1- Windows.
2- Service doors.
3- Louvers.
4- Wall openings.

C- Roof accessories including the following:
1- Eave gutters.
2- Multi-gutters and valley gutters.
3- Roof curbs.

1.5 RELATED SECTIONS

A. Section 00 8100 – BID INFORMATION & INSTRUCTIONS
B. Section 03 300 – CAST-IN-PLACE CONCRETE
C. Section 06 1606 SHEATHING
D. Section 07 2130 PRE-ENGINEERED METAL BUILDING INSULATION
E. Section 07 2500 WEATHER BARRIERS
F. Section 07 4113 EXPOSED FASTENER METAL ROOFING
G. Section 07 7200 ROOF ACCESSORIES
H. Section 08 1113 HALLOW METAL DOORS AND FRAMES
I. Section 08 3600 SECTIONAL OVERHEAD DOORS
J. Section 08 4313 ALUMINUM FRAMED STOREFRONTS
K. Section 08 5113 ALUMINUM WINDOWS

1.6 REFERENCES

A- American Institute of Steel Construction (AISC):
1- AISC 360 - Specification for Structural Steel Buildings.
2- AISC 341 - Seismic Provisions for Structural Steel Buildings (when appropriate).
3- AISC Design Guide 3 - Serviceability for Steel Buildings

B- American Iron and Steel Institute (AISI):
1- AISI S100 - North American Specification for the Design of Cold-Formed Steel Structural Members.

C- American Welding Society (AWS):
1- AWS D1.1 / D1.1M - Structural Welding Code - Steel.
2- AWS D1.3 / D1.3M - Structural Welding Code - Sheet Steel.

D- Association for Iron & Steel Technology (AISE):
1- AISE 13 - Specifications for Design and Construction of Mill Buildings.

E- ASTM International (ASTM):
1- ASTM A 325 - Standard Specification for Structural Bolts, Steel, Heat Treated, 120/105 ksi Minimum Tensile Strength.
2- ASTM A 653 / A 653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.
3- ASTM A 792 / A 792M - Standard Specification for Steel Sheet, 55 % Aluminum-Zinc Alloy-Coated by the Hot-Dip Process.
4- ASTM B 117 - Standard Practice for Operating Salt Spray (Fog) Apparatus.
5- ASTM C 518 - Standard Test Method for Steady-State Thermal Transmission Properties by Means of the Heat Flow Meter Apparatus.

6- ASTM C 1363 - Standard Test Method for Thermal Performance of Building Materials and Envelope Assemblies by Means of a Hot Box Apparatus.
7- ASTM D 522 - Standard Test Methods for Mandrel Bend Test of Attached Organic Coatings.
8- ASTM D 523 - Standard Test Method for Specular Gloss.
9- ASTM D 968 - Standard Test Methods for Abrasion Resistance of Organic Coatings by Falling Abrasive.
10- ASTM D 1308 - Standard Test Method for Effect of Household Chemicals on Clear and Pigmented Organic Finishes.
11- ASTM D 2244 - Standard Practice for Calculation of Color Tolerances and Color Differences from Instrumentally Measured Color Coordinates.
12- ASTM D 2247 - Standard Practice for Testing Water Resistance of Coatings in 100% Relative Humidity.
13- ASTM D 2794 - Standard Test Method for Resistance of Organic Coatings to the Effects of Rapid Deformation (Impact).
14- ASTM D 3361 - Standard Practice for Unfiltered Open-Flame Carbon-Arc Exposures of Paint and Related Coatings.
15- ASTM D 4214 - Standard Test Methods for Evaluating the Degree of Chalking of Exterior Paint Films.
16- ASTM E 84 - Standard Test Method for Surface Burning Characteristics of Building Materials.
17- ASTM E 96 / E 96M - Standard Test Methods for Water Vapor Transmission of Materials.
18- ASTM E 1592 - Standard Test Method for Structural Performance of Sheet Metal Roof and Siding Systems by Uniform Static Air Pressure Difference.
19- ASTM G 87 - Standard Practice for Conducting Moist SO2 Tests.

F- FM Global:
1- FMRC Standard 4471 - Approval Standard for Class 1 Roofs for Hail Damage Resistance, Combustibility, and Wind Uplift Resistance.

G- Metal Building Manufacturers Association (MBMA):
1- MBMA Metal Building Systems Manual.
2- Seismic Design Guide for Metal Building Systems.

H- North American Insulation Manufacturers Association (NAIMA):
1- NAIMA 202 - Standard For Flexible Fiber Glass Insulation to be Laminated for Use in Metal Buildings.

I- The Society for Protective Coatings (SSPC):
1- SSPC-Paint 15 - Primer for Use Over Hand Cleaned Steel performs to SSPC-Paint 15 standards.
2- SSPC-SP2 - Hand Tool Cleaning.

J- Underwriters Laboratories (UL):
1- UL 580 - Standard for Tests for Uplift Resistance of Roof Assemblies.
2- UL 723 - Standard for Test for Surface Burning Characteristics of Building Materials.

K- US Army Corps of Engineers (COE):
1- COE Unified Facilities Guide Specification Section 07 61 13.

1.7 DEFINITIONS

A. Building Width: Measured from outside to outside of sidewall girts. Typically edge to edge of concrete.
B. Building Length: Measured from outside to outside of end wall girts. Typically edge to edge of concrete
C. Building Line: Outside face of steel/girt.
D. Building Eave Height: Measured from the top of the eave member at the outside of the sidewall girt line to the bottom of the sidewall column base plate or to finished floor if columns are on grout or recessed below finished floor.
E. Bay Spacing: Measured from centerline to centerline of primary frames for interior bays and from centerline of the first interior frame to outside of end wall girts for end bays.
F. Roof Pitch: The ratio of the vertical rise to the horizontal run (i.e. 1:12 = 1 inch of rise for every foot of horizontal dimension).

1.8 SYSTEM DESCRIPTION

A. General:

1. Provide metal building frame, metal roof panels, accessories and miscellaneous materials for a complete enclosure including supports for building components specified in other sections.
2. Design structural systems according to professionally recognized methods and standards and legally adopted building codes.
3. Design under supervision of professional engineer licensed in the jurisdiction of the Project.
4. See Section 00 8100 for additional requirements.

B. Design Requirements: (See drawing sheet S002).

1. Bay size: As shown on the drawings.
2. Roof pitch: As shown on the drawings.
3. Building location zip code: 87010
4. Roof Live Load20 psf
5. Roof Live Load20 psf
6. Ground Snow Load 30 psf
7. Collateral Loads: 10 psf
8. Seismic Loads: Calculate in accordance with applicable code
9. Building use/importance Category II Exposure “C”.
10. Dead loads, including the weight of all indicated permanent construction:
11. Elements required for support of lights and light battens, hanging fixtures, mechanical equipment, piping, ceiling hanger wires, and all other items required to provide a complete building and not specifically indicated on the drawings.
12. Wind Loads:
13. Roof Wind Load: Calculate in accordance with applicable code, using 115 mph Basic Wind Speed
14. All load and code information must be obtained directly from the authority having jurisdiction.

C. Performance Requirements:

1. System to withstand gravity and lateral loads in compliance with contract documents.
2. Refer to contract drawings for additional concentrated loads to pre-engineered building hanger beams and support jacks.
3. Allowable Deflections: Deflection/drift criteria shall follow recommendations outlined in AISC Design Guide 3 and MBMA Serviceability recommendations.
4. Metal wall panels (interior and exterior) shall not to be used as shear elements. Specify if metal wall and girt assembly require specific deflection constraints
5. Construct assembly to permit movement of components without buckling, failure of joint seals, undue stress on fasteners or other detrimental effects, when subject to temperature range of 100 degrees F (37 degrees C) in a 24 hour period.
6. Design and fabricate wall and roof systems free of distortion or defects detrimental to appearance or performance. Some oil canning in rolled panels especially in the flats of the panel is normal and is not cause for rejection.

D. Serviceability Criteria: Deflection limits for major components based on VP Buildings standards unless otherwise noted. Deflection requirements on hangars with sliding or fabric doors need to be included for the door support frames both from dead load deflection in inches and uplift deflection in inches. This may differ from the building due to the specific door requirements and should be supplied to eliminate future deflection issues.

1.9 SUBMITTALS

A. Submit under provisions of Section 01300 - Administrative Requirements.
B. Design Data: Provide detailed design criteria and calculations prepared by a licensed structural engineer.
C. Certification: Manufacturer certification that the building conforms to the contract documents and manufacturer's standard design procedures.
D. Shop Drawings: Show building layout, primary and secondary framing member sizes and locations, cross-sections, and product and connection details.
    1. Anchor Bolt Installation Drawings: Layouts with minimum bolt diameters (anchors are typically by others in the metal building industry).
E. Product Data: Information on manufactured products to be incorporated into the project.
F. Selection Samples: For each finish product specified, two complete sets of color chips representing manufacturer's full range of available colors and patterns.
G. Verification Samples: For each finish product specified, two samples, minimum size 6 inches square, representing actual product, color, and patterns.
H. Certificates: Welder certifications

1.10 QUALITY ASSURANCE

A. Manufacturer Qualifications: Not less than 5 years experience in the actual production of specified products.
    1. Member of the Metal Building Manufacturer's Association (MBMA).
    2. Primary manufacturer of frames, secondary steel, roof and wall sheeting, and trim.
B. Installer Qualifications - Firm experienced in application or installation of systems similar in complexity to those required for this project, plus the following:
    1. Acceptable to or licensed by manufacturer.
    2. 3 years experience with systems.
    3. Successfully completed not less than 5 comparable scale projects using this system.

1.11 DELIVERY, STORAGE, AND HANDLING

A. Store products in manufacturer's unopened packaging until ready for installation.
B. Store and dispose of solvent-based materials, and materials used with solvent-based materials, in accordance with requirements of local authorities having jurisdiction.

1.12 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 recommended limits.

1.13 WARRANTY

A. Manufacturer shall warranty installed system for the periods described herein, starting from Date of Substantial Completion or ninety days from delivery, whichever comes first, against all the conditions indicated below. When notified in writing from Owner, manufacturer/installer shall, promptly and without inconvenience and cost to Owner, correct said deficiencies.
    1. Materials and Workmanship Warranty:
        i- Warranty Period: 3 years, standard.
    2. Structural NDL Endorsement:
        i- Warranty Period: 10 years.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Requests for substitutions will be considered in accordance with provisions of Section 01600 - Product Requirements.

2.02 STRUCTURAL STEEL FRAMING

A. Primary Framing: Rigid Frame (RF Series) solid web framing consisting of tapered or uniform depth rafters rigidly connected to tapered or uniform depth columns. Provide a clear span that supports the loads at bay spacing indicated. Frames can have a roof pitch as low as 1/4:12 and span can typically range from 30 feet to 300 feet in increments of 1/16 inch (1.6 mm) spacing, with the steel yield of 55 ksi.

B. End Wall Framing: Corner posts, end posts and rake beams.

2.03 SECONDARY FRAMING

A. Purlins: Zee-shaped; depth as required; with minimum yield strength of 60,000 psi (410 MPa); simple span or continuous span as required for design. G-30 galvanized standard material with G-90 availability. Welded members are manufacturer's standard primer. Continuous for zees only.
   i. Purlin Size: 8.5 inches.

B. Girts: Zee- or Cee-shaped; depth as required, with minimum yield strength of 60,000 psi (410 MPa); simple span or continuous span as required for design. G-30 galvanized standard material with G-90 availability. Welded members are manufacturer's standard primer.
   i. Girt Size: 8.5 inches.

C. Wind Bracing: Portal, torsional, diagonal bracing or diaphragm in accordance with manufacturer's standard design practices; utilizing rods, angles, and other members, with minimum yield strengths as required for design but in most cases, 50 ksi.

2.04 MISCELLANEOUS FRAMING

A. Base Angles: Nominal 2 inch by 3 inch by 0.060 inch acrylic coated G30 galvanized steel angles, with minimum yield strength of 55 ksi (380 MPa), anchored to the floor slab or grade beam with power driven fasteners or equivalent at a maximum spacing of 2 feet (610 mm) (on center and not more than 6 inches from the end of any angle member. Anchors are not provided by the metal building manufacturer.

B. Door Headers and Jambs: Zee- or Cee-shaped; depth as required; with minimum yield strength of 60 ksi (410 MPa).

2.10 ROOF COVERING SYSTEM (See SECTION 07 4113 EXPOSED FASTENER METAL ROOFING)

A. Roof Panels: 7/8 Corrugated Metal Panels
   i. Material (Unpainted): Acrylic coated AZ55 Galvalume coated steel.
   ii. Thickness: 24 gage.
   iii. Galvalume Finish.

2.20 INSULATION

A. See Section 07 2130 PRE-ENGINEERED BUILDING INSULATION for wall and roof insulation relating to this section.

2.22 INSULATION SUPPORT SYSTEM

A. Insulation Support System: as required by Section 07 2130 PRE-ENGINEERED BUILDING INSULATION
   1. Description:
      i. Compatible with roof system.
      ii. Limit to "over-the-purlin" type insulation systems.

2.31 WALL ACCESSORIES

A. Windows: See Section 08 5113 ALUMINUM WINDOWS
B. Doors – See Section 08 1113 HALLOW METAL DOORS AND FRAMES
C. Louvers: 18 gage G-90 galvanized steel, self-framing, self-flashing with integral head gutter, with paint finish:
    i. Type: Operable blade, with weather-stripped blades and 15 feet of pull chain with dogging clip. Blades open up to 45 degrees.
    ii. Self-flashing to Panel Rib, Reverse Panel Rib or Vee Rib wall panels
    iii. Screen: Exterior mounted, removable insect screen.
    iv. Minimum free area: 65 percent.
    v. Color: Manufacturer's standard bronze.
D. Wall Openings: Cold-formed sheet metal framing concealed with manufacturer's standard colored trim.

2.32 ROOF ACCESSORIES

A. See Section 07 7200 ROOF ACCESSORIES
B. Eave Gutters: Roll-formed 26 gage steel sheet, with gutter straps, fasteners and joint sealant; manufacturer's
C. Multi-Gutters and Valley Gutters: 0.059 inch (17 gage) thick cold-formed steel sheet.
    1. Finish: G90/Z275 galvanized coated.
D. Roof Curbs: Welded units fabricated for shingled installation with roof panels; minimum 18 gage Galvalume coated steel, with welds cleaned and treated with protective coating compatible with the Galvalume substrate.
    1. Top of curbs horizontal with 1-1/2 inch perimeter flange.
    2. Curb walls insulated with 1-1/2 inch, 3 pcf density rigid glass fiber insulation.
    3. Water diversion: Integral 4 inch high by full length cricket on upslope side.
    4. Exposed curb flanges pre-drilled for correct fastener locations.
    5. Upslope and down slope curb flanges with integral welded inside and outside cell closures compatible with the roof panel profile.
    6. Curb framing: Mounted on secondary structural members and installed from the top; compatible with the thermal expansion and contraction properties of the roof on which it is used.
    7. Opening size: As indicated on drawings.
    8. Roof Access Hatch: Manufacturer's standard 30 by 36 inch opening, with curb.

2.41 MATERIALS

A. Structural Steel Plate, Bar, Sheet, and Strip for Use in Bolted and Welded Constructions: ASTM A 572/A 572M, A 529/A 529M, A 1011 or A 36/A 36M Modified 50, with minimum yield strength of 55,000 psi (380 MPa).
B. Galvanized Structural Steel Material for Use in Roll Formed or Press Broken Secondary Structural Members: ASTM A 563, with minimum yield strength of 60,000 psi (410 MPa).
C. Galvanized Steel Sheet for Roll Formed or Press Broken Roof and Wall Coverings, Trim and Flashing: ASTM A 653/A 653M, with minimum yield strength of 50,000 psi (345 MPa).
D. Galvalume Steel Sheet Used in Roll Formed or Press Broken Roof Covering: Aluminum-zinc alloy-coated steel sheet, ASTM A 792/A 792M, with minimum yield strength of 50,000 psi (345 MPa); nominal coating weight of 0.5 oz per sq ft both sides, equivalent to an approximate coating thickness of 0.0018 inch both sides.
E. Hot Rolled Steel Shapes: W, M and S shapes, angles, rods, channels and other shapes; ASTM A 500, ASTM A 572/A 572M or ASTM A 36/A 36M as applicable; with minimum yield strengths required for the design.
F. Structural Bolts and Nuts Used with Primary Framing: High strength, ASTM A 325 bolts and ASTM A563 Grade C nuts.
G. Bolts and Nuts Used with Secondary Framing Members: High Strength ASTM A 325 Bolts and ASTM A 563 Grade C nuts.

H. Panel Fasteners:
    1. For Galvalume and KXL finished roof and wall panels: Stainless Steel-capped carbon steel fasteners with integral sealing washer.
    2. Color of exposed fastener heads to match the roof or wall panel finish.
    3. Concealed Fasteners: Self-drilling type, of size as required.
        i. Provide fasteners in quantities and location as required by the manufacturer.

I. Flashing and Trim: Match material, finish, and color of adjacent components. Provide trim at rakes, including peak and corner assemblies, high and low eaves, corners, bases, framed openings and as required or specified to provide weather tightness and a finished appearance.

J. Sealants, Mastics and Closures: Manufacturer's standard type.
    1. Provide at roof panel end laps, side laps, rake, eave, transitions and accessories as required to provide a weather resistant roof system; use tape mastic or gun grade sealant at side laps and end laps.
    2. Provide at rakes, eaves, transitions and accessories.
    3. Closures: Formed to match panel profiles; closed cell elastic material, manufacturer's standard color.
    4. Tape mastic: Pre-formed butyl rubber-based, non-hardening, non-corrosive to metal; white or light gray.
    5. Gun grade sealant: Non-skinning synthetic Elastomeric based material; gray or bronze.

PART 3 EXECUTION

3.01 FABRICATION

A. Fabrication: Fabricate according to manufacturer's standard practice.
    1. Fabricate structural members made of welded plate sections by jointing the flanges and webs by continuous automatic submerged arc welding process.
    2. Welding operators and processes: Qualified in accordance with AWS D1.1.
    3. Field connections: Prepare members for bolted field connection by making punched, drilled, or reamed holes in the shop.

B. Component Identification: Mark all fabricated parts, either individually or by lot or group, using an identification marking corresponding to the marking shown on the shop drawings, using a method that remains visible after shop painting.

3.11 EXAMINATION

A. Verification of Conditions: Examine areas and conditions under which work is to be performed and identify conditions detrimental to proper and or timely completion.
    1. Verify foundations are properly installed, to correct dimensions and within acceptable tolerances.
    2. Verify location of covered or built-in work.
    3. Do not proceed until unsatisfactory conditions have been corrected.

3.12 PREPARATION

A. Framing Erection: Erect framing in compliance with AIS Specification and the latest edition of the MBMA metal building systems manual.

B. Provide for erection and wind loads. Provide temporary bracing to maintain structure plumb and in alignment until completion of erection and installation of permanent bracing. Locate braced bays as required by manufacturer.

3.13 ERECTION OF FRAME

A. Install in accordance with manufacturer's instructions.

1. Do not erect frames without complete installation of tie beams and anchorages.
2. Set column base plates with non-shrink grout to full plate bearing.
3. Do not field cut or alter structural members without written approval.
4. After erection, prime welds, abrasions, and surfaces not primed with primer used in shop painting.

3.14 INSTALLATION

A. Install in compliance with manufacturer's instructions and approved submittals.

1. Exercise care when cutting prefinished material to ensure cuttings do not remain on finish surface.
2. Fasten cladding system to structural supports, aligned level and plumb.
3. Locate end laps over supports. End lap panels according to manufacturer's recommendations. Place side laps over adjacent panel and mechanically seam or stitch fastener per erection guidelines.
4. Provide expansion joints where indicated.
5. Use concealed fasteners.
6. Install sealant and gaskets to prevent weather penetration.
7. Install system free of rattles, noise due to thermal movement, and wind whistles.
8. Install door frames, service doors, overhead doors, window and glass, and gutter system in compliance with manufacturer's instructions.
9. Seal wall and roof accessories watertight and weather tight with sealant in compliance with building manufacturer's standard procedures.
10. Rigidly support and secure gutters and downspouts. Joint lengths with formed seams sealed watertight. Flash and seal gutters to downspouts.

B. Tolerances:

1. Framing Members: 1/4 inch from level; 1/8 inch from plumb.
2. Racking: 1/8 inch from true position. Provide shoring to maintain position prior to cladding installation.

1.14 FIELD QUALITY CONTROL

A. Testing by Contractor:

1. Roof installation inspection by roof manufacturer's representative; as required as part of warranty provision.
2. High Strength Bolted Connections: Specification for Structural Joints Using ASTM A 325 or A 490 Bolts, with minimum testing of bolted connections per the arbitration inspection procedure.
3. Welded Connections: AWS. Visual inspection of 100 percent of welds.
4. General Testing: For materials and installed tolerances.

END OF SECTION 13 120

SECTION 22 0500
COMMON WORK REQUIREMENTS FOR PLUMBING

PART 1 GENERAL

1.01 SCOPE OF WORK

A. See General Conditions and Supplemental General Conditions.

B. The requirements listed under General Conditions and Supplemental General Conditions and the General Requirements are applicable to this section and all subsequent Sections of Division 22 and form a part of the contract.

C. Division 21 for Fire Suppression Systems.

D. Division 23 for Heating, Ventilating & Air Conditioning (HVAC) Systems.

E. Division 26 for Electrical Systems.

F. Section 22 0503 for Trenching, Backfilling and Compaction requirements.

G. All electrical work, regardless of voltage which is provided under Division 22 shall comply with the requirements of the National Electric Code (NEC) and Division 26.

1.02 PLUMBING DIVISION INDEX

Section 22 0500	Common Work Requirements for Plumbing
Section 22 0503	Trenching and Backfilling for Plumbing
Section 22 0504	Pipe and Pipe Fittings for Plumbing
Section 22 0505	Piping Specialties for Plumbing
Section 22 0523	Valves for Plumbing
Section 22 0548	Vibration and Seismic Controls for Plumbing
Section 22 0549	Plumbing and Electrical Installation Coordination
Section 22 0700	Plumbing Insulation
Section 22 1100	Domestic Water Piping
Section 22 1123	Facility Natural Gas System
Section 22 1400	Facility Roof and Area Drainage
Section 22 4000	Plumbing Fixtures and Trim

1.03 CODES AND PERMITS

A. The plumbing work shall be performed in strict accordance with the applicable provisions of the International Building Code, 2015 Edition; the Uniform Plumbing Code, 2015 Edition; the Uniform Mechanical Code, 2015 Edition and the International Fire Code, 2015 Edition as adopted and interpreted by the State of New Mexico, and the National Fire Protection Association (NFPA Regulations), current adopted edition, regarding plumbing systems and electrical systems. All materials and labor necessary to comply with rules, regulations and ordinances shall be provided. Where the drawings and/or specifications indicate materials or construction in excess of code requirements, the drawings and/or specifications shall govern. The Contractor shall hold and save the Architect free and harmless from liability of any nature or kind arising from his failure to comply with codes and ordinances.

B. Permits necessary for performance of the work shall be secured and paid for by the Contractor. All utility connections, extensions, meter pits and meter sets and tap fees for water, storm sewer, sanitary sewer and natural gas shall be paid for by the Contractor, unless otherwise specified herein.

C. The following lists some applicable codes and standards that shall be followed.

Applicable county and state mechanical, electrical, gas, plumbing, health and sanitary codes, laws and ordinances.

National Electrical Manufacturer's Association Standards

National Electrical Code

Underwriters Laboratories, Inc. Standards

American National Standards Institute

American Society for Testing Materials Standards

Standards and requirements of local utility companies.

National Fire Protection Association Standards

American Society of Mechanical Engineers Boiler and Pressure Vessel Codes

Occupational Safety and Health Act

Commercial and Industrial Insulation Standards (MICA)

American Gas Association

The American Society of Sanitary Engineering

National Sanitation Foundation

1.04 RECORD DRAWINGS

A. See Division 1, for requirements associated with Project Record Drawings.

B. The Contractor shall be responsible to maintain a complete and accurate set of marked up PDFs or prints showing information on the installed location and arrangement of all plumbing work, and in particular, where changes were made during construction. The Contractor shall be responsible for keeping record drawings accurate and up-to-date throughout the construction period. Record drawings may be reviewed and checked by the Architect during the construction and in conjunction with review and approval of monthly pay requests. Contractor shall include copies of all addenda, RFI's, bulletins, and change orders neatly taped or attached to record drawing set.

1.05 QUALIFICATIONS

A. All mechanics shall be skilled in their respective trade.

B. All welders shall be certified in accordance with the ASME Boiler Test Code, Section IX, latest issue.

1.06 QUALIFICATION PROCEDURES

A. The storage, handling, and transportation of all refrigerants, oils, lubricants, etc. shall be accomplished in strict compliance with all State, local, and Federal Regulations including all requirements set forth by the Environmental Protection Agency (EPA) for the safe handling of regulated refrigerants and materials. The Contractor shall utilize qualified and/or certified personnel and equipment as prescribed by these requirements. In no situation shall any refrigerant be discharged to the atmosphere. All refrigerants recovered from all systems shall be returned to the owner.

1.07 HAZARDOUS CONDITIONS

A. Protruding metal (bolts, steel angles, etc.) potentially hazardous to maintenance and operation personnel, shall be cut back and/or protected to reduce the risk of injury.

1.08 HAZARD SIGNS

A. Equipment rooms, fan plenums, and similar areas containing moving or rotating parts, or other potentially hazardous environments shall include signs on all doors entering such spaces that shall read similar to the following: "Hazardous Area - Authorized Personnel Only."

B. Confined Spaces: Areas designated by OSHA Standard 1910.146 as a confined space shall be marked with a sign that reads "Confined Space - Entry by authorized personnel only, by permit."

1. "Confined Space" means a space that:

a. Is large enough and so configured that an employee can bodily enter and perform assigned work; and

b. Has limited or restricted means for entry or exit (for example, tanks, vessels, storage bins, hoppers, vaults, and pits are spaces that may have limited means of entry); and

c. Is not designed for continuous employee occupancy.

C. The Contractor shall survey the final premises to determine where any such potentially hazardous areas exist. If the Contractor feels that hazards exist which cannot be suitably provided for through the above typical methods, he shall forward in writing his concerns, and request for a decision concerning the referenced hazard, prior to the final inspection of the facilities.

1.09 SUBMITTALS

A. The Contractor shall submit submittal brochures of all equipment, fixtures and materials to be furnished under Division 22, including but not limited to the following:

1. Piping materials, valves, insulation materials and installation methods, vibration isolation devices, pipe penetration installation methods and products for fire rated assemblies, and all plumbing equipment listed on equipment schedules, and in related construction documents.

2. Materials, certification, shop drawings, and other information as specified in the individual Division 22 Specification Sections within this Specification.

B. Unauthorized Substitutions: If substitute materials, equipment or systems are installed without prior review or are installed in a manner which is not in conformance with the requirement of this Specification and for which the Contractor has not received a written review, removal of all the unauthorized materials and installation of those indicated or specified shall be provided at no change in contract amount.

C. All equipment shall be installed in accordance with the manufacturer's recommendations. Provide all accessories and components for optimum operation as recommended by the manufacturer.

D. Expense: All costs for the preparation, correction, delivery, and return of the submittals shall be borne by the Contractor.

E. Complete data must be furnished showing performance, quality and dimensions. No equipment or materials shall be purchased prior to receiving written notification that submittals have been reviewed and marked either "NO EXCEPTIONS TAKEN" or "EXCEPTIONS AS NOTED." Submittals returned marked "EXCEPTIONS AS NOTED" do not require resubmittal provided that the Contractor agrees to comply with all exceptions noted in the submittal, and so states in a letter.

F. Review of Submittals: Submittals will be reviewed with reasonable promptness, but only for conformance with the design concept of the Project and for conformance with the information indicated on the Drawings and stated in the Specifications. Review of a separate item as such will not indicate review of the assembly in which the item functions. Review of submittals shall not relieve the Contractor of responsibility for any deviation from the requirements of the Contract Documents, nor for errors or omissions in the submittals; or for the accuracy of dimensions and quantities, the adequacy of connections, and the proper and acceptable fitting, execution, functioning and completion of the work. Review shall not relieve the Contractor of responsibility for the equipment fitting within the allotted space shown on the drawings with all clearances required for equipment operation, service and maintenance including minimum clearances required by applicable codes, manufacturer's installation instructions and as necessary for proper clearance in front of all electrical panels as defined by the National Electric Code (NEC). Any relocation of plumbing and/or electrical equipment, materials and systems required to comply with minimum clearances shall be provided by the Contractor without additional cost under the Contract.

G. Shop drawings will be returned unchecked unless the following information is included: cover sheet shall be provided for each submittal of equipment, products and material proposed for use on the project. A common cover sheet for similar equipment (example: all air handling units or all fire protection products) is acceptable. The cover sheet shall list equipment by symbol number; reference all pertinent data in the Specifications or on the drawings; provide size and characteristics of the equipment, name of the project and a space large enough to accept a review stamp. The data submitted shall reflect the actual equipment performance under the specified conditions and shall not be a copy of the scheduled data on the drawings. Cover sheet shall clearly identify any deviations from the specifications for submitted equipment, products, and materials.

H. Use of substitutions reviewed and checked by the Engineer does not relieve the Contractor from compliance with the Contract Documents. Contractor shall bear all extra expense resulting from the use of any substitutions where substitutions affect adjoining or related work required in this Division or other Divisions of this Specification.

I. If Contractor substitutes equipment for that drawn to scale on the drawings, he shall prepare a 1/4" = 1'-0" installation drawing for each equipment room where a substitution is made, using dimensions of substituted equipment, and including piping, and electrical equipment requirements, to verify that equipment will fit space with adequate clearances for maintenance. This 1/4" = 1'-0" fabrication drawing shall be submitted for review with the shop drawing submittals of the substitution. Failure to comply with this requirement will result in the shop drawings being returned unchecked.

1.10 COORDINATION DRAWINGS

A. The Contractor shall, in advance of the work, prepare coordination drawings for:

1. Equipment rooms, and other spaces housing plumbing and equipment, etc.
2. Piping and chases.
3. Complete plumbing piping systems located within the building.
4. Layout of all plumbing equipment.

B. Show the location of piping openings through the building floors, walls and roofs coordinated with Architectural and Structural, as well as the location and elevations of building fire suppression equipment and systems, including piping, coordinated with HVAC plumbing, and electrical systems. Coordination drawings, including plans, elevations and sections, as appropriate, shall clearly show the manner in which the plumbing systems fit into the available space and coordinates with HVAC and plumbing equipment, ductwork, piping, sprinkler heads, and electrical equipment, including conduits, light fixtures, motor control centers, transformers, panels, variable frequency drives, etc. Drawings shall demonstrate required code clearances for mechanical and electrical equipments, control panels, etc., and proper operation, maintenance and replacement of plumbing devices and equipment. Coordination drawings shall be of appropriate scale to satisfy the previously stated purposes, but not smaller than 1/8 inch scale for floor plans and 1/4 scale of equipment rooms and chase areas. Drawings may be composite or may be separate but fully coordinated drawings of the same scale. Every subcontractor must sign-off on coordination drawings prepared by each craft. Failure to sign-off will indicate that subcontractor is proceeding at his own risk. Any cost required to relocate systems to comply with required clearance and equipment installation requirements shall be provided by the Contractor without additional cost under the contract.

C. Seven (7) complete sets of coordination drawings shall be submitted prior to the scheduled start of the work in the area illustrated by the drawings, for the purpose of showing the Contractor's planned method of installation. The objectives of such drawings are to promote carefully planned work sequence and proper coordination, in order to assure the expeditious solutions of problems, and the installation of lines and equipment as contemplated by the contract documents while avoiding or minimizing additional costs to the Contractor and to the Owner.

D. In the event the Contractor, in coordinating the various installations and in planning the method of installation, finds a conflict in location or elevation of any of the plumbing systems, with the

structural items or with other construction items, such conflicts shall immediately be documented and submitted for clarification. In doing so, the Contractor shall explain the proposed method of solving the problem, or shall request instructions as to how to proceed if adjustments beyond those of usual trades coordination are necessary.

E. Installation of plumbing work shall not proceed prior to the submission and completion of the review of the coordination drawings, and any conflicts which are disclosed by the coordination drawings. It is the responsibility of the Contractor to submit the required drawings in a timely manner consistent with the requirements for completing the work covered by this contract within the prescribed contract time.

1.11 USE OF CADD FILES

A. Under certain conditions, the Contractor will be permitted the use of the Engineer's CADD files for documentation of as-builts, submittals, or coordination drawings.

B. The Engineer shall be compensated for the time required to format the CADD files for delivery to the Contractor. Such work may include removal of title blocks, professional seals, calculations, proprietary information, etc.

C. The Contractor shall complete the enclosed License, Indemnity and Warranty Agreement, complete with contractor's name, address, and Contractor's Representative signature prior to request for CADD file usage.

1.12 PRIOR APPROVAL

A. Prior approval (approval prior to bid) of alternate mechanical equipment suppliers and service providers is not required. Please do not request prior approval. Alternate manufacturers and service providers may be submitted after bid in accordance with the submittal process provided they meet or exceed the specifications and the indicated design intent.

B. Equipment manufacturers and service providers are listed within the specifications for the work specified in this division. For the items listed below, the specified manufacturers and providers are the only ones presently approved, and may be the only ones allowed:

C. Manufacturers and service providers who are not listed in these specs, and who offer equivalent or superior products or services, are invited to submit for approval prior to bid (prior approval). Submit two copies. Requests for prior approval must:

1. Include the substitution request form at the end of this spec section.
2. Include technical data sufficient for the Engineer to generally assess appropriateness for this project.
3. Be submitted minimum ten days prior to the bid date in effect at the time of submission.
4. Comply with any additional requirements per specification Division 1.

D. Any additional prior approved alternate manufacturers and service providers will be published in an addendum prior to bid. Prior approval indicates that based on the information submitted it appears to the Engineer that the alternate might be capable of meeting the specifications and the design intent, and might be appropriate for the project. But prior approval does not guarantee this. Prior approved products and service providers must still go through the submittal process after award, and must still comply with the design intent and all specification requirements.

E. Please do not request prior approval for products and service providers that are not listed above. Instead, for those items alternate manufacturers and alternate service providers may be submitted after bid in accordance with the submittal process, provided they meet or exceed the specifications and the indicated design intent.

1.13 GUARANTEE-WARRANTY

A. The following guarantee is a part of the specifications and shall be binding on the Contractor:

"The Contractor guarantees that this installation is free from defects. He agrees to replace or repair any part of the installation which may fail within a period of one year after date established below, provided that such failure is due to defects in the materials or workmanship or to failure to follow the specifications and drawings. Warranty of the

Contractor-furnished equipment or systems shall begin on the date the system or equipment is placed in operation for beneficial use of the Owner or occupancy by the Owner, whichever occurs first; such date will be determined in writing, by means of issuing a 'Certificate of Substantial Completion', AIA Form G704", or equivalent.

B. The extent of guarantees or warranties by Equipment and/or Materials Manufacturers shall not diminish the requirements of the Contractor's guarantee-warranty to the Owner.

Hot Water Generators

Water Softeners

PART 2 PRODUCTS

2.01 QUALITY OF MATERIALS

A. All equipment and materials shall be new, and shall be the standard product of manufacturers regularly engaged in the production of plumbing equipment and shall be the manufacturer's latest design. Specific equipment, shown in schedules on drawings and specified herein, is to set forth a standard of quality and operation.

B. Hazardous or Environmentally Damaging Materials: Products shall not contain asbestos, mercury, PCS, or other materials harmful to people or the environment.

2.02 ALTITUDE RATINGS

A. Unless otherwise noted, all specified equipment capacities are for an altitude of 5000 feet above sea level and adjustments to manufacturer's ratings must be made accordingly.

2.03 ELECTRICAL SERVICES - MOTORS

A. Each motor, unless otherwise specified of 3/4 HP and greater, shall be designed for operation with 3 phase, 60 Hz, 460 volt electrical service. Unless otherwise specified, motors of 1/2 hp and less shall be designed for operation with single phase, 60 Hz, 120 volt electrical service. Motors shall be 1750 RPM, squirrel cage, normal starting torque and normal starting current, in accordance with NEMA standards unless otherwise specified.

B. All T-frame, ODP motors 5 HP and above shall be premium efficiency motors with a minimum power factor of 0.85 on 1800 RPM motors and a minimum efficiency rating in accordance with IEEE Standard 112, Test Method ‘B’ as scheduled below. In addition, all motors used in conjunction with variable frequency drives shall be premium efficiency.

NEMA EFFICIENCY	
Motor Horsepower	Efficiency, Minimum
5	90.2
7-1/2	91.0
10	91.7
15	92.4
20	93.0
25	92.4
30	93.0
40	93.6
50	93.6
60	93.6
75	95.0

C. Motors, including premium efficiency motors shall be manufactured by General Electric Baldor, Louis Allis (Spartan), Marathon, Reliance Electric, Westinghouse, or equivalent having equal efficiencies.

D. Special motors as may be necessary by the application and as specified herein and on the drawings include C-FACE, totally enclosed fan cooled (TEFC),explosion-proof, etc., shall be provided as required and shall be furnished manufacturer's premium efficiency rating for 5 HP and larger.

E. Each motor shall be of the horsepower as specified and suitable for use at an altitude of 5000 feet. All motors shall have grease lubricated sealed ball bearings. Motors larger than 1 HP shall have a standard grease fitting "Zerk" and a separate grease relief tapping. Motors shall be factory lubricated. Motors shall be commercially dynamically balanced and tested at the factory before shipment and shall be selected for quiet operation. The Contractor shall line up motors and drives and place motors and equipment on foundations ready for operation.

F. Unless indicated otherwise, motors shall be NEMA design B with a service factor of 1.15 with 40^0C rise and total temperature rise of 65^oC ambient and when powered from the system voltage feeding the motor. TEFC motors shall have a service factor of 1.00 with total temperature rise of 65^oC in the above conditions. Motors located in areas exceeding 40^oC in the ambient shall be factory rated for the ambient temperature of the motor environment. Single phase motors shall generally be NEMA Type N split phase induction motors with built-in thermal protectors. Unless otherwise specified for a particular application use electric motors with the following requirements.

1. Single-phase Motors: Capacitor-start type for hard starting applications. Motors for centrifugal fans and pumps may be split phase or permanent split capacitor (PSC).
2. Polyphase Motors: NEMA Design B, Squirrel cage, induction type. Each two speed motor shall have two separate windings.
3. Rating: Continuous duty at 100% capacity in an ambient temperature of 40^oC.

G. If the Division 22 Contractor proposes to furnish motors varying in horsepower and/or characteristics from those specified, he shall first submit his request for the change and shall then coordinate the change with Division 26 and shall pay all additional charges in connection with the change.

2.04 ELECTRICAL WIRING AND CONTROL EQUIPMENT

A. All wiring and conduit shall be furnished and installed as scheduled in Section 22 0549, Plumbing and Electrical Installation Coordination, unless otherwise noted or directed.

B. The Contractor shall coordinate completely with all trades and Sub-Contractors as required to ensure that all necessary components of control work are included and fully understood. No additional cost shall accrue to the Owner as a result of lack of such coordination.

C. The piping system may be bonded to the electrical ground bus at the electrical service equipment, but shall not under any circumstances be used as the main grounding electrode for the electrical service.

2.05 PAINTING

A. All finish painting of plumbing systems and equipment will be under "Painting," unless equipment is hereinafter specified to be provided with factory applied finish coats.

B. All equipment shall be provided with factory applied prime finish, unless otherwise specified.

C. Touch-Up: If the factory finish on any equipment is damaged in shipment or during construction of the building, the equipment shall be refinished.

2.06 COUPLING GUARDS

A. All flexibly connected pumps shall be provided with protective steel coupling guards.

2.07 IDENTIFICATION OF VALVES

A. Each valve shall be provided with a stamped metal tag secured to the valve. Tag shall indicate the valve number, the service and function of each valve and system valve numbers and designations shall be coordinated with existing valve identification. The Contractor shall furnish two sets of prints of drawings showing floor plan for each floor with all valves accurately located and labeled. Submitted drawings shall be neat and easily readable. In addition, the Contractor shall provide a valve chart, typed neatly on 8-1/2" x 11" sheets, listing the number, size, location, function, normal operating position, on each valve installed under Division 22. Valves shall be listed by system, i.e. domestic cold water, hot water, chilled water etc. Tags shall be stamped brass 1-1/2" diameter, and secured to valves by heavy copper figure eight hooks, braided stainless steel wire anchor, or other approved means.

B. Division 22 valve tags shall be coordinated with Division 21 and Division 23 valve tags for coordinated format between each Division.

C. Valve tags shall be coordinated with existing facility valve tags and Contractor shall obtain a copy of existing facility valve chart and provide updated valve chart to the Owner's Representative.

2.08 PIPING SYSTEM IDENTIFICATION

A. Means of Identification: All piping shall be identified by each of the means described below. The Contractor shall provide shop drawing submittal data for proposed labeling system materials and manufacturer's recommended installation procedures.

B. Piping Systems shall be identified by means of an identifying legend on color coded background appropriately worded to indicate the "service" name of the pipe as shown on the drawings. Color coded banding shall also be provided. Additionally, an arrow shall be included to indicate the direction of flow through the pipe.

C. Locations of Piping System Identification: The identifying legends and directional arrows described in the paragraphs preceding shall be located at the following points on each piping system:

- Adjacent to each valve in piping system.
- At every point of entry and exit where piping passes through a wall.
- On each pipe riser and junction.
- At a maximum interval of 20 feet on pipe lines exposed and concealed above accessible ceilings.
- Adjacent to all special fittings (regulating valves, etc.) in piping systems.
- At every access door.

D. Piping identification shall meet the standards of the Federal Occupational Safety Health Act (OSHA) which refers to the ANSI Standard A13.1. The following standardized color code scheme shall be used:

Yellow	- Hazardous Materials
Green	- Liquid Materials of Inherently Low Hazard
Blue	- Gaseous Materials of Inherently Low Hazard
Red	- Fire Protection Materials

E. The size of letter and length of color field shall conform to the ANSI standard and shall be as follows:

Outside Diameter of Pipe or Covering	Length of Color Field	Size of Letters
------ to 1-1/4"	8"	1/2"
1-1/2" to 2"	8"	3/4"
2-1/2" to 6"	12"	1-1/4"
8" to 10"	24"	2-1/2"
Over 10"	32"	3-1/2"

F. All pipe labels exposed within mechanical equipment spaces shall be semi-rigid plastic identification markers. Each label shall have appropriately color-coded background with printed legend. Directional flow arrows shall be included on label. Labels shall "snap-on" around pipe without the requirement for adhesive or bonding of piping sizes 3/4" through 5". Labels for piping 6" and larger shall be furnished with spring attachment at each end of label. Labels shall be "SETMARK" Type SNA, 3/4" through 5" size and Type STR, 6" and larger, as manufactured by Seton Name Plate Corporation, Brady, or equivalent.

G. Attach pipe markers to lower quarter of the pipe on horizontal runs and on the centerline of vertical piping where view is not obstructed. Flow indicator arrow shall point away from pipe marker.

H. Provide the following labels, with ANSI/OSHA color for all piping systems as shown on the drawings and as listed below:

Service/Legend	Letter Color	Background Color
Domestic Cold Water	White	Green
Domestic Hot Water	Black	Yellow
Domestic Hot Water Return	Black	Yellow
Soft Cold Water	White	Green
Soft Hot Water	Black	Yellow
Industrial (non potable) Cold Water	White	Green
Reverse Osmosis	White	Green
Compressed Air	White	Blue
Roof Drain	White	Green
Sanitary Sewer	White	Green
Storm Sewer	White	Green

2.09 IDENTIFICATION OF CONTROL SYSTEM DEVICES

A. All automatic controls, control panels, zone valves, pressure electric, electric pressure switches, relays and starters shall be clearly tagged and identified. Wording shall be identical to that on the control diagram in the contract drawings.

2.10 UNDERGROUND PIPING SYSTEM IDENTIFICATION

A. Bury a continuous, preprinted, bright colored, plastic ribbon cable marker with each underground pipe regardless of whether encased. Locate directly over buried pipe, 6" to 8" below finished grade. Marker tape used in conjunction with buried plastic piping systems shall be special detector type. Marker tape used in conjunction with buried plastic piping systems shall be special

detection type.

2.11 EQUIPMENT TAGS

A. Furnish and install equipment identification tags for all items of PLUMBING equipment furnished and installed under Division 22. Equipment tags shall be a minimum of 3/32" thick laminated phenolic plastic.

2.12 ACCESS DOORS

A. Provide all access doors required for access to valves, controls, or other items for which access is required for either operation or servicing. All costs incurred through failure to perform this function as the proper sequence of this work shall be borne by the Contractor. The type of access door shall be as required by the room finish schedule. Acoustical tile access doors shall be equal to Krueger Style B, Style A for acoustical plaster, Style C-CE for sidewall drywall or plaster construction.

B. Access doors shall be not less than 24" x 24" in size except that larger panels shall be furnished where required, and panels in tile or other similar patterned ceilings shall have dimensions corresponding to the tile or pattern module.

C. Where access doors are installed in walls required to have a specific fire rating, the access door installed shall be a fire rated access door with UL label, as manufactured by Milcor or equivalent. Access door in 1-hour construction shall be Class C and access doors in 2-hour construction shall be Class B.

PART 3 EXECUTION

3.01 COOPERATION WITH OTHER TRADES

A. The Contractor shall refer to other parts of these specifications covering the work of other trades which must be carried on in conjunction with the plumbing work so that the construction operations can proceed without harm to the Owner from interference, delay, or absence of coordination. The Contractor shall be responsible for the size and accuracy of all openings.

3.02 DRAWINGS

A. The plumbing drawings show the general arrangement of all piping, fixtures, equipment, etc., and shall be followed as closely as actual building construction and work of other trades will permit. Whenever discrepancies occur between plans and specifications, the most stringent shall govern. All Contract Documents, including but not limited to Division 21 Fire Suppression, Division 23 HVAC, and Division 26 Electrical shall be considered as part of the work insofar as this information furnishes the Contractor with details relating to design and construction of the building. Architectural and Structural drawings shall take precedence over the plumbing, HVAC and fire suppression drawings. Install plumbing fixtures, floor drains, floor sinks, roof drains, etc. in locations as indicated on Architectural drawings. Because of the small scale of the plumbing, HVAC and fire suppression drawings, it is not possible to indicate all offsets, fittings and accessories which may be required. The Contractor shall investigate the structural and finish conditions affecting the work and shall arrange his work accordingly, providing such fittings, valves, and accessories as may be required to meet such conditions. Should conditions necessitate a rearrangement of piping, such departures and the reasons therefore shall be submitted by the Contractor for review in the form of detailed drawings showing the proposed changes. No such changes shall be made without the prior written approval. All changes shall be marked on the set of record drawings by the Contractor.

B. Should any doubt or question arise in respect to the true meaning of the drawings or specifications, the question shall be submitted in writing.

C. Installation of all plumbing equipment and piping systems shall be arranged to provide all clearances required for equipment operation, service, and maintenance, including minimum clearances required by applicable codes, manufacturer's installation instructions and as necessary for proper clearance in front of all electrical panels as defined by the National Electric Code (NEC). Piping systems shall not be routed through or above electrical equipment room or electrical equipment space designed within equipment rooms.

D. The installation of all concealed plumbing systems shall be carefully arranged to fit within the available space without interference with adjacent structural and electrical systems. The Contractor shall make all necessary provisions for penetrations of piping, including sleeves and blockouts in structural systems. The exact location of all exposed plumbing systems; access doors; piping exposed within finished areas; and other equipment and devices as applicable, shall be coordinated with the Architect, who shall have final authority for the acceptance of the work as it specifically relates to the architectural aesthetic design requirements for the facility.

3.03 FIELD MEASUREMENTS

A. The Contractor shall verify the dimensions and conditions governing his work at the building. No extra compensation shall be claimed or allowed on account of differences between actual dimensions, including dimensions of equipment, fixtures and materials furnished, and those indicated on the drawings. Contractor shall examine adjoining work, on which his work is dependent for perfect efficiency, and shall report any work which must be corrected. Coordination of all plumbing work within the building will be the direct responsibility of the Contractor. Review of submittal data in accordance with paragraph "Submittals" shall in no manner relieve the Contractor of responsibility for the proper installation of the plumbing work within the available space. Installation of equipment and systems within the building space shall be carefully coordinated by the Contractor with all building trades. Each contractor shall so harmonize his work with that of the several other trades that it may be installed in the most direct and workmanlike manner without hindering or handicapping the other trades. Piping interferences shall be handled by giving precedence to pipe lines which require a stated grade for proper operation. Sewer lines shall take precedence over water lines in determination of elevations. In all cases, lines requiring a stated grade for their proper operation shall have precedence over electrical conduit and ductwork. Installation of plumbing, HVAC and fire suppression equipment within the ceiling cavity shall be in the following order of priority: plumbing waste lines; roof drains; supply, return, outside air, makeup, and exhaust ductwork; fire sprinkler mains; fire sprinkler branch piping and sprinkler runouts; heating hot water and chilled water piping; domestic hot and cold water; control piping, wiring and conduit;

3.04 EQUIPMENT SUPPORT

A. Contractor shall provide support for equipment to the building structure. Contractor shall furnish all necessary structures, inserts, sleeves, and hanging devices for installation of mechanical and plumbing equipment, ductwork and piping, etc. Contractor shall completely coordinate installation of such devices with all trades and Sub-Contractors. Contractor must further verify that the devices and supports are adequate as intended and do not overload the building's structural components in any way.

3.05 SEISMIC SUPPORTS

A. The Contractor shall be responsible for all anchors and connections for the mechanical work to the building structure to prevent damage of equipment and systems due to earthquakes. The complete fire protection systems shall be supported as required to resist stresses produced by lateral forces as required by NFPA No. 13. Where mechanical equipment, piping, and ductwork is connected to the building structure, exact method and means of attachment to the structural system shall be approved by the Architect.

B. See Section 22 0548 for requirements for seismic supporting of plumbing equipment and systems.

3.06 PROTECTION OF MATERIALS AND EQUIPMENT

A. The Contractor shall be responsible for the protection of all work, materials and equipment furnished and installed under this section of the specifications, whether incorporated in the building or not.

B. Plumbing equipment and materials, including piping, valves and fittings, etc., shall be protected from damage and contamination. Equipment and materials shall not be stored outside and exposed to weather and ambient conditions without appropriate protection measures and without the approval of the Architect. Equipment and materials shall be delivered to the jobsite and maintained while on the jobsite with all openings, controls and control panels covered with caps, with heavy duty polyethylene wrap or other proper means. Equipment and materials where stored

within the building shall be protected at all times from construction damage and contamination from dust, dirt, debris, and especially during fireproofing, painting and gypboard sanding and finishing. Unprotected equipment and piping will require special field cleaning by the Contractor prior to acceptance by the Architect and Owner's Representative.

C. The Contractor shall provide protection for all work where necessary and shall be responsible for all damage done to property, equipment and materials. Storage of materials within the building shall be approved by the Architect prior to such storage.

D. Pipe openings shall be closed with caps or plugs, or covered to prevent lodgment of dirt or trash during the course of installation. At the completion of the plumbing work, fixtures and materials shall be cleaned and polished thoroughly and delivered in a condition satisfactory to the Architect.

3.07 TRENCHING AND BACKFILLING

A. All excavation, trenching and backfilling required for the plumbing installation shall be provided by this Contractor.

3.08 MANUFACTURER'S INSTRUCTIONS

A. All equipment shall be installed in strict accordance with recommendations of the manufacturer. If such recommendations conflict with plans and specifications, the Contractor shall report such conflicts to the Architect and Owner's Representative, who shall make such compromises as he deems necessary and desirable.

3.09 CONCRETE BASES AND HOUSEKEEPING PADS

A. Concrete bases and housekeeping pads shall be installed under all pieces of plumbing equipment unless specifically deleted by the specifications or drawings.

B. Contractor shall be responsible for the accurate dimensions of all pads and bases and shall furnish and install all vibration isolators, anchor bolts, etc.

C. Contractor shall provide concrete housekeeping pad foundations for all floor mounted equipment installed under this section unless otherwise shown on the drawings. All concrete bases and housekeeping pads shall conform to the requirements specified under Division 3, Concrete, portions of these specifications. Pad foundations shall be 4" high minimum, unless otherwise indicated on the drawings. Chamfer edges shall be 1". Faces shall be free of voids and rubbed smooth with carborundum block after stripping forms. Tops shall be level. Provide dowel rods in floor for lateral stability and anchorage.

D. Equipment anchor bolts shall be set in a galvanized pipe or sheet metal sleeves 1" larger than bolt diameter. Anchor bolts shall be high strength steel J shape. Anchor bolt design shall be arranged and paid for by the Contractor.

E. Machinery bases, bed plates, sole plates, or vibration isolation units shall be carefully aligned, shimmed, leveled, then grouted in place with commercial non-shrink grout. When a flexible coupling is employed as a part of the drive train, the coupling shall be aligned before the machinery base is grouted.

3.10 ALIGNMENT OF FLEXIBLE COUPLINGS

A. Flexible couplings between motors and driven equipment shall be aligned by the qualified service technician after the equipment is installed and ready for operation. Proper aligning shall be provided within manufacturer's maximum alignment tolerance at equipment operating conditions and temperature. Alignment shall follow unit manufacturer's written procedures using approved dial indication methods for parallel and angular alignment. The Contractor shall provide written certification that each device has been so aligned.

3.11 LUBRICATION

A. The Contractor shall provide all oil for the operation of all equipment until acceptance. The Contractor shall be held responsible for all damage to bearings while the equipment is being operated by him up to the date of acceptance of the equipment. The Contractor shall protect all bearings and shafts during installation and shall thoroughly grease the steel shafts to prevent corrosion. Bearings for items of plumbing equipment shall be marked at each bearing location as to whether the bearing is a sealed type or relubricable type unit.

3.12 PRESSURE RELIEF DEVICES

A. Pressure relief devices and fusible plugs shall be installed with piping to a safe location in accordance with Code requirements.

3.13 TESTS

A. Tests shall be conducted in the presence of the designated and authorized Owner's Representative. The Contractor shall notify the Architect a minimum of one week in advance of scheduled tests. Requirements for testing are specified under the sections covering the various systems. The Contractor shall furnish all necessary equipment, materials, and labor to perform **the required tests.**

3.14 INSTALLATION CHECK

A. An experienced, competent, and authorized representative of the equipment listed below shall visit the site of the work and inspect, check, adjust if necessary, and approve the equipment installation. In each case, the equipment supplier's representative shall be present when the equipment is placed in operation. The equipment supplier's representative shall revisit the job site as often as necessary until all trouble is corrected and the equipment installation and operation is approved and accepted.

B. Each equipment supplier's representative shall furnish a written report certifying that the equipment (1) has been properly installed and lubricated; (2) is in accurate alignment; (3) is free from any undue stress imposed by connecting piping or anchor bolts; and, (4) has been operated under full load conditions and that it has operated satisfactorily.

C. Equipment requiring installation check includes the following:

End Suction Pumps

Domestic Water Heaters

3.15 OPERATION AND MAINTENANCE INSTRUCTIONS

A. The Contractor shall furnish complete operating and maintenance instructions covering all units of plumbing equipment fixtures, faucets, etc., herein specified together with parts lists. Equipment spare parts shall include all components requiring service, including motors, bearings, shafts, etc. A "Lubrication Chart" framed under Plexiglass shall be provided listing all types of oil to be used for each piece of equipment and the recommended frequency of lubrication. This chart shall be hung on the wall of the equipment room.

B. Operating and maintenance manuals as required herein shall be submitted for review and distribution to the Owner not less than two (2) weeks prior to the date scheduled for the Contractor to provide Operating and Maintenance Instructions to the Owner as specified herein.

C. Upon completion of all work and all tests, Contractor shall furnish the necessary skilled labor and helpers for operating the plumbing systems and equipment for a period of five (5) days of eight (8) hours each. During this period, the Contractor shall instruct the Owner or his representative fully in the operations, adjustment and maintenance of all equipment furnished. Contractor shall provide at least two weeks notice in advance of this period, with a written schedule of each training session, the subject of the session, the Contractors' representatives who plan to attend the session, and the time for each session.

D. Operational test shall be conducted by the Contractor with the assistance of the equipment manufacturer's representative or service technician. Test shall be conducted in the presence of the designated and authorized Owner's Representative.

3.16 CERTIFICATIONS

A. Before receiving final payment, the Contractor shall certify in writing that all equipment furnished and all work done is in compliance with the contract documents and all applicable codes. Submit certifications and acceptance certificates, including proof of delivery of O&M manuals, spare parts required, and equipment warranties which shall be bound with O&M manuals.

3.17 CONSTRUCTION PHASING AND SCHEDULE

A. All work furnished and installed under Division 22 of this Specification shall be provided in

accordance with the project schedule and phase requirements [as described on the Architectural Drawings and Specifications.

3.18 PLUMBING SYSTEM SHUTDOWN AND REACTIVATION

A. The Contractor shall shutdown existing facility plumbing equipment and piping systems as required for installation of the project plumbing construction work. As a part of the required work, the Contractor shall drain down the existing systems and after completion of new work and pressure testing of systems, the Contractor shall refill the systems and re-establish proper system circulation, remove all air from piping system and equipment, and place system in full and proper operation.

3.19 SITE VISITS AND OBSERVATION OF CONSTRUCTION

A. The design professional shall make periodic visits to the project site at various stages of construction in order to observe the progress and quality of various aspects of the Contractor's work, in order to determine in general if such work is proceeding in accordance with the Contract Documents. This observation, however, shall in no way release the Contractor from his complete responsibility to supervise, direct, and control all construction work and activities. The design team has no authority over, or a responsibility to means, methods, techniques, sequences, or procedures of construction provided by the Contractor or for safety precautions and programs, or for failure by the Contractor to comply with all law, regulations, and codes.

B. Prior to the "Final" observation visit, the attached "Final Observation Checklist" shall be completed by the Contractor. Any non-applicable items shall be marked "N/A." The completed form shall be submitted, indicating that all necessary items are complete and requesting a final observation within 10 days. The Contractor shall be notified of any uncompleted items within seven (7) days. A resubmittal of the form and a new final observation request by the Contractor is required if the form is returned and noted as incomplete.

END OF SECTION 22 0500

Project:_____ **Date Submitted:**____

General Contractor:_____ **Date of Final Mechanical System:**_____

Mechanical Contractor:_____ **Observation Requested:**_____

CONTRACTOR'S MECHANICAL & PLUMBING CHECK LIST
(ALL APPLICABLE ITEMS MUST BE COMPLETED PRIOR TO FINAL OBSERVATION)

In advance of requesting a final mechanical observation for installed mechanical systems, please check all items that have been completed. For all items not applicable to this project mark N/A.

HVAC/PIPING

_____1. All plumbing fixtures are set, sealed and cleaned.

_____2. All domestic pipe systems are insulated.

_____3. All pipe systems are identified with specified labels and directional arrows.

_____4. Floor sinks and drain grates are cleaned and debris removed.

_____5. Valve tags are installed.

_____6. Special equipment (water softeners, water heaters, piping systems, etc.) have been checked and put into service.

_____7. Medical gas systems have been checked and certified.

_____8. Special piping systems have been cleaned and pressure tested.

_____	Process Piping	_____	Nitrogen
_____	Compressed Air	_____	Vacuum
_____	Natural Gas	_____	Argon
_____	Other	_____	Medical Gas
		_____	Other

_____9. Limestone chips have been installed in acid dilution sumps.

_____10. Plumbing/piping connections have been completed to Owner furnished equipment and equipment furnished by other Contractors/Sub-Contractors.

_____11. Exterior wall hydrants have been cleaned.

_____12. Concrete collars have been installed at clean-out to grade, valve box, or other specified plumbing items.

_____13. Drains and relief lines from plumbing equipment have been installed and secured in a proper manner.

_____14. All plumbing equipment and areas of equipment have been cleaned and debris removed.

_____15. All plumbing equipment required by the Specifications has been identified and/or numbered.

_____16. Domestic water systems sterilization has been completed.

_____17. Strainers/suction diffusers have been cleaned.

_____18. Backflow preventers have been tested.

_____19. Air has been vented from all systems.

_____20. Ethylene glycol system has been charged with correct mixture and tested.

_____21. Water systems have been cleaned (X) and pressure tested (P).

_____	Non-potable Water	_____	Domestic Hot Water
_____	Domestic Cold Water	_____	Acid Waste and Vent
_____	Sanitary Sewer & Vent	_____	Roof and Overflow Drains
_____	Other (list)		

_____22. PRV's have been adjusted (water, gasses).

PLUMBING EQUIPMENT

_____1. All pump shafts and couplings have been aligned.

_____2. Boilers and domestic water heaters have been fired and tested.

_____3. All plumbing equipment has been lubricated.

_____4. Plumbing equipment has been labeled in accordance with the specifications.

_____5. "HAZARDOUS AREA" signs installed where applicable.

_____6. Variable frequency drives have been tested by the manufacturer's representative and certified to be in compliance with all of the specified requirements.

GENERAL ITEMS

The following specified items have been submitted:

_____1. Record drawings (to be submitted prior to final payment to the Contractor).

_____2. Operation and maintenance manuals.

_____3. Manufacturer's representative installation check and certification submitted (see list of equipment, Section 22 0500).

_____4. Test kits furnished to Owner.

_____ Flow Measuring Devices
_____ Flow Balance Valves
_____ Flow Control Devices

_____5. Control schematics and sequence of operation.

_____6. Plumbing equipment and lubrication, valve, charts have been provided to Owner's Representative.

END CHECKLIST

DIVISION 22 SUBSTITUTION REQUEST FORM (SRF)

TO: **BRIDGERS & PAXTON CONSULTING ENGINEERS, INC.**

PROJECT: _____

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

Section: _____ Page: _____ Paragraph/Line: _____ Specified Item: _____

Proposed Substitution: _____

_____

Attach complete product description, drawings, photographs, performance and test data, and other information necessary for evaluation. Identify specific Model Numbers, finishes, options, etc.

1. Will changes be required to building design in order to properly install proposed substitutions? YES ☐ NO ☐
   If YES, explain: _____
2. Will the undersigned pay for changes to the building design, including engineering and drawing costs, caused by requested substitutions? YES ☐ NO ☐
3. List differences between proposed substitutions and specified item.

Specified Item	Proposed Substitution
_____	_____
_____	_____
_____	_____

4. Does substitution affect Drawing dimensions? YES ☐ NO ☐
5. What affect does substitution have on other trades? _____
   _____
6. Does the manufacturer's warranty for proposed substitution differ from that specified? YES ☐ NO ☐
   If YES, explain: _____
   _____
7. Will substitution affect progress schedule? YES ☐ NO ☐
   If YES, explain: _____
   _____
8. Will maintenance and service parts be locally available for substitution? YES ☐ NO ☐
   If YES, explain: _____
   _____
9. Does proposed product contain asbestos in any form? YES ☐ NO ☐

SUBMITTED BY: Firm: _____ Date: _____

Address: _____

Signature: _____ Telephone: _____

For Engineer's Use Only

Accepted _____ Not Accepted: _____ Received too Late: _____

By: _____ Date: _____

Remarks: _____

LICENSE AGREEMENT FOR CADD DATABASE OR BIM MODEL

PROJECT: _____

LICENSE GRANT: Contractor is granted use of the CADD Database or BIM Model (Database/Model) for the indicated project for the specific purpose of preparing submittal documents for this Project. No other use of the Database/Model is granted. Title to the Database/Model is not transferred to the Contractor. The Database/Model may be of value to the Contractor in preparing submittals, but use of the model does not relieve the contractor of the requirement to verify measurements in the field.

COPYING RESTRICTIONS: Contractor may copy the Database/Model in whole or in part, but only for backup and archival purposes or for use by the Contractor's Subcontractors. Contractor agrees to ensure that any entities that receive the Database/Model from Contractor, either in whole or in part, comply with the terms and conditions of this agreement. Contractor shall safeguard the Database/Model from falling into the hands of parties other than Subcontractors with a legitimate need for it.

WARRANTY: Bridgers & Paxton (B&P) offers this Database/Model without warranty and specifically without express or implied warranty of fitness. If Contractor chooses to use the Database/Model, then he does so at his own risk and without any liability or risk to B&P.

INDEMNITY: Contractor shall to the fullest extent permitted by law, defend, indemnify and hold harmless the Owner, Architect, B&P, their employees and agents from all claims, damages, losses, and attorney fees arising out of or resulting from the use of the Database/Model.

ACKNOWLEDGMENT: Contractor acknowledges that (s)he has read this Agreement, understands it, and agrees to be bound by its terms and conditions.

CONTRACTOR'S REPRESENTATIVE

Signature: _____ Company Name: _____

Name: _____ Address 1: _____

Title: _____ Address 2: _____

Date: _____

SECTION 22 0503

TRENCHING AND BACKFILLING FOR PLUMBING

PART 1 GENERAL

1.01 REQUIREMENTS

A. Conform with applicable provisions of the General Conditions, Supplemental General Conditions and the General Requirements.

1.02 SCOPE OF WORK

A. The work in this section includes the furnishing of all labor, materials, equipment, transportation, hauling and services required in connection with the excavation, backfilling, compaction, grading and removal of earth from the site required for the installation of the mechanical work specified herein under Division 22.

B. The Contractor shall provide the services of a qualified underground locator to field locate and mark all existing buried utility lines, public and private, piping, conduits, etc., within the required construction area prior to the start of any trenching or excavation work.

1.03 SAFETY REGULATIONS

A. All work performed under this Section shall conform to the requirements of the General Conditions, Supplementary Conditions and Safety Requirements for this type of work.

PART 2 PRODUCTS

Not Applicable.

PART 3 EXECUTION

3.01 TRENCHING AND BACKFILLING

A. General Excavation: The Contractor shall perform all excavation of every description and of whatever substances encountered, to the depths indicated on the drawings or as otherwise specified. During excavation, material suitable for backfilling shall be piled in an orderly manner a sufficient distance from the banks of the trench to avoid overloading and to prevent slides or cave-ins. All excavated material not required or suitable for backfill shall be removed and wasted. Berming and grading shall be done as may be necessary to prevent surface water from flowing into trenches or other excavations, and any water accumulating therein shall be removed by pumping or by other approved methods. Sheeting and shoring shall be done as required for the protection of the work and for the safety of personnel.

B. Trench Excavation: Trenches shall be of adequate width for the proper laying of the pipe, and the banks shall be as nearly vertical as practicable and safe for workmen. The bottom of the trenches shall be accurately graded and bedded to provide uniform bearing and support for each section of the pipe at every point along its entire length. Bell holes and depressions for joints shall be dug after the trench bottom has been graded, and bedded in order that the pipe rests upon the prepared bottom for as nearly its full length as practicable. Care shall be taken not to excavate below the depths indicated. Where rock excavation is required, the rock shall be excavated to a minimum overdepth of 4 inches below the trench depths indicated on the drawings or specified. Overdepths in the rock and common excavation shall be backfilled with coarse sand, fine gravel, or otherwise suitable material. Whenever wet or otherwise unstable soil that is incapable of properly supporting the pipe is encountered in the bottom of the trench, such soil shall be removed to the depth required and the trench backfilled to the proper grade with coarse sand, fine gravel, or other suitable materials, as hereinafter specified.

C. The Contractor shall move trucks and equipment on prescribed roads and keep the roads free from mud, dirt and spillage.

D. If additional material is needed for fill on the project, it shall be furnished by the Contractor.

E. Bracing and Bulkheading: In all excavation work the Contractor shall provide necessary underpinning, bracing, or bulkheading to safeguard the work, the present structures, workmen, the public, and the property, and shall assume all responsibility in connection therewith.

F. Backfilling: The trenches shall not be backfilled until all required pressure tests are performed and until the utilities as installed conform to the requirements specified. The trenches shall be carefully backfilled with materials approved for backfilling; free from large clods of earth or stones. The entire depth of trench shall be backfilled in layers, and each layer shall be spread evenly, wetted to optimum moisture and thoroughly mixed to uniform consistency and compacted to the required maximum density obtainable as the same soil, as determined by ASTM D698.

G. All imported fill required under this section will be furnished by the Contractor. Imported fill will be base course material approved for use by the State Highway Department.

H. Fill material shall be free from trash, lumber or any type of debris which may be detrimental to producing the required density in the fill.

I. The earth beneath all sidewalks and concrete slabs shall be backfilled and compacted to at least 8" below any gravel or sub-base material before the placement of gravel or other base material and shall be coordinated with requirements contained within Division 33.

J. Piping below roadways or service drives buried at a depth of less than 48" shall be protected with a reinforced concrete slab above the piping, either at grade or below the final grade as directed by the Architect.

K. All piping not encased in concrete shall be bedded in sand or fine gravel, without rocks or other foreign material. Bedding material shall be placed around the pipe in accordance with manufacturer's recommendations. The bedding material shall be distributed around pipe to assure full consolidation.

L. In grass and planted areas, the Contractor shall backfill his excavation to approximately 8" below finished grade. Contractor shall coordinate backfill requirements contained in Division 33.

M. The Contractor shall protect from damage all existing underground utilities indicated on the survey or field located by underground utility locator service by the Owner prior to excavation operations. Any damage to such existing utilities shall be repaired by the Contractor without additional costs to the Owner.

N. Provide density test for trench, backfill in accordance with Division 33 requirements.

END OF SECTION 22 0503

SECTION 22 0504

PIPE AND PIPE FITTINGS FOR PLUMBING

PART 1 GENERAL

1.01 REQUIREMENTS

A. Conform with applicable provisions of the General Conditions, Supplemental General Conditions and General Requirements.

B. Lead Ban: All systems and system components, pipe, fittings, and fixtures delivering water for human consumption shall be lead free.

1. Any product designed for dispensing potable water shall meet both the NSF 61 and NSF 372 test standards via third-party testing and certification.

2. Lead free refers to <0.25% weighted average lead content in relation to wetted surface of pipe, fittings, and fixtures in systems delivering water for human consumption, and solder and flux which does not contain more than 0.2% lead.

1.02 RELATED SECTIONS

A. Section 22 0500, Common Work Requirements for Plumbing.

1.03 SUBMITTAL DATA

A. Contractor shall furnish complete submittal data for all piping materials, including manufacturer's specifications, certifications, class, type and schedule. Submittal data shall additionally be furnished for pipe hangers and supports, seismic restraints, pipe sleeves including sealing and fire safing materials and installation.

PART 2 PRODUCTS

See Division 23, Section 23 0504 – Pipe and Pipe Fittings, for applicable requirements.

PART 3 EXECUTION

See Division 23, Section 23 0504 – Pipe and Pipe Fittings, for applicable requirements.

END OF SECTION 22 0504

SECTION 22 0505

PIPING SPECIALTIES FOR PLUMBING

PART 1 GENERAL

1.01 REQUIREMENTS

A. Contractor shall furnish and install all piping specialties necessary for satisfactory operation of the systems. Conform with applicable provisions of the General Conditions, Supplemental General Conditions and General Requirements.

B. Lead Ban: All systems and system components, pipe, fittings, and fixtures delivering water for human consumption shall be lead free.

1. Any product designed for dispensing potable water shall meet both the NSF 61 and NSF 372 test standards via third-party testing and certification.

2. Lead free refers to <0.25% weighted average lead content in relation to wetted surface of pipe, fittings, and fixtures in systems delivering water for human consumption, and solder and flux which does not contain more than 0.2% lead.

1.02 RELATED SECTIONS

A. Section 22 0500, Common Work Requirements for Plumbing.

B. Section 22 0504, Pipe and Pipe Fittings for Plumbing.

C. Section 22 0523, Valves for Plumbing.

D. Section 22 0700, Plumbing Insulation.

E. Section 22 0549, Plumbing and Electrical Installation Coordination.

1.03 SUBMITTAL DATA

A. The Contractor shall furnish complete submittal data for all piping specialties including manufacturer's specifications, performance characteristics, ratings, installation instructions, certifications and approvals of listing agencies, wiring diagrams, and selection analysis.

PART 2 PRODUCTS

See Division 23, Section 23 0505, Piping Specialties.

PART 3 EXECUTION

See Division 23, Section 23 0505, Piping Specialties.

END OF SECTION 22 0505

SECTION 22 0523

VALVES FOR PLUMBING

PART 1 GENERAL

1.01 REQUIREMENTS

A. All Valves shall conform with current applicable provisions of the General Conditions, Supplemental General Conditions, and General Requirements.

B. All Valves shall meet the current MSS Specifications covering Bronze & Iron Valves. MSS-SP-80, MSS-SP-70, MSS-SP71, MSS-SP-85 where applicable.

C. Lead Ban: All systems and system components, pipe, fittings, and fixtures delivering water for human consumption shall be lead free.

1. Any product designed for dispensing potable water shall meet both the NSF 61 and NSF 372 test standards via third-party testing and certification.

2. Lead free refers to <0.25% weighted average lead content in relation to wetted surface of pipe, fittings, and fixtures in systems delivering water for human consumption, and solder and flux which does not contain more than 0.2% lead.

1.02 RELATED SECTIONS

A. Section 22 0500, Common Work Requirements for Plumbing.

B. Section 22 0504, Pipe and Pipe Fittings for Plumbing.

C. Division 21 for Fire Suppression System.

D. Division 22 for Plumbing.

1.03 SCOPE

A. Contractor shall furnish and install all valves and accessories necessary for satisfactory operation of the systems.

1.04 VALVE REQUIREMENTS

A. All Gate, Globe, Check, Ball valves shall be manufactured by Milwaukee, Nibco, Apollo, Stockham, Powell, Crane, Grinnell, or equivalent.

B. All lubricated plug valves shall be as manufactured by Rockwell, Walworth, Homestead, or equivalent.

C. Ball valves shall be utilized in lieu of gate valves and globe valves for all plumbing systems for sizes 2" and smaller.

D. All valves furnish under Division 22 and 23 of the same type shall be products of a single manufacturer unless otherwise approved by Owner's Representative.

E. Provide gate and globe valves with packing that can be replaced with the valve under full working pressure.

PART 2 PRODUCTS

See Division 23, Section 23 0523 - Valves, for applicable requirements.

PART 3 EXECUTION

See Division 23, Section 23 0523 - Valves, for applicable requirements.

END OF SECTION 22 0523

SECTION 22 0548

VIBRATION AND SEISMIC CONTROLS FOR PLUMBING

PART 1 GENERAL

1.01 REQUIREMENTS

A. Conform with the applicable provisions of the General Conditions, Supplemental General Conditions, and General Requirements.

1.02 RELATED SECTIONS

A. Section 21 0500, Common Works Requirements for Fire Suppression.

B. Section 22 0504, Pipe and Pipe Fittings for Plumbing.

C. Section 22 0551, Instrumentation and Controls for Plumbing.

D. Section 22 1100, Domestic Water Piping.

E. Section 22 1316, Sanitary Waste and Vent Piping.

F. Section 22 1400, Facility Roof and Area Drainage.

G. Section 22 6000, Medical Gas and Vacuum Systems for Healthcare Facilities.

1.03 SCOPE

A. It shall be understood that the requirements for seismic restraints are in addition to other requirements as specified elsewhere for the support and attachment of equipment and mechanical services, and for the vibration isolation of same equipment. Nothing on the project drawings or specifications shall be interpreted as justification to waive the requirements for seismic restraint as specified herein, shown on the drawings and required by Code.

B. The work under this section shall include furnishing all labor, materials, tools, appliances and equipment, and performing all operations necessary for the complete execution of the installation of seismic snubber restraint assemblies as shown, detailed and/or scheduled on the drawings and/or specified in this section of the specifications.

C. The materials and systems specified in this section shall be provided by the Contractor from a single Seismic Snubber Restraint Materials Manufacturer to assure sole source responsibility for the performance of the seismic restraints used.

D. The seismic snubber restraint materials manufacturer shall be responsible for detailed design for seismic supports, including calculation for size and attachment, signed and sealed by registered State of New Mexico Structural Engineer.

1.04 SUBMITTALS

A. See Section 22 0500 for general requirements for submittal materials. In addition to the requirements contained in Section 22 0500, provide submittal information for all products and materials covered under this Section of the Specifications as listed herein.

B. Furnish complete catalog data on all vibration isolators, restraints, and equipment vibration bases to be utilized for the project in order to establish compliance with the plans and specifications and all code requirements.

C. Furnish complete shop drawing information including construction details for all vibration bases; support points and anchor bolt requirements and locations; method of support for piping; method of isolation for piping passing through the building structure; and location and arrangement of seismic restraints.

D. Manufacturers not listed as approved in ‘Part 2 - Products’ of this section must submit for prior approval in accordance with provisions contained in Section 22 0500.

E. Drawings shall be reviewed and certified by a registered Professional Engineer, with a minimum of five (5) years working experience in this field, certifying that the submitted seismic restraint system design and anchorage details complies with all specification requirements and applicable codes.

1.05 CODE REQUIREMENTS

A. Seismic restraints shall be provided for equipment, materials and systems furnished and installed under Division 22 of this Specification in accordance with the requirements of the 2012 International Building Code as adopted and interpreted by the State of New Mexico.

B. Performance requirements:

1. Risk Category = IV.
2. Site Class = D.

1.06 SEISMIC RESTRAINT REQUIREMENTS

A. The Contractor shall submit calculations prepared by a State of New Mexico licensed Structural Engineer to substantiate that all items of plumbing equipment and piping systems are properly supported to resist earthquake forces as required herein.

B. All plumbing equipment mounted on vibration isolators shall be provided with seismic restraints securely anchored to the building structure capable of resisting horizontal forces of 100% of their weight and/or in accordance with IBC Requirements.

C. All items of plumbing equipment required for life safety shall be provided with seismic restraints securely anchored to the building capable of resisting horizontal forces of 100% of their weight and/or in accordance with IBC Requirements.

D. All items of plumbing equipment, except as specified above, and all piping furnished and installed under Division 22 shall be provided with seismic restraints securely anchored to the building capable of resisting horizontal forces of 50% of their weight.

E. Seismic restraint/snubber manufacturer shall be responsible for the structural design of attachment hardware as required to attach seismic restraints/snubbers to both the equipment and supporting structure on vibration isolated equipment, or to directly attach equipment to the building structure for non-isolated equipment.

F. The Contractor shall furnish a complete set of approved shop drawings of all mechanical and electrical equipment which is to be restrained to the seismic restraint manufacturer, from which the selection and design of seismic restraint devices and/or attachment hardware will be completed. The shop drawings furnished shall include, at a minimum, basic equipment layout, length and width dimensions, installed operating weights of the equipment to be restrained and the distribution of weight at the restraint points.

PART 2 PRODUCTS

See Division 23, Section 23 0548, for applicable requirements.

PART 3 EXECUTION

See Division 23, Section 23 0548, for applicable requirements.

END OF SECTION 22 0548

SECTION 22 0549

PLUMBING AND ELECTRICAL INSTALLATION COORDINATION

PART 1 GENERAL

1.01 REQUIREMENTS

A. Conform with applicable provisions of the General Conditions, Supplemental General Conditions and General Requirements.

1.02 RELATED DIVISIONS AND SECTIONS

A. Section 22 0500, Common Work Requirements for Plumbing.

B. Section 23 0900, Facility Management System.

C. Division 26 for Electrical.

D. Division 28 for Electronic Safety and Security.

1.03 SCOPE

A. It is the intention of this section to summarize the coordination of effort defined in the related sections and divisions of this specification.

B. If there is a conflict between this Section and other Sections and Divisions of this specification, this Section shall be the governing and decisive Section.

C. Make all connections to motors and controls for equipment supplied and/or installed under Division 22 according to Table 1 on the following page.

PART 2 PRODUCTS

Not Applicable

PART 3 EXECUTION

3.01 INSTALLATION

A. No work shall be performed until the reviewed and marked submittal data have been reissued to the Contractor, unless written permission is obtained from the Architect.

Item or System	Note	Supplied By (3)	Installed By (3)	Powered By	Control Field Wiring By
Equipment Motors		Div. 22	Div. 22	Div. 26	N/A
Motor Control Center Including Starters, Pilot Lights, Heater, Switches, Auxiliary Contacts, and Internal Control Wiring		Div. 26	Div. 26	Div. 26	Div.23 **[25]**
Stand Alone Motor Starters (outside motor control centers)	(1)	Div. 26	Div. 26	Div. 26	Div. 23 **[25]**
Variable Frequency Drives (VFD's)		Div. 22	Div. 22	Div. 26	Div. 23 **[25]**
Fused and Non-Fused Disconnects	(1)	Div. 26	Div. 26	Div. 26	N/A
Control Relays & Control Transformers	(1)	Div. 22	Div. 22	Div. 26	Div. 23 **[25]**
Boilers & Domestic Water Heaters		Div. 22	Div. 22	Div. 26	Div. 23 **[25]**
Pressure Booster Pump Systems		Div. 22	Div. 22	Div. 26	Div. 23 **[25]**
Water Softeners & Other Process Water Equipment		Div. 22	Div. 22	Div. 26	N/A
Facility Management System (FMS) for Automatic Control and/or Monitoring of Plumbing System & Equipment	(2)	Div. 23	Div. 23	Div. 26	Div. 23 **[25]**
Medical Gas System - Alarm Panels, Sensors, Pressure Switches	(3)	Div. 22	Div. 22	Div. 26	Div. 22

TABLE 1

TABLE NOTES:

1. Unless specified to be supplied with the equipment
2. Division 26 shall coordinate with Division 23, FMS Contractor as required to provide 120 VAC power to each mechanical space and the central plant as necessary for the FMS and as shown on the drawings. Any additional power, transformers, and distribution shall be provided by the Section or Division indicated.
3. Division 22 indicates the plumbing contractor or their designated representative including equipment suppliers, sub-contractors, etc.

END OF SECTION 22 0549

SECTION 22 0700
PLUMBING INSULATION

PART 1 GENERAL

1.01 REQUIREMENTS

A. Conform with applicable provisions of the General Conditions, Supplemental General Conditions and General Requirements.

B. Materials shall conform to applicable ASTM standards.

1.02 RELATED SECTIONS

A. Section 22 0500, Common Work Requirements for Plumbing.

B. Section 22 0504, Pipe and Pipe Fittings for Plumbing.

1.03 SCOPE

A. All condensate pipe and fittings, domestic hot water pipe including, circulating hot water, interior roof drains including roof drain bowls, interior overflow roof drains including overflow roof drain bowls, domestic cold water including non-potable water and soft cold water piping, water piping located outdoors exposed to ambient freezing conditions.

B. Equipment covering, including heat exchangers, storage tanks, pumps, domestic hot water boiler stacks and breeching, domestic water heater stacks and breeching.

1.04 FITTINGS

A. All fittings except as otherwise specified, shall be insulated with the same material and thickness as specified for the pipe.

B. Unions, flanges and valves on hot water, will not require insulation.

1.05 TESTING

A. All piping shall be tested in accordance with the applicable Specification Sections, before any insulation is applied.

PART 2 PRODUCTS

2.01 INSULATION

A. Insulation shall be as manufactured by Owens-Corning Fiberglas, Knauf, CertainTeed, Johns Manville, or Armstrong, or equivalent, and shall be equal to that specified below. Insulation and all materials on the interior and exterior surfaces of ducts, pipes, and equipment shall have a composite fire and smoke hazard rating not exceeding: Flame spread - 25; fuel contribution - 50; smoke developed - 50, as determined in accordance with ASTM Standard E-84. All insulation materials used for valves and fittings shall have the same ratings as the pipe insulation. Information must be submitted by means of manufacturer's literature showing that the proposed materials conform to above specification without exception.

B. Fiberglass pipe insulation shall be rigid molded and non-combustible with 'K' factor of 0.23 at 75^{o}F. Jacket shall be all service (ASJ) vapor barrier jacket with white kraft paper reinforced with glass fiber yarn and bonded to aluminum foil, secured with self sealing longitudinal laps and butt strips. Johns Manville 'Micro-Lok' or equivalent.

C. Hydros Calcium Silicate insulation shall be rigid molded, non-combustible per ASTME 136, conforming to ASTM 533, asbestos-free with 'K' factor of 0.40 at 300^{o}F., maximum service temperature 1200^{o}F., compression strength (block) minimum of 200 PSI to produce 5% compression at 1-1/2" thickness. Johns Manville 'Thermo-12 Gold' or equivalent.

D. Fiberglass rigid board insulation for equipment shall conform to ASTM C612 with 'K' factor of 0.23 at 75^{o}F, R=8.0 minimum, 3.0 pound per cubic foot density. Provide vapor barrier jacket (FSK) with aluminum foil reinforced with fiberglass yarn and laminated to fire-resistant kraft, secured with UL listed pressure sensitive tape and outward clinched expanded staples and vapor barrier mastic. Johns Manville 'Spin-Glas' or equivalent.

E. Elastomeric foam insulation for piping and equipment shall be flexible, cellular, molded or sheet, conforming to ASTM C534, with 'K' factor of 0.28 at 75°F., maximum service temperature of 220°F., maximum flame spread rating of 25 and maximum smoke development rating of 50 (3/4" thickness and less). Connections shall be made using manufacturer's approved waterproof vapor barrier retarder adhesive. Provide outdoor U.V. protective coating on all insulation exposed to ambient conditions.

2.02 FITTINGS

A. Valves and fittings, where required to be insulated, shall be covered with the same insulation material and thickness as specified for the pipe insulation and finished with PVC covers.

B. Valves and fittings with systems specified to be covered with metal or canvas, or polyvinyl chloride (PVC) jacket shall be covered with material to match piping system jacketing.

C. Polyvinyl chloride (PVC) preformed fitting covers with fiberglass inserts shall be used on valves and fittings, except where metal or canvas jacket is required for piping system. PVC fitting covers shall be Zeston 2000 or equivalent, gloss white and shall have a composite fire and smoke hazard rating not exceeding; flame spread - 25; smoke development - 50. Connections shall be made using tacks and pressure sensitive color matching vinyl tape. Seams shall be on the bottom side of pipe and fittings.

2.03 METAL JACKETING

A. Metal jacket shall be 0.010-inch smooth Type 304 stainless steel, smooth. Provide moisture barrier lining for service temperatures 60°F and less, except where applied over insulation with All Service (ASJ) vapor barrier jacket. Stainless steel jacket shall be installed where specified herein or otherwise indicated on the drawings.

B. Metal jacket shall be 0.016-inch embossed aluminum. Provide moisture barrier lining for service temperatures 60°F and less except where applied over insulation with All Service Jacket (ASJ) vapor barrier jacket. Aluminum jacketing shall be installed where specified herein or otherwise indicated on the drawings.

2.04 PIPE HANGERS AND SUPPORTS

A. See Specification Section 22 0504 for requirements associated with hangers and supports for piping systems.

B. All insulated piping systems shall be provided with individual hangers sized to encircle the insulation. Hangers for domestic cold water and roof drains may be installed under the insulation, provided that the vapor barrier system for cold piping and the hanger rods are protected from the formation of condensation by application of a heavy coating of vapor barrier mastic material.

C. Insulated piping supported by means of trapeze hangers or roller type hangers shall not rest directly on the hanger or support.

D. The insulation at hangers, trapezes and supports shall be protected by means of galvanized steel insulation half diameter support shields. Provide insulation insert between support shield and piping for piping size 1-1/2" and larger. Insulation inserts shall be heavy density calcium silicate molded insulation. Insulation inserts shall be the following minimum lengths. Factory fabricated thermal pipe shield as manufactured by Pipe Shields, Inc., and specified in Section 22 0504, may be used at Contractor's option.

Pipe Size, In.	Insert Length
1-1/2" to 2-1/2"	10" Long
3" to 6"	12" Long
8" to 10"	16" Long
12" and larger	22" Long

2.05 PIPE SLEEVES

A. See Specification Section 22 0504 for requirements associated with pipe sleeves for piping penetrations for building walls and frames.

B. Pipe sleeves shall be provided at penetrations through concrete and masonry construction and at fire rated and smoke rated walls and penetrations when required to comply with UL approved penetration assembly. Insulated piping passing through fire walls and smoke walls shall be provided with UL approved fire safing insulation to match the required insulation thickness and the space between the piping penetration and the adjacent wall construction shall be sealed air tight with UL approved fireproof caulking material. Pipe penetration arrangement and installation requirements shall match the applicable UL approved penetration assembly details.

PART 3 EXECUTION

3.01 DOMESTIC HOT WATER PIPING

A. Domestic hot water pipingwith operating temperatures of 140^{o}F and less, including water and recirculating hot water piping shall be insulated with 1-inch thick fiberglass preformed pipe insulation with All Service Jacket (ASJ). Fittings shall be finished with PVC fitting covers.

B. All voids formed by support saddles or other mounting or support hardware shall be filled with insulation.

3.02 DOMESTIC COLD WATER AND ROOF DRAINS

A. Domestic cold water piping shall be insulated with 1-inch thick fiberglass preformed pipe insulation with All Services Jacket (ASJ). Fittings shall be finished with PVC fitting covers.

B. Roof drain bowls and horizontal roof drain piping shall be insulated with 1-inch thick fiberglass insulation as specified for domestic cold water piping.

C. Overflow roof drain bowls and horizontal overflow roof drain piping shall be insulated with 1-inch thick fiberglass insulation as specified for domestic cold water piping.

D. All voids formed by support saddles or other mounting or support hardware shall be filled with insulation.

3.03 HANDICAP LAVATORY AND SINKS

A. Domestic hot and cold water piping and P-traps exposed below handicapped lavatories and sinks shall be insulated with HANDI LAV-GUARD insulation kits which satisfy ANSI A117.1 requirements. Insulation shall have a flexible vinyl finish which protects against burning and cushions impact.

B. Countertop sinks indicated within the Architectural drawings to be handicap-compliant shall have an off-centered drain opening and a maximum sink depth of 7-inches.

3.04 METAL JACKETING

A. Metal jacketing shall be installed on all field insulated plumbing equipment and on plumbing piping systems exposed within the mechanical equipment spaces, that are installed exposed below 8 feet above the floor, where exposed to physical damage, on outdoor insulated piping.

B. The jacketing shall be applied with joints overlapped 2" and located to shed water. Joints and seams shall be caulked with an approved weatherproof caulking when located outdoors. The insulation shall be banded 12" on centers or screwed in place 3" on centers.

C. Fittings and valves shall have insulation covered with metal jacket, as specified herein. Fittings and valves on exterior piping and ductwork shall be covered with metal jacketing to match pipe and duct covers.

3.05 PVC JACKETING

A. PVC jacketing shall be installed on all field insulated plumbing equipment and on all piping systems exposed within the mechanical equipment spaces, that are installed below 8 feet above the floor, where exposed to physical damage, inside accessible tunnels, and where noted on the drawings and specifications, except where metal or canvas jacketing is required.

B. Jacketing shall be secured in place in an approved manner by means of tacks and pressure sensitive tape.

C. Fittings and valves shall have insulation covered with PVC pre-molded PVC fittings to match jacketing, as specified below.

D. PVC jacketing shall not be permitted for use on exterior piping systems.

3.06 TERMINATION OF INSULATION

A. The termination of all insulation on pipes, at uninsulated valve connections, or unions, flexible connections, etc., shall be beveled and finished.

3.07 FACTORY INSULATED EQUIPMENT

A. Domestic water domestic water heaters and other equipment as specified in the equipment schedules on the drawings shall be factory insulated.

3.08 VICTAULIC COUPLINGS

A. Where Victaulic type couplings or similar piping systems are used, all couplings shall be insulated with insulation materials and thickness equal to the piping system. Insulation of couplings shall be as specified herein for fittings.

3.09 BOILER STACKS AND BREACHING

A. Domestic hot water boiler and water heater stacks and breaching shall be insulated with 4" thick calcium silicate as specified in Paragraph 2.1.C and finished with metal jacketing.

3.10 VESSELS, TANKS, AND EQUIPMENT

A. Insulate hot vessels, tank, and equipment, including**,** etc., with 1" thickness, 3 pound density fiberglass insulation for surface temperatures from 40^{o}F to 60^{o}F, 2" thickness, 3 pound density fiberglass insulation for surface temperatures from 60^{o}F to 400^{o}F, and 4" thickness, calcium silicate insulation for surface temperatures in excess of 400^{o}F to 1200^{o}F. Insulation board shall be scored, beveled, or mitered to provide tight joints and shall be secured in place by mechanical pin and clip fasteners and insulation bonding adhesive applied to underside surfaces or with bands. All joints, cracks, seams and voids shall be filled with insulation bedding compound and finished to smooth surface, provide corner beads to protect edges of insulation. Cover insulation with canvas jacket as specified herein. Cover insulation with metal jacket as specified herein. Stretch 1" mesh wire, with edges laced together over insulation and finished with insulating and finishing cement applied in one coat, 1/4" thick, and troweled to a smooth finish. Bevel insulation away from all flanges, nameplates, and access fittings. Provide removable and re-usable insulation cover for all access fittings and manhole covers.

END OF SECTION 22 0700

SECTION 22 1100
DOMESTIC WATER PIPING

PART 1 GENERAL

1.01 REQUIREMENTS

A. Conform with the applicable provisions of the General Conditions, Supplemental General Conditions, and the General Requirements.

B. Lead Ban: All systems and system components, pipe, fittings, and fixtures delivering water for human consumption shall be lead free.

1. Any product designed for dispensing potable water shall meet both the NSF 61 and NSF 372 test standards via third-party testing and certification.

2. Lead free refers to <0.25% weighted average lead content in relation to wetted surface of pipe, fittings, and fixtures in systems delivering water for human consumption, and solder and flux which does not contain more than 0.2% lead. Solder shall be 95/5 tin antimony, alloy Sb5, conforming to FS QQ-S-571 and NSF 61.

1.02 RELATED SECTIONS

A. Section 22 0500, Common Work Requirements for Plumbing

B. Section 22 0504, Pipe and Pipe Fittings for Plumbing.

C. Section 22 0505, Piping Specialties for Plumbing.

D. Section 22 0523, Valves for Plumbing.

E. Section 22 0700, Plumbing Insulation.

F. Section 22 6801, Onsite Utilities, Plumbing.

1.03 SCOPE

A. A complete domestic cold water, hot water, recirculating hot water, and make-up water system including water heaters, pumps, thermal expansion tanks, meters, backflow protection, shock absorbers, and associated miscellaneous accessories. This section shall include all work within the building to a point approximately 5'-0" outside the building, or as otherwise indicated.

PART 2 PRODUCTS

2.01 PIPING

A. Domestic water piping including below grade or slab-on-grade shall be Type L soft copper, ASTM B88. Copper piping 2" and smaller shall be soft tubing and 2-1/2" thru 4" shall be either soft tubing or hard pipe. Domestic water piping 6" and larger below grade within the building and to a point approximately 5'-0" from the building shall be ductile iron pressure pipe, minimum 150 PSIG working pressure with mechanical joints.

B. Domestic water piping above grade within the building 4" and smaller shall be Type L hard drawn copper, ASTM B88. Domestic water piping larger than 4" shall be copper as specified herein or flanged ductile iron pipe.

C. Proper insulating fittings, as specified in Section 22 0504, shall be installed to prevent electrolytic action between steel and copper piping connections.

2.02 FITTINGS

A. Fittings for copper piping shall be wrought copper or cast brass conforming to ANSI B16.22 and B16.23, with 95-5 solder joints, as specified in Section 22 0504.

B. Mechanically formed tee connections and couplings for copper piping system as specified in Section 22 0504, may be utilized where approved.

C. Fittings for galvanized steel pipe shall be screwed Class 150, standard galvanized malleable iron conforming to ANSI B16.3.

D. Fittings for ductile iron pipe shall be flanged or mechanical joint conforming to ANSI/AWWA C110 and C111, Class 250 minimum, cement lined, with bituminous coating.

2.03 FLANGES

A. Flanges for copper piping systems shall be Class 150 wrought copper or cast brass conforming to ANSI B16.24.

B. Flange connections for valves and equipment shall match the rating and drilling of the valves and equipment furnished.

C. Flanges for galvanized steel piping system shall be galvanized cast or malleable iron Class 125, standard threaded plain face companion flanges for flanged connections in threaded piping systems.

D. Gaskets shall be 1/16" thick ring type or full face non-asbestos material suitable for the temperatures and pressure application.

E. Flange bolting shall be carbon steel machine bolts or studs and hex nuts, ASTM A307, Grade B.

2.04 JOINTS

A. Joints in copper piping system shall be made using approved "lead-free" solder and flux as described herein and approved by all applicable codes and regulations. Surfaces to be soldered shall be cleaned bright by manual or mechanical means.

B. All joints shall be properly fluxed with a non-corrosive "lead-free" type flux manufactured to approved standards, Federal Specification QQ-S-517. Joints for copper piping systems for cold water 3" and smaller and hot water 2" and smaller shall be made using composition 95-5 tin-antimony solder. Composition 15% silver solder shall be used for all other piping sizes and for all underground joints.

2.05 SHOCK ABSORBERS

A. Furnish and install factory sealed shock absorbers conforming to Federal Specification WW-P-541 at locations shown on the drawings and/or as outlined by Plumbing Drainage Institute Standard WH-201. Josam, Precision, Jay R. Smith, Wade, Watts, Zurn or equivalent.

2.06 DOMESTIC HOT WATER GENERATING EQUIPMENT

A. Water heaters and associated auxiliary equipment shall be as specified on the equipment schedule on the drawings. Natural gas fired or electric domestic water heaters shall be as manufactured by Bock, Bradford-White, Lochinvar, P.V.I., Ruud, Rheem, A.O. Smith, State, or equivalent.

B. Electric instantaneous water heaters shall be by Chronomite, Eemax, Hubbell, Keltech, Rheem, Stiebel Eltron, State, or equivalent.

C. Natural gas fired domestic hot water boilers and water heater combustion flues, stack, breeching, and combustion air louvers, ducts, etc., shall be provided under Division 23.

2.07 VALVES

A. Valves other than automatic control valves are specified in Section 22 0523, Valves.

B. Automatic control valves shall be as specified in Section 23 0900, Facility Management System, except for automatic control valves furnished as a part of equipment packages, including hot water generating equipment, as specified on the equipment schedule.

2.08 PUMPS

A. Pumps shall be of the type and capacity listed in the equipment schedule. Pumps shall be selected so that the motors will not overload under any operating condition. Furnish one spare mechanical seal of each size required in conjunction with the pumps furnished under this Contract. All base mounted pumps shall have drain pans with tapped pipe connections and 3/4" drain line extended to floor drain. Pumps shall be installed so that they may be

removed without the removal of the associated piping. All pumps for potable water applications shall have bronze or stainless steel body and trim.

B. Domestic water inline re-circulating pumps shall be as specified on the drawings and as manufactured by Armstrong, Bell & Gossett, Taco, Thrush, or equivalent.

C. Manufacturer shall furnish a full one (1) year warranty, including all parts and labor for the water pressure booster pumping system.

2.09 WATER METER

A. Domestic water meter assembly shall be furnished by the City of Rio Rancho. Meter size and general arrangement shall be as indicated on the drawings. The Contractor shall coordinate with the applicable representatives for the installation of the water meters and shall furnish all associated piping, valves and materials, including meter box/vault, in accordance with details on the drawings and applicable Requirements.

B. All costs, fees, and permits required for the installation of the water meter shall be secured and paid for by the Contractor unless otherwise indicated.

C. Water meters shall be installed by the Contractor.

2.10 BACKFLOW PROTECTION

A. All cross-contamination control shall be provided to ensure that no installation of the potable water supply piping system shall be made in a manner that will allow used, unclean, polluted, or contaminated water or substances to enter the domestic potable water system.

B. All backflow devices and assemblies shall be approved by the applicable Administration Authorities and shall be installed according to all applicable codes, regulations, and manufacturer's instructions. Installation shall allow for required access and clearance for required testing, maintenance, and repair.

C. Reduced pressure backflow preventer assembly shall be furnished and installed by the Contractor. Backflow preventer size and arrangement shall be as indicated on the drawings, and shall be as manufactured by Febco, Hersey, Beeco, Watts, Wilkins, or equivalent. All costs, fees, and permits required shall be secured and paid for by the Contractor, unless otherwise indicated.

D. See Section 23 0504 for backflow preventer required for make-up water connections to HVAC systems.

PART 3 EXECUTION

3.01 INSTALLATION

A. Piping installation shall conform to the requirements of Section 22 0500, Common Work Requirements for Plumbing and Section 22 0504, Pipe and Pipe Fittings for Plumbing. Installation of specialties shall conform to the requirements of Section 22 0505, Piping Specialties for plumbing.

B. Insulating Fittings: Insulating unions shall be furnished and installed at all connections between dissimilar metals.

C. Valves: Each water service main, branch main and branch to a group of two or more fixtures shall be valved. Stop valves shall be as specified under fixtures.

D. Flexible Connections: If the Contractor uses a pipe material other than copper to connect to the City water main, provide mechanical joints at the connection point and also either a swing joint or expansion joint at a point 5 ft. outside the building to prevent failure of piping caused by differential settling of building and piping systems. The expansion joint material shall be suitable for domestic water usage and compatible with the sterilization chemicals.

3.02 STERILIZATION

A. All new water piping shall be charged with a chlorine solution containing not less than 50 PPM available chlorine. The solution shall remain in the piping for a period of 24 hours, during which time valves shall be opened and closed to permit a small flow of the solution. At

the end of 24 hours, the solution shall be tested and must contain a residual of at least 5-10 PPM chlorine. The system shall then be drained and flushed to provide satisfactory potable water before final connection is made to the existing distribution system.

B. The Contractor shall submit a sample of the water, after sterilization and flushing for testing by an approved laboratory. A copy of the acceptable test report shall be submitted to the Architect prior to substantial completion.

3.03 BACKFLOW PROTECTION

A. Protection: All plumbing fixtures, faucets with hose connections, and all other equipment having plumbing connections shall have their water supplies protected against back-siphonage.

B. Testing: Arrange for testing backflow devices as required by the local health authorities.

3.04 TESTS

A. All water piping, hot and cold, shall be made tight under a hydrostatic test pressure of 150 lbs. per square inch and maintained without pressure loss for a minimum of four (4) hours. No caulking of joints will be permitted. Any joint found to leak under this test shall be broken, remade and a new test applied.

END OF SECTION 22 1100

SECTION 22 1123

FACILITY NATURAL GAS SYSTEM

PART 1 GENERAL

1.01 REQUIREMENTS

A. Conform with applicable provisions of the General Conditions and Supplemental General Conditions.

1.02 RELATED SECTIONS

A. Section 22 0500, Common Work Requirements for Plumbing.

B. Section 22 0504, Pipe and Pipe Fittings for Plumbing.

C. Section 22 0505, Piping Specialties for Plumbing.

D. Section 22 0523, Valves for Plumbing.

1.03 SCOPE

A. Complete building natural gas piping system including meters, regulators, and miscellaneous accessories.

PART 2 PRODUCTS

2.01 PIPING

A. Above ground pipe used for the installation, extension, alteration, and/or repair of any gas piping system shall be black steel pipe ASTM A53 Grade A or B, ERW or BW, standard wall, Schedule 40.

B. All underground gas piping shall be steel or polyethylene plastic piping as specified in Section 22 0523, Valves for Plumbing. All underground steel piping and fittings shall be protected from corrosion by approved coatings or wrapping materials as specified in Section 22 0504, Pipe and Pipe Fittings for Plumbing, and Section 22 6801, Outside Utilities, Plumbing.

2.02 FITTINGS

A. Fittings for steel piping 2" and smaller shall be either screwed or welded. Screwed fittings shall be Class 150 standard black malleable iron conforming to ANSI B16.3. Weld fittings shall be either standard weight steel butt-weld fittings conforming to ANSI B16.9, or forged steel socket-weld fittings, 2000 pound Schedule 40 conforming to ANSI B16.11.

B. Fittings for steel piping 2-1/2" and larger shall be standard weight steel butt-weld fittings conforming to ANSI B16.9.

2.03 FLANGES

A. Flanges for steel piping system shall be forged steel, weld neck, or slip-on, 1/16" raised face Class 150 flanges conforming to ANSI B16.5.

B. Flange connections for valves and equipment shall match the rating and drilling of the valves and equipment furnished.

C. Where specifically required by the application, black cast iron Class 125 standard threaded plain face companion flanges may be utilized for flanged connections in threaded piping systems.

D. Gaskets shall be 1/16" thick full face non-asbestos material suitable for the temperatures and pressure application.

E. Flange bolting shall be carbon steel machine bolts or studs and hex nuts, ASTM A307, Grade **B.**

2.04 VALVES

A. Valves shall be as specified in Section 22 0523, Valves for Plumbing.

B. Valves used in conjunction with gas piping shall be approved for the required service.

2.05 SEISMIC SHUT-OFF VALVE

A. Seismic earthquake actuated automatic gas shut-off valve shall automatically actuate (close) when subject to a horizontal sinusoidal oscillation having a peak acceleration of 0.3 G and a period of 0.4 seconds, or as otherwise required by the authority having jurisdiction. Valve shall not be sensitive to vibrations caused by passing trucks or accidental bumping. Valve shall provide positive sealing from -10°F to 150°F, and shall have a visual open-close indicator and manual reset. Valve shall be UL listed and FM approved, and shall be AGA and IAPMO approved. Valves 3/4" through 1-1/2" shall be NPT connections and 2" size and larger shall be Class 125 flange connections. Valve shall be installed on downstream side of meter and regulator station in an accessible location outside the building, and shall be installed and securely supported with uni-strut brackets as recommended by the manufacturer. Valves for low pressure gas application shall have a 0.5 PSIG maximum pressure rating, and valve for high pressure gas application shall have a 20 PSIG maximum pressure rating. Valves shall be as manufactured by KOSO, Safe T Quake, SISMO, Quick Master, or equivalent.

2.06 GAS METERS

A. Natural gas meters shall be furnished and installed by the natural gas utility company, unless otherwise indicated on the drawings. All required permits and fees shall be secured and paid for by the Contractor in accordance with Section 22 0500. Gas meter shall be the type and capacity required for the application and shall be located as indicated on the drawings and in accordance with utility company requirements and applicable codes and ordinances.

B. All natural gas meters shall be preceded by a main gas supply shut-off valve serviceable and accessible outside the building.

2.07 NATURAL GAS REGULATOR

A. Natural gas regulator shall be furnished and installed with the gas meter by the utility company, set for the required gas leaving pressure shown on the drawings.

B. Natural gas appliance and equipment regulators for all gas fired equipment furnished and installed under Division 23 and for natural gas fired equipment furnished by the Owner and/or under other sections of this specification shall be furnished by the equipment manufacturer or supplier and sized for the system inlet pressure and the required appliance operating pressure.

C. Natural gas regulators, as specified and shown on the drawings, shall be furnished and installed by the Contractor.

2.08 PIPING SUPPORTS

A. Natural gas piping installed on the building roof shall be supported by means of piping supports, especially designed to absorb thermal expansion and contraction of piping installed on built up and single ply membrane roofs. Wood blocks are not acceptable. Four inch and smaller gas piping shall be mounted on Erico Pyramid pipe supports or equivalent, pipe supports with a total weight not to exceed 100 pounds per pipe stand. Larger piping, and all piping requiring roller bearing action for pipe expansion, shall be mounted on Erico Pyramid RPS-H or equivalent, with a total weight not to exceed 1500 pounds per pipe collar support. Pipe support spacing shall be as recommended by manufacturer and as required by Code.

B. Piping hangers and supports shall be in accordance with Section 22 0504, Pipe and Pipe Fittings for Plumbing.

2.09 PAINTING

A. All natural gas piping installed outside the building exposed to the weather and/or exposed to view shall be field painted in accordance with the painting sections of this specification.

PART 3 EXECUTION

3.01 INSTALLATION

A. Piping installation shall conform to the requirements of Section 22 0500, Common Work Requirements for Plumbing, and Section 22 0504, Pipe and Pipe Fittings for Plumbing. Installation of specialties shall conform to the requirements of Section 22 0505, Piping Specialties for Plumbing.

B. Installation of piping and equipment shall be in accordance with applicable codes and regulations, including Uniform Plumbing Code and Uniform Mechanical Code, and NFPA No. 54, National Fuel Gas code.

C. No gas piping shall be installed in or on the ground under any building or structure, and all exposed gas piping shall be at least 6-inches above grade. Ferrous gas piping installed underground in exterior locations shall be protected for corrosion as specified herein and in Section 22 0504, Pipe and Pipe Fittings for Plumbing

D. Gas piping supplying the building or facility shall be provided with a shut-off valve located outside the building and readily accessible. Where gas piping supplies multiple buildings or facilities, each building shall be provided with a shut-off valve as described herein.

3.02 EQUIPMENT AND APPLIANCE CONNECTIONS

A. All gas fired equipment and appliances shall be connected to the gas piping system in an approved manner and shall be furnished with a shut-off valve installed ahead of the unit. Connections shall in no case be less than the unit inlet connection size and shall be rigidly connected, except as otherwise shown on the drawings and allowed by codes and regulations.

3.03 DRIPS

A. Accessible capped drip pockets shall be furnished at low points in piping system, connections to appliances and equipment, and other locations where condensation may tend to collect.

3.04 VENTS

A. All gas regulators and other required devices installed within the building shall be vented to the outside of the building in accordance with manufacturer's requirements, codes, and regulations.

3.05 TESTS

A. All gas piping shall be pressure tested using air, CO2, or nitrogen in accordance with the applicable codes and regulations, including Uniform Plumbing and Mechanical Code as adopted and interpreted by the City of Rio Rancho and State of New Mexico and NFPA No. 54.

END OF SECTION 22 1123

SECTION 22 1400
FACILITY ROOF DRAINAGE

PART 1 GENERAL

1.01 REQUIREMENTS

A. Conform with the applicable provisions of the General Conditions and Special Provisions.

1.02 RELATED SECTIONS

A. Section 22 0500, Common Work Requirements for Plumbing.

B. Section 22 0504, Pipe and Pipe Fittings for Plumbing.

C. Section 22 0700, Plumbing Insulation.

1.03 SCOPE

A. A complete roof drainage and overflow roof drainage system and associated miscellaneous accessories. This section shall include all work within the building and to a point approximately 5'-0" outside the building, or as otherwise indicated.

PART 2 PRODUCTS

2.01 PIPING

A. Pipe, fittings and couplings below grade or slab-on-grade shall be service weight cast iron no hub pipe, coated inside and outside, conforming to ASTM A-74 and 87 Standards, or polyvinyl chloride (PVC) sewer pipe Schedule 40, conforming to ASTM D3034.

B. Pipe, fittings and couplings above slab on grade shall be either service weight cast iron no hub pipe, coated inside and outside, conforming to ASTM A-74 and 87 Standards.

C. No-hub cast iron pipe shall conform to CISPI Standard 301 and shall be marked with CISPI Label.

D. All above and/or below ground cast iron pipe and/or fittings shall be marked with the trademark of the Cast Iron Soil Pipe Institute.

2.02 FITTINGS

A. Fittings for cast iron pipe shall be service weight or no-hub cast iron drainage pattern, conforming to ASTM C564, coated for underground installation.

B. Fittings for galvanized steel pipe shall be screwed galvanized cast iron or malleable iron drainage pattern.

2.03 JOINTS

A. Joints for cast iron pipe and fittings shall be suitable to match the required piping system and shall be either lead and oakum, or double seal compression-type molded neoprene gaskets conforming to ASTM C-564 Standards, and suitable for the class of pipe being jointed, with adhesive type joint lubricant, Tyler "LUBRI/FAST" or equivalent. No-hub couplings shall be minimum four (4) band type with neoprene gasket material, conforming to ASTM 564, and 0.008-inch minimum, Type 304 stainless steel shear ring. Couplings shall be Tyler "Wide Body," Husky Series 4000, Clamp-All, Mission Heavy Weight, Ideal, or equivalent.

B. Joints for galvanized steel shall be threaded, made with approved joint compound.

2.04 DRAINS

A. Roof drains, overflow roof drains, shall be Froet, J. R. Smith, Josam, Mifab, Sioux Chief, Wade, Watts, Zurn, or equivalent as specified on the drawings and compatible with the required piping system. Drains shall be suitable for the required building construction system and shall be furnished complete with all extensions, receptors, flashings, and accessories required for the complete water-proof installation.

2.05 CLEANOUTS

A. Cleanouts shall be as manufactured by Froet, J. R. Smith, Josam, Mifab, Sioux Chief, Wade, Watts, Zurn, or equivalent, and shall be of the same size as the pipe, except that cleanout plugs

larger than 4 inches will not be required. Cleanouts installed in connection with cast iron soil pipe shall consist of a long sweep, quarter-bend or one or two eighth bends extended to an easily accessible place, or as indicated on the drawings. A standard cleanout fitting, Zurn No. ZN-1400-ZB, with polished bronze top shall be caulked into the hub of the fitting and finished flush with the floor. Heavy duty cleanouts shall be Zurn Z-1474, with integral anchor flanges. Where cleanouts in connection with threaded pipe are shown and are accessible, they shall be cast iron drainage T-pattern, 90-degree branch fittings with square head brass screw plugs of the same size as the pipe up to and including 4 inches. Wall cleanouts in finished areas shall be Zurn No. Z-1460-8 with polished stainless steel or chrome plated metal cover.

2.06 ACCESSORIES

A. Refer to Section 22 1316, Sanitary Waste & Vent Piping, for roof flashing requirements.

PART 3 EXECUTION

3.01 INSTALLATION

A. Piping installation shall conform to the requirements of Section 22 0500, Common Work Requirements for Plumbing, and Section 22 0504, Pipe and Pipe Fittings for plumbing. Installation of specialties shall conform to the requirements of Section 22 0505, Piping Specialties for Plumbing.

B. Roof drainage piping shall be properly graded and installed in strict accordance with all applicable codes and requirements. All turns and fittings shall be supported same as for waste and vent piping as specified in Section 22 1300.

3.02 TESTS

A. The roof drainage system shall be tested by filling system with water. System shall remain filled with no loss of water for a minimum of 2 hours. The system water test shall be applied to the systems either in its entirety or in sections. Preliminary testing shall be accomplished as necessary prior to final test.

B. If applied to the entire system, all openings in the piping shall be tightly closed, except the highest opening, and the system filled with water to point of overflow. If the system is tested in sections, each opening shall be tightly plugged except the highest opening of the section under test, and each section shall be filled with water, but no section shall be tested with less than a ten (10) foot of water. In testing successive sections, at least the upper ten (10) feet of the next preceding section shall be tested, so that no joint or pipe in the building (except the uppermost ten feet) of the system shall have been submitted to a test of less than a ten (10) foot head of water. The system shall then be tight at all points.

END OF SECTION 22 1400

SECTION 22 4000
PLUMBING FIXTURES AND TRIM

PART 1 GENERAL

1.01 REQUIREMENTS

A. Conform with applicable provisions of the General Conditions, Supplemental General Conditions and the General Requirements.

B. Lead Ban: All systems and system components, pipe, fittings, and fixtures delivering water for human consumption shall be lead free.

1. Any product designed for dispensing potable water shall meet both the NSF 61 and NSF 372 test standards via third-party testing and certification.

2. Lead free refers to <0.25% weighted average lead content in relation to wetted surface of pipe, fittings, and fixtures in systems delivering water for human consumption, and solder and flux which does not contain more than 0.2% lead.

1.02 RELATED SECTIONS

A. Section 22 0500, Common Work Requirements for Plumbing.

B. Section 22 0504, Pipe and Pipe Fittings for Plumbing.

C. Section 22 1100, Domestic Water Piping.

D. Section 22 1316, Sanitary Waste and Vent Piping.

PART 2 PRODUCTS

2.01 FIXTURES AND EQUIPMENT

A. Vitreous china and enameled cast iron fixtures by American Standard, Kohler, Sloan, Zurn, Mansfield, Toto, or equivalent as listed and described in the plumbing fixture schedule on the drawings. All vitreous china and enameled cast iron fixtures shall be white, unless otherwise indicated on the drawings. The material used for plumbing fixtures shall be of non-absorptive, acid-resistant vitreous china, enameled cast iron or stainless steel, and free from all imperfections. Lavatories and sinks required in patient care areas shall have the water spout mounted so that the discharge point is a minimum distance of 5" above the rim of the fixture. Where blade handles are used, they shall not exceed 4-1/2" in length except that handles on scrub sinks and clinical sinks shall be not less than 6" long. Clinical sinks shall have an integral trap in which the upper portion of a visible trap seal provides a water surface. Each water service main, branch main, riser and branch to a group of fixtures shall be valved or as otherwise shown on the drawings to provide more stringent requirements. Stop valves shall be provided at each fixture. One piece chrome plated escutcheons shall be installed on all water piping and trap connections at walls or base cabinets. All exposed connecting piping and material shall be chrome plated.

B. Handicap accessible lavatories and counter mounted sinks shall have exposed supply and waste services insulated with rigid, molded insulation kits as manufactured by T.C.I. "Skal-Gard", Brocar "Trap Wrap", True-Bro "Handi Lav-Guard", McGuire "Prowrap", or equivalent. Provide off-set tail piece fittings on all handicap accessible laboratories and sinks as required.

C. Flush valves shall be low water consumption type as specified on drawings. Valves shall be diaphragm or piston type, with metal oscillating non-hold open handle, screw driver back check angle stop assembly with cap, adjustable tailpiece, vacuum breaker flush connection, and spud couplings as required for wall and fixture rough-in. Exposed flush valves shall be fully chrome plated, with chrome plated supply pipe cover. Flush valves shall be American Standard, Delany, Delta, Sloan Regal, Sloan Royal, Zurn, , Toto, or equivalent.

D. Closet seats shall be furnished for water closets as specified on the Plumbing Fixture Schedule on the drawings. Closet seats shall be white unless otherwise required to match water closet. All closet seats shall be of smooth non-absorbent material and shall be properly sized for the water closet bowl type. All closet seats for fixtures for public use shall be open-front type without cover. Water closet seats provided for handicapped fixtures shall meet all handicapped requirements.

Hinges, posts, nuts, and pintles shall be of a 300 series stainless steel construction. Water closet seats shall be furnished by the plumbing fixture manufacturer as specified on the Fixture Schedule on the drawings, or shall be as manufactured by Bemis, Beneke, Centoco, Church, Jones Stephens, Olsonite, Sperzel, or equivalent.

E. Floor mounted mop sinks and shower floors shall be as specified on the Plumbing Fixture Schedule on the drawings, molded stone or terrazzo, size and arrangement as shown on the drawings, as manufactured by Acorn, Centoco, Designer's Choice, Fiat, Mustee, Stern-Williams, Zurn, or equivalent. All mop sink faucets shall be equipped with inlet checkstops.

F. Stainless steel sinks shall be as specified on the Plumbing Fixture Schedule on the drawings and as manufactured by Kohler, American Standard, Elkay, Just, Advance Tabco, Moen, Intersan, or equivalent. Countertop sinks indicated within the Architectural drawings to be handicap-compliant shall have an off-centered drain opening and a maximum sink depth of 7-inches. All sink basins shall have a center-rear outlet unless noted otherwise.

G. Electric water coolers (EWC) and drinking fountains shall be as specified on the Plumbing Fixture Schedule on the drawings and as manufactured by Acorn Aqua, Elkay, Guardian, Halsey, Haws, Murdock, Oasis, Sunroc, Taylor or equivalent.

H. Hose bibbs and wall hydrants shall be as specified on the Plumbing Fixture Schedule on the drawings and as manufactured by Zurn, Jay R. Smith, Wade, Woodford, Acorn, Chicago, T&S Brass, Watts, Prier, or equivalent. Handles, if specified shall be constructed of metal or brass and finished to match valve unit.

I. Shower valves and mixing valves shall be as specified on the Plumbing Fixture Schedule on the drawings, and as manufactured by Powers, Leonard, Lawler, Speakman, Symmons, Bradley, or equivalent.

J. Emergency fixtures including showers and eyewash shall be as specified on the Plumbing Fixture Schedule on the drawing and as manufactured by Bradley, Chicago, Haws, Speakman, Western, Guardian, Acorn Safety, or equivalent.

2.02 FAUCETS

A. Plumbing fixture faucets shall be brass construction and fully chrome plated, unless special finish is specified on the Plumbing Fixture Schedule on the drawings. Faucets shall be furnished complete with all accessories required for the necessary application, including aerators, handles, spouts, and operating cartridges. Contractor shall coordinate exact faucet requirements with required fixture drilling and water and waste rough-in. Faucets for handicapped fixtures shall meet all handicapped and ADA requirements, including a maximum of five (5) pounds of force to activate controls and adjustable metering faucet water flow duration of ten (10) seconds, minimum. Single hole faucets shall have anti-clocking pin to prevent rotation of valve body.

B. Plumbing fixture faucets shall be furnished by the fixture manufacturer as specified in the Plumbing Fixture Specification on the drawings and Paragraph 2.1 herein, or shall be as manufactured by Chicago, Delta, Moen, Speakman, T&S Brass, Zurn, or equivalent, and shall be commercial grade.

2.03 PLUMBING FIXTURE TRIM

A. Plumbing fixture trim including P-traps, supplies, and strainers shall be furnished by the fixture manufacturer as specified in the Plumbing Fixture Specification on the drawings and Paragraph 2.1 herein, or shall be as furnished by Chicago, Brass Craft, McGuire, T&S Brass, EBC, Zurn, or equivalent.

B. Unless otherwise specified, traps shall be copper-alloy adjustable tube-type with slip joint inlet and swivel, not less than 20 gauge and without cleanout. Inlets shall have rubber washer and copper alloy nuts for slip joints above the discharge level and swivel joints below the discharge level, metal-to-metal or metal-to-plastic type as required for the application. Outlet shall be threaded or socket for solder joint connection as required by the application. Tailpiece shall be copper-alloy, offset style, to match P-trap. Furnish brass or copper wall escutcheon at waste penetration through walls. P-traps, tailpieces, escutcheon, and all piping for above floor exposed installations, including installation within cabinets and casework shall be chrome plated.

C. Fixture supplies, strainers, and trim shall be brass construction. Supplies shall be commercial grade, quarter-turn all brass ball valves, plastic stems and handles are not acceptable. Furnish supply with loose key unless otherwise specified. Supply pipe shall be 3/8" O.D., with smooth (non-corrugated) flexible copper riser and wall escutcheon. Supply assembly shall be completely chrome plated for all exposed installations, including installation within cabinets and casework. Strainers and other miscellaneous fixture trim shall be furnished as required for the proper installation and shall be chrome plated to match faucets, unless special finish is required.

PART 3 EXECUTION

3.01 INSTALLATION

A. The Contractor shall provide all necessary supports and connection materials and trim for plumbing fixtures as required to assure a complete properly installed and operating system. Installation shall be in accordance with manufacturer's recommendations and with Uniform Building Code and Uniform Plumbing Code requirements. The Contractor shall caulk fixtures to the adjacent wall, floor and countertop construction with non-shrink, mildew resistance caulking material.

B. Fixture mounting height shall conform to the ADA Accessibility Requirements and coordinated with the Architectural drawings.

1. ADA required Water Closet shall be mounted with top of seat 17” – 19” above finished floor.
2. ADA required Urinal shall be mounted at a maximum of 17” top of rim to finished floor.
3. ADA required Lavatory to be mounted with the rim or counter surface no higher than 34” above finished floor.
4. ADA required shower controls shall be located from 38” minimum to 48” maximum height above the shower floor.
5. ADA required Bathtub controls shall be located maximum of 48” above bottom of tub surface.
6. ADA required Sinks shall be mounted with counter or rim no higher than 34” above finished floor.
7. ADA required Drinking Fountains or Water Coolers spouts shall be no higher than 36” measured from the floor or ground surface to the spout outlet.

3.02 EQUIPMENT/FIXTURE SUPPORT

A. Furnish and install all "back-up" materials for fixtures and accessories, or as otherwise required by the equipment schedule to properly support and provide a sturdy installation.

3.03 FIXTURE CARRIERS

A. Fixture carriers shall be provided for all wall hung plumbing fixtures, including water closets, urinals, lavatories, sinks, etc., as manufactured by Josam, Jay R. Smith, Watts, Wade, Zurn, MiFab, or equivalent. Carriers shall be bolted to the floor using all of the support bolts recommended by the manufacturer. Where the water closet nipple and studs extend beyond the maximum carrier recommended length, provide additional carrier support as recommended by manufacturer. Water closet carriers shall be horizontal or vertical, single or back-to-back units as required for the fixture installation and piping arrangement, and shall be adjustable.

B. Single water closet carriers shall have factory installed rear hold down lugs and anchor foot to provide cantilever support.

C. Wall hung urinals shall be provided with floor mounted fixture carrier complete with upper and lower fixture support plates as required to match fixture installation requirements.

D. Wall hung lavatories and sinks shall be provided with floor mounted concealed arm type chair carriers, single or double (back-to-back) units as required for the fixture installation and arrangement.

E. Contractor shall be responsible to provide the proper arrangement and selection of fixture carriers required for fully concealed installation in the available plumbing chase and/or wall construction.

3.04 FOOT PEDALS

A. Plumbing fixture foot pedals, when specified, shall be provided with required back-up support and shall not be installed until wall support methods have been submitted for review.

3.05 EQUIPMENT FURNISHED BY OTHERS

A. The Contractor shall furnish and install complete rough-in and connections, including stop valves on all supply piping for all mechanical services required for equipment furnished and installed under other sections of this specification, and for all owner-furnished equipment.

B. Types of equipment in this category shall include but not be limited to the following: kitchen equipment, shop equipment, hospital and laboratory casework, medical equipment, etc. The Contractor shall provide all pipe fittings, unions, traps, connecting wastes, valves, cocks, regulators, pressure reducing valves, flexible connectors, etc., as required for the services to each piece of equipment.

C. Installation and setting of equipment and fixtures furnished under other Sections of this Specification will not be provided under Division 22 of this Specification, unless otherwise indicated.

3.06 FIELD MEASUREMENTS AND COORDINATION

A. Exact location and rough-in requirements shall be carefully coordinated. Contractor shall refer to drawings and specifications, and shall check manufacturer's data, shop drawings and rough-in drawing submitted under Division 22 and other Divisions of this specification and make all field measurements to the extent necessary to ensure his understanding of the work required to provide for complete rough-in installation.

3.07 CLEANING

A. All fixtures shall be thoroughly cleaned before final acceptance of the work.

END OF SECTION 22 4000

SECTION 23 0500

COMMON WORK REQUIREMENTS FOR HVAC

PART 1 GENERAL

1.01 SCOPE OF WORK

A. See General Conditions and Supplemental General Conditions.

B. The requirements listed under General Conditions and Supplemental General Conditions and the General Requirements are applicable to this Section and all subsequent sections of this Division and form a part of the contract.

1.02 DESIGN INTENT

1.03 INDEX OF SPEC SECTIONS FOR THIS DIVISION

23 0500	Common Work Requirements for HVAC
23 0503	Trenching and Backfilling
23 0504	Pipe and Pipe Fittings
23 0505	Piping Specialties
23 0523	Valves
23 0548	Vibration and Seismic Controls for HVAC
23 0549	HVAC and Electrical Installation Coordination
23 0593	Testing, Adjusting and Balancing of Mechanical Systems
23 0700	Mechanical Systems Insulation
23 3000	Air Tempering System and Equipment

1.04 DEFINITIONS

A. General: Terms will have meanings as defined in Webster's Eleventh New Collegiate Dictionary except as noted below.

B. Entities

1. Owner: Santa Fe County
2. Architect: Lloyd and Assoc.
3. Engineer: Bridgers & Paxton
4. Owner's Representative: The Owner will designate his representative after bid. The abbreviation "OR" may be used throughout these specifications to refer to the Owner's Representative.
5. Owner's Agents: The Architect, Engineer, and others authorized to act on behalf of the Owner.

C. Actions

1. Supply: Procure and deliver to the site with all features as specified, required per code, and as required for proper installation. Include submittals, O&M manuals, operator instructions, and warranty.
2. Install: Set in place in accordance with manufacturer's instructions, contract documents, and applicable codes and standards. Coordinate the installation with other disciplines, start, and demonstrate proper operation.
3. Furnish: Supply and install.
4. Provide: Supply and install.
5. Accepted: By the Owner's Representative except as noted.
6. Approved: By the Owner's Representative except as noted.

7. Review: By the Engineer except as noted.

D. Locations

1. Buried: Surrounded by soil or other material, either beneath the building or exterior to the building.
2. Exterior: Exposed to rain or snow. Examples include rooftop locations, spaces around cooling towers, pipe racks, etc.
3. Interior: Not exterior or buried. Examples include not only spaces within the heated envelope of the building, but also unheated attics, covered loading docks in which spaces are protected from rain and snow, utility tunnels, sheds, etc.
4. Finished Spaces: Interior spaces other than mechanical and electrical equipment rooms, furred spaces, pipe and duct chases, unheated attics, spaces above ceilings, crawlspaces, and tunnels.
5. Exposed: Exposed to view. Examples include finished spaces mechanical equipment rooms, rooftops, etc.
6. Concealed: Not Exposed.

E. Other Definitions:

1. 24/7: 24 Hr/day, 7 days per week, year-round.
2. AHJ: Authorities having jurisdiction. The authorities having jurisdiction over this project are established by statute, and include governmentally designated building departments, the fire marshal, fire departments, etc. No attempt is made to list all such entities here; a qualified Contractor is expected to know and coordinate with the various authorities having jurisdiction.
3. FMS: Facility Management System
4. Local: Based no further from the job site than the Engineer is. For example, where the specifications call for a local factory authorized service agent, then on a daily basis that agent must be based in an office or warehouse located no further from the project site than the Engineer’s office.
5. OAE: Or approved equal.

1.05 CODES AND PERMITS

A. Perform all work in accordance with the 2015 International Building Code, the 2015 Uniform Plumbing Code, and the 2015 Uniform Mechanical Code, as adopted and interpreted by the State of New Mexico and City of New Mexico, and the National Fire Protection Association (NFPA Regulations), current adopted edition. Provide all materials and labor necessary to comply with rules, regulations and ordinances. Where the drawings and/or specifications indicate materials or construction in excess of code requirements, the drawings and/or specifications shall govern. Contractor shall hold and save the Owner and his agents free and harmless from liability of any nature or kind arising from the Contractor’s failure to comply with codes and ordinances.

B. Secure and pay for all permits necessary for performance of the work, including utility connections, extensions, meter pits and meter sets and tap fees for water, storm sewer, sanitary sewer and natural gas, unless otherwise specified herein.

C. Comply with the requirements of, and the recommendations of:

1. Applicable county and state mechanical, electrical, gas, plumbing, health and sanitary codes, laws and ordinances
2. National Electrical Manufacturer's Association
3. National Electrical Code
4. Underwriters Laboratories
5. American National Standards Institute

6. American Society for Testing Materials
7. Local utility companies
8. National Fire Protection Association
9. ASME Boiler and Pressure Vessel Codes
10. Occupational Safety and Health Administration
11. International Fire Code
12. Midwest Insulation Contractors' Association (MICA)
13. Sheet Metal and Air Conditioning Contractors' National Association (SMACNA)
14. American Society of Sanitary Engineering
15. American Gas Association

1.06 PRIOR APPROVAL

A. Refer to Division 1 for Prior Approval Requirements.

B. Equipment manufacturers and service providers are listed within the specifications for the work specified in this division. For the items listed below, the specified manufacturers and providers are the only ones presently approved, and may be the only ones allowed:

Air Conditioning Units

Pumps

Boilers

Facility Management System

C. Manufacturers and service providers who are not listed in these specs, and who offer equivalent or superior products or services, are invited to submit for approval prior to bid (prior approval). Submit two copies. Requests for prior approval must:

1. Include the substitution request form at the end of this spec section.
2. Include technical data sufficient for the Engineer to generally assess appropriateness for this project.
3. Be submitted minimum ten days prior to the bid date in effect at the time of submission.
4. Comply with any additional requirements per specification Division 1.

D. Any additional prior approved alternate manufacturers and service providers will be published in an addendum prior to bid. Prior approval indicates that based on the information submitted it appears to the Engineer that the alternate might be capable of meeting the specifications and the design intent, and might be appropriate for the project. But prior approval does not guarantee this. Prior approved products and service providers must still go through the submittal process after award, and must still comply with the design intent and all specification requirements.

E. Please do not request prior approval for products and service providers that are not listed above. Instead, for those items alternate manufacturers and alternate service providers may be submitted after bid in accordance with the submittal process, provided they meet or exceed the specifications and the indicated design intent.

F. Prior approval (approval prior to bid) of alternate mechanical equipment suppliers and service providers is not required. Please do not request prior approval. Alternate manufacturers and service providers may be submitted after bid in accordance with the submittal process provided they meet or exceed the specifications and the indicated design intent.

1.07 DOCUMENT MANAGEMENT

A. Contractor is encouraged to use a web-based document management system for RFIs and submittals. If used, Contractor shall provide and pay for licenses and training for the engineer's project personnel. The section below describes procedures for handling submittals if a web-based document management system is not used. If a web-based system is used,

the procedures below shall be modified as appropriate.

1.08 SUBMITTALS

A. See Division 1 and individual specification sections within this division for additional submittal requirements.

B. Prior to purchasing materials, equipment and services, submit descriptive literature for review.

C. See Division 1 and individual specification sections within this division for additional submission requirements. The following describes general submittal procedures. More specific procedures will be established after award. Whenever electronic files are to be submitted, e-mail them through normal channels. But if files are too large to e-mail, then submit them in quantities as described below.

1. Submittal Schedule: Along with the first item submitted for review, include a schedule listing all items to be submitted and an approximate date for each submittal. Submit this schedule in both hard copy and electronic form (Microsoft Excel). Normal review time will be 10 working days or as indicated in Division 1. Schedule should identify any submittals for which expedited review is requested. Update this schedule and resubmit it monthly (by e-mail) for information.
2. Include the following information with each submittal:
    a. Cover sheet identifying the project name, contractor, architect, engineer, and items included. Indicate symbol numbers, spec section, etc.
    b. A blank space large enough to accept a review stamp.
    c. Performance under the specified conditions
    d. Cover sheet shall clearly identify and **HIGHLIGHT** any ways in which the submitted materials, equipment or services deviate from the Specifications.
3. Quantities:
    a. Brochures: Submit no more than seven copies plus a PDF.
    b. Drawings: Submit one reproducible, one print, plus a PDF.
4. Engineer will review one original submittal and one resubmittal for each item. If the Contractor fails to provide the required data or acceptable items with his second submittal, he will be charged for the Engineer's costs for the third and subsequent reviews.
5. Required Information: Submit information to allow the Engineer to easily determine whether the submitted components comply with the general design intent. Include relevant descriptions of materials, features, performance, quality and dimensions. Cross out all features, options and accessories which will not be provided. It is assumed that all specified, indicated and/or required features will be provided unless specifically noted otherwise.
6. Where specifications require a local factory authorized service agent, submit the name, address, and contact information for this agent. Include this information also in the O&M Manual.

D. Review of Submittals: Engineer will review submittals for general conformance with the design intent.

1. Review of a separate item as such will not indicate review of the assembly in which the item functions.
2. Review of submittals shall not relieve the Contractor of responsibility for any deviation from the requirements of the Contract Documents, nor for errors or omissions in the submittals; or for the accuracy of dimensions, the adequacy of connections, and the proper and acceptable fitting, execution, functioning and completion of the work.
3. Review will not relieve the Contractor of responsibility to comply with the contract requirements, or responsibility to ensure that equipment fits within the allotted space with

required clearances for equipment operation, service and maintenance, including minimum clearances required by applicable codes, manufacturer's installation instructions and as necessary for proper clearance in front of all electrical panels as defined by the National Electric Code (NEC).

4. For commodity type items (plumbing fixtures, terminal units, registers, diffusers, etc), Engineer will review submittals for type only. Contractor to coordinate sizes and quantities.

5. Actions: Engineer will return submittals with one of the following actions:

NO EXCEPTIONS TAKEN	Contractor may proceed with the work as submitted
EXCEPTIONS AS NOTED	Contractor may proceed with the work and without resubmittal provided he complies with all exceptions noted in the submittal, and so states in a letter
REVISE AND RESUBMIT	Resubmit in accordance with the indicated comments
REJECTED	Resubmit in accordance with the contract documents
RETURNED WITHOUT ACTION	This submittal has not been reviewed, and therefore the Engineer is returning it with no direction to the Contractor.

E. Substitutions:

1. Unauthorized Substitutions: If substitute materials, equipment or systems are installed without prior review or if any work is installed in a manner which is not in conformance with the requirements of this specification and for which the Contractor has not received written authorization, remove such unauthorized work and install work in accordance with the contract documents at no change in contract amount.

2. Authorized Substitutions: Provide all accessories and features as required and coordinate substitutions with other disciplines. Bear any extra expenses resulting from the use of substitutions which affect adjoining or related work required in this division or other divisions of the work.

3. If the Contractor substitutes equipment for that indicated on the drawings, he shall prepare a 1/4 inch = 1foot installation drawing for each equipment room where a substitution is made, using dimensions of substituted equipment, and including piping, and electrical equipment requirements, to verify that equipment will properly fit within the space with adequate clearance for maintenance and replacement. Submit this drawing for review.

F. Schedule: Submit all submittals in a timely manner consistent with the requirements for completing the work covered by this contract within the prescribed contract time. Be aware that there is risk in ordering components, fabricating work, and/or installing work prior to review. If the Contractor proceeds prior to review, and then the review comments required modifications to work which has begun or has been completed, then Contractor must comply with the review comments at no change in contract amount or schedule.

G. Shop Drawings

1. Submit shop drawings for

a. Mechanical equipment rooms and other spaces housing air handling equipment, heat transfer equipment, fluid handling equipment, machinery, etc.

b. Complete supply, return, and exhaust ductwork systems, both exposed and concealed.

c. Piping for HVAC, plumbing, and fire protection systems, both exposed and

concealed.

2. Show the location and elevation of all equipment, ductwork and piping, as well as openings through slabs and walls. Include plans, elevations and sections as appropriate. Clearly show the manner in which the systems fit into the available space and relate to each other and to the building elements. Indicate required sleeves and openings in general construction elements. Indicate required clearances for operation, maintenance and replacement of operating devices and equipment. Drawings shall be of appropriate scale to facilitate coordination and understanding, but not smaller than 1/4 inch scale for floor plans and 1/4 inch scale for equipment rooms and chases.

3. Conflicts: The engineer has endeavored to work out conflicts in areas where the design is congested, but has not tried to show all required offsets to coordinate with the building construction and building systems, particularly in less congested areas. The intent is that the Contractor coordinate the design of the piping and ductwork distribution systems with the building construction and the various building systems, particularly in less congested areas. Provide experienced designers to perform such services and prepare shop drawings. Exercise good design practice in working out conflicts without compromising system operation or maintenance. Provide fittings, offsets, etc., as required. Contractor shall include this design effort and include the labor and materials for such fittings and offsets in his base bid. Except in extremely unusual circumstances, no additional costs will be allowed related to working out conflicts. Coordinate with other disciplines as required. Identify on the shop drawings those areas where redesign was necessary to resolve design conflicts.

   a. In the event that the Contractor desires direction in resolving a design conflict or desires prior approval of a recommended approach to resolving a conflict, submit an RFI which identifies the conflict and suggests a recommended solution.

   b. In resolving conflicts, gravity lines and larger distribution mains will generally have priority over pressurized lines and smaller lines as follows:

      Plumbing waste and vent lines

      Roof drains

      Steam and condensate piping

      Supply, return and exhaust ductwork

      Fire sprinkler mains

      Heating hot water and chilled water piping

      Domestic hot and cold water

      Fire sprinkler branch piping and sprinkler runouts

      Pneumatic control piping

      Miscellaneous special piping systems

4. Use of Engineer’s CADD Database or BIM Model: The Engineer will provide the Contractor electronic files of the Engineer’s CADD Database or BIM Model of the design documents if the Contractor completes and submits the License Agreement form included at the end of this spec section. These files show the general design intent and may be used as a starting point for the Contractor to begin his shop drawings and coordination effort, but the Contractor should not use them as a basis for ordering or fabrication. The normal submittal process still applies, regardless whether the Contractor elects to use the Engineer’s CADD Database or BIM Model.

H. Submittals Required under this Specification Section:

1. Electrical Components: Motors, Motor Controllers, and Variable Speed Drives

2. Identification: Products used to identify equipment, ductwork, valves, piping, and control devices.

3. General Construction Components: Roof Curbs & Access doors.

1.09 DOCUMENTED COORDINATION EFFORT

A. After shop drawings are reviewed, incorporate any review comments and then participate in a formal and documented coordination effort with the contractors and subcontractors for other divisions of the work. Show all piping systems and equipment on the ductwork drawings, and send electronic CADD files to the General Contractor and the subcontractors for plumbing, fire protection, electrical, and other disciplines. The other subcontractors will then add their work to the CADD files.

B. Make full-size plots of the drawings. Participate in meetings with the GC and other subcontractors to review each area, identify conflicts, and resolve conflicts. Submit the resolutions to the Engineer for review. Maintain adequate space for operation, maintenance, and code-required clearances. Ensure that all subcontractors initial each plan to indicate that they have participated in the coordination effort.

1.10 MISCELLANEOUS PROVISIONS

A. Qualifications

1. All mechanics shall be skilled in their respective trade.
2. All welders shall be certified in accordance with the ASME Boiler Test Code, Section IX, latest issue.

B. Regulated Materials: Comply with all state, local and federal regulations regarding the storage, handling or disposal of oils, lubricants, cleaning agents, refrigerants, other liquids and gases, and hazardous materials.

C. Factory Identification: Provide all materials and equipment with labels sufficient to show compliance with these specifications and the performance requirements indicated on the drawings. All equipment shall carry a permanent label installed by the manufacturer stating that the equipment complies with ASHRAE/IESNA Std. 90.1.

D. Hazardous Conditions: Protruding metal (bolts, steel angles, etc.) potentially hazardous to maintenance and operation personnel, shall be cut back and/or protected to reduce the risk of injury.

E. Hazard Signs

1. Provide a sign reading, "Hazardous Area - Authorized Personnel Only" on the doors to all equipment rooms, fan plenums, and similar areas containing moving or rotating parts, or other potentially hazardous environments.
2. Provide a sign reading, "Confined Space - Entry by authorized personnel only by permit" for all confined spaces. Confined spaces shall be as designated by OSHA Standard 1910.146. This generally means a space that:
   a. Is large enough and so configured that an employee can bodily enter and perform assigned work; and
   b. Has limited or restricted means for entry or exit (for example, tanks, vessels, storage bins, hoppers, vaults, and pits are spaces that may have limited means of entry); and
   c. Is not designed for continuous employee occupancy.
3. Survey the final premises to determine where any potentially hazardous areas exist. If the Contractor feels that hazards exist which cannot be suitably provided for through the above typical methods, he shall forward in writing his concerns, and request for a decision concerning the referenced hazard, prior to the final inspection of the facilities.

1.11 GUARANTEE-WARRANTY

A. See Division 1 for additional information on warranties. Warranties shall run for one year from substantial completion unless indicated otherwise.

B. The following warranty shall be binding:

"The Contractor warrants that this installation is free from mechanical defects. Contractor agrees to replace or repair any part of the installation which may fail within a period of one year after the date established below, provided that such failure is due to defects in materials or workmanship, or to failure to follow the specifications and drawings. This warranty shall begin on the date set forth in the Certificate of Substantial Completion, AIA Form G704, or other such date as documented in writing by the Owner's Representative."

C. The extent of guarantees or warranties by equipment and/or materials manufacturers will not diminish the requirements of the Contractor's warranty to the Owner.

PART 2 PRODUCTS

2.01 PRODUCT GENERAL REQUIREMENTS

A. General: Products supplied under Division 23 shall comply with the following except as noted elsewhere.

B. Products shall be new; shall be the product of manufacturers regularly engaged in the production of plumbing, heating, ventilating, air conditioning, and control system equipment; and shall be the manufacturer's latest design. Specs and equipment schedules establish expectations regarding standard of quality and operating intent.

C. Hazardous or Environmentally Damaging Materials: Products shall not contain asbestos, mercury, PCBs, or other materials harmful to people or the environment.

D. Products shall be suitable for the conditions under which they are installed and operated. Prior to or during the submittal phase advise the Owner’s representative and the Engineer in writing regarding any concerns about the suitability of the specified products for the intended application or service. Request clarification if any question exists regarding the design intent.

E. Performance Ratings: Unless otherwise noted, all scheduled equipment performance is based on an elevation of 5500 feet above sea level. Adjust manufacturer's ratings accordingly.

F. Structural Soundness: Products shall have structural integrity appropriate to the component and its application. Bases shall be rigid and shall keep all components in proper alignment. Structural integrity shall be adequate for both rigging and final installation. Components shall not be loose, rattle, or vibrate unnecessarily in their final installed condition.

G. Corrosion Resistance: Equipment shall be of materials inherently corrosion resistant, or shall be finished with a corrosion-resistant finish suitable for the location in which the equipment is installed.

H. Touch-up: If the factory finish of any component is damaged prior to substantial completion, touch up to original condition per manufacturer’s recommendations.

I. Equipment Access Doors or Panels: Provide access doors and panels within equipment to ensure good access to all components requiring inspection, service or maintenance. Provide appropriate hardware. Equipment installed outdoors shall be weather-tight.

J. Fans: Statically and dynamically balanced, shaft first critical speed shall be above operating speed at design conditions.

K. Bearings: Grease lubricated or permanently lubricated.

L. V-Belt Drives: All components sized for 150% of motor HP, multiple belts shall be matched, fixed sheaves for motors 20 Hp and larger, adjustable sheaves for lower HP motors, all safety components for OSHA compliance (e.g., belt guard or other safety provisions) motor mounted on adjustable base. Provide a replacement sheave for each fixed sheave after T&B is complete. Include belt data in O&M manual. Gates Rubber Co, OAE.

1. Belt Guards: Rigidly constructed and attached, removable, galvanized steel, expanded mesh. Design to provide ready access to bearings.

M. Couplings: Provide coupling guard.

N. Motors and VFDs: See requirements described elsewhere in this spec section.

O. Drive Lines (starter or VFD, motor, coupling and shaft or v-belt drive and pulleys, and driven equipment): Coordinate with all suppliers and ensure all components are compatible to work as a system.

P. Coils: ARI rated, copper tubes mechanically expanded into aluminum fins, galvanized steel casing, drainable, pressure tested to 150% of working pressure but not less than 300 psi.

Q. Cooling Coil Drain Pans: Provide for all cooling coils, galvanized or stainless steel, double pitched with piped outlet. For units with more than one coil stacked, provide intermediate drain pans piped to the main drain pan.

R. Gas Burners: Natural gas fired, performance based on gas at 1000 Btu/SCF HHV but suitable for use with gas at 900 – 1050 Btu/SCF and 7 – 11 inches water column, factory installed and pressure tested gas train, all necessary safety and operating controls.

S. Filter Frames: Galvanized steel, provide wherever filters are specified.

T. Roof Curbs and Support Rails for Roof-Mounted Equipment: Roof curbs should generally be supplied with the equipment which the curb supports, and shall comply with the requirements of the National Roofing Contractors' Association. Match curb to the requirements of the supported equipment. The roof pitch is indicated on the architectural drawings. If roof pitch exceeds the recommendations of the equipment manufacturer, provide a curb that will level the equipment. Factory fabricated, minimum 12-inch, structurally adequate for the load supported, not less than welded 18-gauge (16-gauge or heavier for sizes more than 50-inches) galvanized steel with minimum 1-inch fiberglass insulation, 2 x 2 wood nailer, and with cant and step if required to match specified roof. Provide damper tray for un-ducted fan applications. Ship small curbs fully assembled; large curbs may be knocked down for shipment.

U. Electrical & Controls: Except where specifically noted, electric service to each component listed on the equipment schedules will be through a single electrical feed at the voltage indicated on the equipment schedules. Include all components, cabling and conduits to distribute power to all components which are factory supplied and mounted. Provide transformer(s) if required to serve unit-mounted components requiring electric service at voltages different from the main electric service, including controls components. Provide secondary overcurrent protection. Provide terminal strips for field-installed control wiring. Provide unit-mounted, unit-specific wiring diagrams on durable paper, attached to inside of control panel door or otherwise affixed to the unit. All electrical components shall be UL Listed or Recognized. All factory-installed electrical work shall comply with the NEC unless the overall unit is listed by an organization acceptable to the AHJ, and listed to a standard acceptable to the AHJ.

1. Where equipment includes an LCD or other, similar display for operator interface, display all information in English. Displays should be readily understandable and should not require the user to look up display codes in a reference manual.
2. Provide battery backup to retain all memory and programming, and to keep all clock-related functions powered through a 1-week power outage.
3. Controls interface with the FMS:
    a. Digital Inputs to FMS: 24V DC sourced from equipment.
    b. Digital Outputs from FMS: Equipment to have form C relays, max 250V DC, 2 A.
    c. Analog Inputs to FMS: 4-20 mA, 0-5V DC, or 0-10V DC sourced from equipment.
    d. Analog Outputs from FMS: 4-20 mA sourced from FMS.

2.02 ELECTRICAL COMPONENTS

A. General: Except as noted, all electrical products and equipment shall comply with the requirements of this section, whether field installed or factory installed. See "Product General

Requirements" and "Installation General Requirements" in Parts 2 & 3 of this spec section for additional requirements.

B. Motors

1. General: Except as noted motors shall be horizontal, open drip-proof, 4-pole, 1750 RPM, rated per NEMA MG-1, with fabricated steel or cast iron casing, motor terminal box adequately sized for conductors one-size larger than specified, SS nameplate per NEMA MG-1-20.60, connection diagram attached to motor, compression lugs for power feeds and ground conductor, grease lubricated sealed ball bearings or roller bearings with standard grease fitting zerk and relief tapping, factory lubricated, dynamically balanced to no more than 50% of the NEMA allowable vibration limits. For motors powering V-belt drives, provide a cast iron or steel base with slide rail and adjustable belt tension device. Install motors and equipment on foundations and align as required. 40 deg C rise and total temperature rise of 65 deg C ambient.

a. 3/4 hp and smaller: 115V, single phase, 60 Hz, split phase or permanent split capacitor (PSC), NEMA Type N or O, with built-in thermal overload protection.

1) Multi-speed motors.

b. 1 hp and greater: 208 V, 3 phase, 60 Hz, squirrel cage induction type, NEMA design B, T-frame, with Class B or F insulation, lifting lugs, 150,000 hr L-10 bearings for direct-coupled applications, 50,000 hr L-10 bearings for belt-driven application with radial loads and pulley sizes per NEMA MG1-14.43. Service Factor: ODP motors shall be rated for 1.15 SF at 40°C or 1.0 SF at 65°C; TEFC motors shall be 1.0 SF.

1) Two speed motors: Provide with two separate windings.

2) Variable speed motors: Drive compatible per NEMA MG1-31, premium efficiency as specified below regardless of Hp, Class F insulation, minimum 5-year warranty.

2. Efficiency: Except as noted, motors shall be premium efficiency type, with nominal efficiencies not less than the following as per the Consortium on Energy Efficiency (CEE), and minimum power factor of 0.85:

	Open Drip-Proof (ODP)			Totally Enclosed Fan-Cooled (TEFC)		
HP	1200 RPM	1800 RPM	3600 RPM	1200 RPM	1800 RPM	3600 RPM
1	82.5	85.5	80.0	82.5	85.5	78.5
1.5	86.5	86.5	85.5	87.5	86.5	85.5
2	87.5	86.5	86.5	88.5	86.5	86.5
3	89.5	89.5	86.5	89.5	89.5	88.5
5	89.5	89.5	89.5	89.5	89.5	89.5
7.5	91.7	91.0	89.5	91.7	91.7	91.0
10	91.7	91.7	90.2	91.7	91.7	91.7
15	92.4	93.0	91.0	92.4	92.4	91.7
20	92.4	93.0	92.4	92.4	93.0	92.4
25	93.0	93.6	93.0	93.0	93.6	93.0
30	93.6	94.1	93.0	93.6	93.6	93.0
40	94.1	94.1	93.6	94.1	94.1	93.6
50	94.1	94.5	93.6	94.1	94.5	94.1
60	95.0	95.0	94.1	94.5	95.0	94.1

75	95.0	95.0	94.5	95.0	95.4	94.5
100	95.0	95.4	94.5	95.4	95.4	95.0
125	95.4	95.4	95.0	95.4	95.4	95.4
150	95.8	95.8	95.4	95.8	95.8	95.4
200	95.4	95.8	95.4	95.8	96.2	95.8

3. Approved Manufacturers: General Electric Energy Saver, Baldor Super-E, Marathon Series E, Reliance Electric XE, Westinghouse TEE II, Eaton/Cutler Hammer, Toshiba, Louis Allis, or approved equal.
4. If the Contractor proposes to furnish motors varying in horsepower and/or characteristics from those specified, he shall first submit his request for the change and shall then coordinate the change with all other parties (e.g. electrical contractor) and pay any costs associated with the change.

C. Motor Controllers
1. Single Phase Manual Starters to 1 Hp and 120-277 V: Cutler Hammer MS with indicating light.
2. 3-Phase: Full voltage, non-reversing, electro-mechanical, combination circuit breaker and motor controller, UL Listed, NEMA rated, 460V, 65,000 AIC, minimum 50 VA 24V controls transformer with secondary overcurrent protection, suitable for operation at -4°F to +149°F and specified voltage -15% to + 10%, adjustable solid state overloads initially set at Class 10, HOA switch, run indicator, two auxiliary contacts for remote monitoring of status, and enclosure for surface mounting. Cutler Hammer OAE.
   a. Provide enclosure appropriate to the location:
      1) NEMA-1 for indoor dry locations.
      2) NEMA-3R for outdoors.
      3) NEMA-4 for wet applications.
      4) NEMA-12 for dusty locations.
      5) Explosion-proof – where required.
   b. Motor controllers factory mounted and wired on AC units, boilers, etc, may be definite purpose, and need not have all the features specified here.

D. Variable Speed Drives
1. General: Factory fabricated, variable voltage and frequency type for driving the specified AC motor in a typical HVAC variable torque application, listed per UL-508, and rated for installation within a return air plenum. Performance specified here is based on driving a 4-pole NEMA B induction motor. Select and size VFDs so they are compatible to drive motors with characteristics as indicated on the drawings.
2. Conditions of Service: Suitable for installation and operation at 0 – 100% speed and load throughout the following conditions:
   a. Electric Service: Indicated voltage +10% or -30%, voltage imbalance +/-3%, 48-63 Hz.
   b. Ambient Temp & Humidity: 32-104°F and 0-95% RH non-condensing. Derate capacity 1% per 1.8F° above 104°F.
   c. Elevation: As specified in Section 23 0500. Derate capacity 2% per 1000 ft above 3300 Ft elevation.
   d. Output Cable: Up to 328 ft length or additional length if indicated on drawings.
   e. Vibration: Rated per IEC 68-2-34/35/36.

f. Seismic: Certified and labeled to IBC 2015.

3. Enclosure: NEMA-rated and suitable for mounting on a wall or Unistrut stand; zero clearance to obstructions on the sides and back; and conduit connection on top, bottom, back or sides (field selectable).
4. Power Side: All required power components including 3-phase rectifier bridge, DC capacitor bank, and output IGBT. Manual bypass starter (if indicated in schedule): Electro-mechanical or electronic, 3-contact type, but with provisions to power VFD controls troubleshooting while operating on bypass starter.
5. Controls: All required safety and operating controls, control transformer with secondary overload protection, removable and hot pluggable local control panel with LCD display. Fully programmable from the LCD display without the use of any additional devices. LCD shall be bright, easy to read, English language, engineering or SI units (set it up to display in engineering units), not utilizing codes or lookup tables. Provide the following functionality:
   a. Automatic load-dependent carrier frequency control to optimize motor-drive efficiency, maximize motor life, and minimize motor heating. Automatically optimize between low speed switching (for reliable starts and smooth low speed operation) and high speed switching (to maximize drive efficiency).
   b. Power failure auto restart.
   c. Flying start to automatically synchronize power-up after voltage trip.
   d. Drive over-temperature protection with automatic carrier frequency adjustment and automatic derate prior to tripping.
   e. 3-phase output current sensing.
   f. 1-3600 second manually adjustable acceleration and deceleration ramps with automatic over-ride to prevent overload.
   g. Temperature-controlled VFD cooling fans.
   h. PID controller.
   i. Minimum three lockout frequencies.
   j. Trickle current feature to allow current flow to prevent condensation when a motor is shut down.
   k. Controls to prevent damage in the event that an input or output disconnect is opened while VFD is powering motor.
   l. No load/broken belt warning.
   m. Separate warnings for high frequency, low frequency, high current, low current.
   n. Hold last state if analog control signal, RS-485 communication, or keypad control signal is lost.
   o. Provisions for up to 4 digital inputs to trip the VFD, with programmable English-language display message on LCD (e.g., “Vibration Switch,” “Smoke Detector,” “Duct High Pressure,” etc.
   p. Fault log storing the most recent ten faults with error code, time and value.
6. Protection: Motor thermal overload; short circuit, ground fault, heat sink high temperature cutout, high or low voltage on DC bus, loss of phase, motor-generated over-voltage, phase reversal.
7. Output

   a. Voltage: 0 – 100% of motor rated voltage at any input voltage within the range given above.
   b. Frequency: 0 – 120% of input frequency.

c. Minimum 96% efficiency at rated frequency and full load, and 80% efficiency at 50% speed.

d. Minimum 98% power factor at all speeds and loads.

e. Torque: Capable of the following torque output as a percentage on rated full speed torque: Breakaway: 160% for 0.5 seconds; Acceleration: 100%; Overload: 110%.

f. Audible Sound: Not to exceed the following dBA sound pressure when measured one meter from the VFD under any operating condition:

	VFD	
Hp	NEMA-1	NEMA3R/12
1 – 10	50	62
15 – 60	61	66
75 – 300	70	65

g. Harmonic Distortion Analysis: Supplier or manufacturer must have the capability to perform a computerized analysis of the electrical distribution system to determine the harmonic distortion generated by the VFDs. If such an analysis is requested, a change order will be issued to cover the associated costs. The Engineer will provide a CD of the electrical CADD files, and will define the harmonic distortion criteria to be met. Analyze different input line reactors or other approaches to address harmonic distortion, and recommend the most appropriate approach to meet these criteria.

8. Interface with the project's FMS (hard-wired, may be individual points or may be through the RS-485 communication port:

a. DIs: Start/stop (24VDC sourced from VFD).

b. DOs: Status, Common Alarm (Form C Relays, max 250VAC 2A).

c. AIs: Control signal (4-20 mA, 0-5 VDC, or 0-10 VDC).

d. AOs: Output speed (%), output current (%) (4-20 mA).

9. Safeties: Minimum two sets of terminals that can be wired to external safeties. When safety is energized VFD shall display a programmable alarm message (e.g., "Vibration Switch," "Fire Alarm", "High Static Pressure."

10. Startup: Provide startup by a factory-trained technician. Provide as many site visits as required to properly start VFDs and driven equipment. Coordinate with the controls contractor regarding proper interface with the FMS. Coordinate with the suppliers of the driven equipment, and program all lockout frequencies into the drive. Submit a startup report for each VFD. Where multiple VFDs are provided and for projects with phased construction, multiple site visits will be required. Instruct the Owner's operating personnel regarding VFD programming and operation.

11. Approved Manufacturers: Danfoss VLT 6000, ABB, Yaskawa, OAE.

2.03 ELECTRICAL WIRING AND CONTROL EQUIPMENT

A. Provide wiring and conduit as scheduled in Section 23 0549.

B. Coordinate with all disciplines to ensure that all necessary components of control work are included and fully understood.

2.04 IDENTIFICATION

A. Scope: Identify all equipment, ductwork, valves, piping, and control devices shown on the Drawings, identified in the equipment schedules, and indicated in these Specifications. Provide submittals for products and procedures used for identification.

B. Equipment: For all mechanical equipment supplied or installed under Division 23, provide an

equipment identification tag or stencil unit number onto the equipment. Stencils shall be minimum 3-inch height, dark contrasting color, of a material suitable for the application.

1. For rooftop HVAC equipment, provide a permanently affixed, weather-resistant label to identify the areas served.

C. Valves: Provide each valve with a stamped metal tag secured to the valve. Tag shall indicate the valve number, service and function. Provide two sets of prints of drawings showing floor plan for each floor with all valves accurately located and labeled. Drawings shall be neat and easily readable. Provide a typed valve chart, listing the valve number, size, location, function, normal operating position, for each valve. List valves by system, i.e., domestic cold water, hot water, chilled water, etc. Tags shall be stamped brass 1-1/2" diameter, and secured to valves by heavy copper figure eight hooks, braided stainless steel wire anchor, or other approved means.

D. Ductwork: Identify ductwork at or near the fan with stenciled signs on insulated ductwork or engraved laminated plastic signs secured by rustproof screws on un-insulated ductwork. Sign shall identify air conditioning system or fan unit and area served.

E. Piping

1. Provide color-coded pipe labels indicating the service of the pipe and the direction of flow. Piping labels shall comply with ANSI Standard A13.1 regarding color coding and size of lettering. The following standardized color code scheme shall be used:

   a. Yellow - Hazardous Materials.
   b. Green - Liquid Materials of Inherently Low Hazard.
   c. Blue - Gaseous Materials of Inherently Low Hazard.
   d. Red - Fire Protection Materials.

2. Labels shall be semi-rigid plastic identification markers. Labels shall "span-on" around pipe without the requirement for adhesive or bonding of piping sizes 3/4 inch through 5 inches. Labels for piping 6 inches and larger shall be furnished with spring attachment at each end of label. "SETMARK" Type SNA, 3/4 inch through 5 inch size and Type STR, 6 inches and larger, as manufactured by Seton Name Plate Corporation, Brady, or equivalent.
3. For retrofit projects the system names shall match existing.
4. Attach pipe markers to lower quarter of the pipe on overhead horizontal runs and on the centerline of vertical piping where view is not obstructed.
5. Provide the following labels, with ANSI/OSHA color and banding for all piping systems as shown on the Drawings and as listed below:

	Letter	Background	Tape Banding
Service/Legend	Color	Color	Color
Domestic Cold Water	White	Green	2" Green
Domestic Hot Water	Black	Yellow	2" Yellow
Domestic Hot Water Return	Black	Yellow	2" Yellow
Soft Cold Water	White	Green	2" Green
Soft Hot Water	Black	Yellow	2" Yellow
Industrial Cold Water	White	Green	2" Green
Fire Protection Water	White	Red	2" Red
Fire Auto Sprinkler	White	Red	2" Red

Service/Legend	Letter Color	Background Color	Tape Banding Color
Fire Dry Standpipe	White	Red	2" Red
Fire Wet Standpipe	White	Red	2" Red
Fire Comb. Standpipe	White	Red	2" Red
Compressed Air	White	Blue	2" Blue
Roof Drain	White	Green	2" Green
Sanitary Sewer	White	Green	2" Green
Storm Sewer	White	Green	2" Green
Natural Gas	Black	Yellow	2" Black
Steam, PSIG	Black	Yellow	2" Black
Condensate Return, Gravity	Black	Yellow	2" Black
Condensate Return, Pumped	Black	Yellow	2" Black
Boiler Feed Water	Black	Yellow	2" Black
Chilled Water Supply	White	Green	2" Green
Chilled Water Return	White	Green	2" Green
Heating Water Supply	Black	Yellow	2" Yellow
Heating Water Return	Black	Yellow	2" Yellow
Condensing Water Supply	White	Green	2" Green
Condensing Water Return	White	Green	2" Green

6. Locations: Label pipes at the following points on each piping system:
   a. Adjacent to each valve in piping system.
   b. At every point of entry and exit where piping passes through a wall.
   c. On each pipe riser and junction.
   d. At a maximum interval of 20 feet on pipe lines exposed and concealed above accessible ceilings.
   e. Adjacent to all special fittings (regulating valves, etc.) in piping systems.
   f. At every access door.
7. Underground Piping: Provide a continuous, preprinted, bright colored, plastic ribbon cable marker with each underground pipe regardless of whether encased. Locate directly over buried pipe, 6 inches to 8 inches below finished grade. Marker tape used in conjunction with buried plastic piping systems shall be special detector type.

F. Control System Devices: All automatic controls, control panels, zone valves, pressure electric, electric pressure switches, relays and starters shall be clearly tagged and identified. Wording shall be identical to that on the control diagram in the Contract Drawings.

2.05 GENERAL CONSTRUCTION COMPONENTS

A. Roof Curbs and Equipment Support Rails
1. General: Factory fabricated, minimum 12-inch high, galvanized steel, configured to account for roof pitch where pitch exceeds 1/4-inch/ft or where required by manufacturer of supported equipment. Coordinate with roofer and provide cant and step if needed to

match roof construction. Actual curb heights to be coordinated by contractor with roofing insulation height to maintain code-required height above final roofing elevation.

2. Roof Curbs: 1.5-inch fiberglass insulation with nominal 2" x 2" wood nailer. Provide damper tray where a damper is indicated. Thycurb TC, Greenheck, RPS, OAE.
3. Equipment Support Rails: Nominal 2" x 4" wood nailer. Thycurb TEMS, Greenheck, RPS, OAE.

B. Access Doors (ADs)

1. Steel frame and door, surface mounted, factory primed, 150^{o} opening, flush, screw-driver operated cam lock, minimum 24” x 24” except as approved, but larger where required for proper access. Where ADs are installed in general construction with a pattern, match AD dimensions to this pattern. Milcor, Krueger, OAE.
   a. Sheet Rock Wall or Ceiling: With drywall bead on frame, Milcor Style DW.
   b. Plaster Wall or Ceiling: Milcor Style K.
   c. Masonry Walls: Milcor Style M.
   d. 1-hr and 2-hr rated walls: UL Listed for 1.5-hr Class B Fire Rating, self-closing and self-latching. Milcor Style UFR.
   e. Suspended Ceilings: Milcor Style AT.
   f. Fire Rated Suspended Ceilings: Milcor Style ATR.

C. Painting: Finish painting of mechanical systems and equipment will be under Spec Section 09 9100, “Painting," unless equipment is specified to be provided with factory-applied finish.

2.06 MISCELLANEOUS PROVISIONS

A. Flow Diagrams: Provide half-size prints of each system flow diagram, including air handling, steam, chilled water, heating water, domestic water, domestic HW, etc. Mount framed under plexiglass, and locate either on the associated AHU or on a nearby wall. Incorporate any as-built revisions.

PART 3 EXECUTION

3.01 INSTALLATION GENERAL REQUIREMENTS

A. Cooperation with Other Trades: Refer to other parts of these Specifications covering the work of other trades which must be carried on in conjunction with the mechanical work so that the construction operations can proceed without harm to the Owner from interference, delay, or absence of coordination. Be responsible for the size and location of all openings, foundations, etc.

B. Trenching and Backfilling: Provide all excavation, trenching and backfilling required for the installation of the work of this division.

C. Manufacturer's Instructions: Install all products in accordance with manufacturers’ recommendations and the requirements of any applicable listings. If manufacturers’ recommendations and/or requirements of applicable listings conflict with plans and specifications, report such conflicts to the Owner's Representative.

D. Field Measurements: Verify all dimensions and conditions governing the work. Examine adjoining work on which the work of this Division is dependent, and report any deficiencies.

E. Do not compromise the building structural, fire resistant construction or vapor barrier system.

F. Supports for Equipment and Systems: Foundations and structural supports for equipment will generally be provided by others. The contractor for this division shall provide supplementary supports as required to support equipment, distribution systems, and other components installed under this division. Prior to installing mechanical work, examine foundations and supports to ensure they are adequate to properly support the equipment. Provide all necessary foundations, structures, supports, inserts, sleeves, etc, for installation of mechanical and plumbing equipment, ductwork and piping, etc. Coordinate installation of such devices with all disciplines. Verify that the devices and supports are adequate as

intended and do not overload the building structure.

G. Concealed or Buried Work: For work which is underground or which will be concealed by building construction, provide digital photographs to document the installation throughout the construction project, but not less than weekly. Include plans indicating where the photographs were taken. Notify the OR of when the work will be complete and provide OR a minimum five-day period to inspect the work after completion but prior to when it is backfilled or concealed by building construction.

H. Access Doors: Provide as required for access to valves, dampers, controls, or other items for which access is required for either operation or servicing. The type of access door shall be as required by the room finish schedule.

I. Alignment of Flexible Couplings: Flexible couplings between motors and driven equipment shall be aligned by a qualified service technician after the equipment is installed and ready for operation. Align equipment per manufacturer's recommendations under operating conditions and temperature. Provide written certification that each device has been so aligned.

J. Lubrication: Provide all oil for the operation of all equipment until acceptance. Be responsible for all damage to bearings while the equipment is being operated by Contractor up to the date of acceptance of the equipment. Protect all bearings and shafts during installation and thoroughly grease shafts to prevent corrosion. Bearings for items of mechanical equipment shall be marked at each bearing location as to whether the bearing is a sealed type or relubricable type unit.

K. Tests: All tests shall be conducted in the presence of the designated and authorized Owner's Representative. Notify the Owner's one week in advance of all tests. Requirements for testing are specified under the sections covering the various systems. Provide all necessary equipment, materials, and labor to perform the required tests.

L. Protection of Material and Equipment:

1. Protect all work, materials and equipment furnished and installed under Division 23, whether incorporated in the building or not.

2. All items of mechanical equipment shall be stored in a protected weatherproof enclosure prior to installation within the building, or shall be otherwise protected from the weather in a suitable manner as approved.

3. Protect all work and be responsible for all damage done to property, equipment and materials. Coordinate material storage with the Owner's Representative.

4. Pipe and duct openings shall be closed with caps or plugs, or covered to prevent lodgment of dirt or trash during the course of installation. Plumbing fixtures shall not be used by the construction forces. At the completion of the work clean and polish fixtures, equipment and materials prior to turning them over to the Owner.

M. Systems Commissioning: A commissioning Agent will participate in the construction phase of the project.

3.02 DRAWINGS

A. The drawings show the general arrangement of the piping, ductwork, equipment, etc. Follow them as closely as actual building construction and work of other trades will permit. Where discrepancies occur between Plans and Specifications, the more stringent shall govern. All Contract Documents shall be considered as part of the work. Because of the small scale of the drawings, it is not possible to indicate all offsets, fittings and accessories, which may be required, and no attempt has been made to do so. Rather, the drawings convey the general design intent. Investigate the structural and finish conditions affecting the work and arrange the work accordingly, providing fittings, valves, and accessories as required to meet such conditions. Show any such changes on the Record Drawings.

B. Should any doubt or question arise in respect to the true meaning of the drawings or specifications, submit an RFI.

C. Install equipment, piping, ductwork, and electrical systems with proper clearance for operation,

service, and maintenance, including minimum clearances required by applicable codes, manufacturer's installation instructions, etc. Include proper clearance in front of and above electrical equipment as defined by the National Electric Code (NEC). Piping and ductwork systems shall not be routed through or above electrical equipment rooms, telecommunications rooms, elevator machine rooms, or electrical equipment spaces within mechanical equipment rooms.

D. Arrange all concealed mechanical systems carefully to fit within the available space without interference with adjacent structural and electrical systems. Make all necessary provisions for penetrations of piping and ductwork, including sleeves and blockouts in structural systems. The exact location of all exposed mechanical systems, including grilles, registers, and diffusers; access doors; sprinkler heads; piping and ductwork exposed within finished areas; and other equipment and devices as applicable, shall be coordinated with the Architect, who shall have final authority for the acceptance of the work as it relates to the aesthetic design for the facility.

3.03 CONCRETE BASES AND HOUSEKEEPING PADS

A. Concrete bases and housekeeping pads shall be installed under all pieces of mechanical equipment unless specifically deleted by the Specifications or Drawings.

B. Be responsible for the accurate dimensions of all pads and bases and furnish and install all vibration isolators, anchor bolts, etc.

C. Provide concrete housekeeping pad foundations for all floor mounted equipment installed under this section unless otherwise shown on the Drawings. All concrete bases and housekeeping pads shall conform to the requirements specified under Division 3, Concrete, portions of these Specifications. Pad foundations shall be 4 inches high minimum, unless otherwise indicated on the Drawings. Chamfer edges shall be 1 inch. Faces shall be free of voids and rubbed smooth with carborundum block after stripping forms. Tops shall be level. Provide dowel rods in floor for lateral stability and anchorage.

D. Equipment anchor bolts shall be set in a galvanized pipe or sheet metal sleeves 1 inch larger than bolt diameter. Anchor bolts shall be high strength steel J-shape. Anchor bolt design shall be arranged and paid for by the Contractor.

E. Machinery bases, bed plates, sole plates, or vibration isolation units shall be carefully aligned, shimmed, leveled, and then grouted in place with commercial non-shrink grout. When a flexible coupling is employed as a part of the drive train, the coupling shall be aligned before the machinery base is grouted.

3.04 SEISMIC RESTRAINTS

A. The Contractor shall be responsible for all anchors and connections for the mechanical work to the building structure to prevent damage of equipment and systems due to earthquakes. The complete fire protection systems shall be supported as required to resist stresses produced by lateral forces as required by NFPA No. 13. Where mechanical equipment, piping, and ductwork are connected to the building structure, exact method and means of attachment to the structural system shall be approved.

B. See Section 23 0548 for requirements for seismic supporting of mechanical equipment and systems.

3.05 PRESSURE RELIEF DEVICES

A. Refrigerant pressure relief devices and fusible plugs shall be installed with piping to a safe location in accordance with ANSI/ASHRAE Standard 15. Discharge shall be to atmosphere at a location not less than 15 feet above the adjoining ground level and not less than 20 feet from any window, ventilation opening, or exit from any building. Discharge line sizing shall conform to ANSI/ASHRAE Standard 15-1994.

B. Each discharge pipe shall be equipped with a drip leg capable of holding 1 gallon of liquid. The drip leg shall include a manual drain valve.

3.06 INSTALLATION CHECK

A. An experienced, competent, and authorized representative of the equipment listed below shall visit the site of the work and inspect, check, adjust if necessary, and approve the installation for the equipment listed below. The equipment supplier's representative shall revisit the job site as often as necessary until all trouble is corrected and the equipment installation and operation is approved and accepted.

B. Each equipment supplier's representative shall furnish a written report certifying that the equipment (1) has been properly installed and lubricated; (2) is in accurate alignment; (3) is free from any undue stress imposed by connecting piping or anchor bolts; and, (4) has been operated under full load conditions and that it has operated satisfactorily.

C. Equipment requiring installation check includes the following:

Water Softener

Domestic Hot Water Heaters

3.07 OPERATION PRIOR TO ACCEPTANCE

A. Operation of equipment and systems for the benefit of the Owner prior to substantial completion will be allowed provided that a written agreement between the Owner and the Contractor has established warranty and other responsibilities to the satisfaction of both parties.

B. Operation of equipment and systems for the benefit of the Contractor, except for the purposes of testing and balancing, will not be permitted without a written agreement between the Owner and the Contractor establishing warranty and other responsibilities.

3.08 OPERATION AND MAINTENANCE (O&M) INSTRUCTIONS

A. At completion of the project provide two complete bound sets of the following documents, along with two CDs containing searchable PDFs of these documents. Organize bound information in a logical fashion with a table of contents and tabs for the different sections. Organize PDFs in a logical fashion with bookmarks to assist the operating personnel in retrieving desired data. Provide minimum two 1-hour sessions to instruct Owner's facility personnel in how to find information in the bound O&Ms and the PDFs. Take attendance and submit the attendance list to the Owner's Representative. Include the following:

1. Approved Submittals.
2. Test reports.
3. O&M manuals and instructions covering all equipment supplied under this Division, with all non-applicable information crossed out. Clearly identify all required routine maintenance. Include parts lists.
4. A master Lubrication Chart listing each piece of equipment, the recommended oil or grease, and the recommended frequency of lubrication.
5. The names and addresses of at least one service agency capable of providing required maintenance for each item of equipment supplied.
6. Complete temperature control diagrams including control descriptions, system sequence of operation, operating instructions, control system maintenance and calibration information, wiring diagrams, and all control setpoints. See Section 23 0900 for additional requirements.

B. See Division 1 for additional requirements concerning manuals, manual distribution, and maintenance materials.

C. Submit O&M manuals for review and distribution to the Owner not less than two weeks prior to the date scheduled for O&M instructions as specified.

D. Demonstrate proper system operation to the owner's operating staff. Provide the services of the contractor and subcontractors (e.g., mechanical, T&B, temperature control, etc), as required to properly demonstrate system operation.

E. Provide the necessary skilled labor and helpers to operate the mechanical systems and

equipment for a period of 7 days of eight hours each. During this period, instruct the owner's facility staff fully in the operations, adjustment and maintenance of all equipment provided. Provide at least two weeks advanced notice, with a written schedule of each training session, the subject of the session, the Contractors' Representatives who plan to attend the session, and the time for each session. Take attendance and submit attendance sheets to the Owner's Representative.

3.09 RECORD DRAWINGS

A. See Division 1, for additional requirements associated with Project Record Drawings.

B. Maintain a full-size set of marked-up prints showing the installed location and arrangement of all work under this division, and in particular where changes were made during construction. Keep record drawings accurate and up-to-date throughout the construction period. Owner's Agents may request to review record drawings during construction and in conjunction with review and approval of monthly pay requests. Include copies of all addenda, RFIs, bulletins, and change orders neatly taped or attached to record drawing set. At the completion of the project send the Engineer full-size plans clearly showing all changes from the original design marked up in red so as to facilitate the Engineer incorporating these changes into the Engineer's CADD files. Forward record drawings to the Owner's Representative prior to submitting a request for substantial completion.

3.10 SITE VISITS AND OBSERVATION OF CONSTRUCTION

A. The Engineer may make periodic visits to the project site at various stages of construction in order to observe the progress and quality of various aspects of the work so as to determine if such work is proceeding in general accordance with the Contract Documents. This observation will not release the Contractor from his responsibility to supervise, direct, and control all construction work and activities. The Engineer has no authority over, or responsibility for means, methods, techniques, sequences, or procedures of construction or for safety precautions and programs, or for failure of the Contractor to comply with applicable laws, regulations, or codes.

B. Prior to substantial completion, request that the Engineer provide a final observation visit. Complete the attached "Final Observation Checklist," and include it with this request. For any items that are not applicable, mark them "N/A."

3.11 PROJECT CLOSEOUT

A. Submit written certification that all work complies with the specifications and applicable codes. Submit certifications and acceptance certificates including proof of delivery of record drawings, O&M manuals, spare parts required, and equipment warranties.

END OF SECTION 23 0500

Project:_____ Date Submitted:_____

General Contractor:_____ Date of Final Mechanical System:_____

Mechanical Contractor:_____ Observation Requested:_____

CONTRACTOR'S MECHANICAL & PLUMBING CHECK LIST
(ALL APPLICABLE ITEMS MUST BE COMPLETED PRIOR TO FINAL OBSERVATION)

In advance of requesting a final mechanical observation for installed mechanical systems, please check all items that have been completed. For all items not applicable to this project mark N/A.

PLUMBING/PIPING

_____1. All plumbing fixtures are set, sealed and cleaned.

_____2. All domestic and HVAC pipe systems are insulated.

_____3. All pipe systems are identified with specified labels and directional arrows.

_____4. Floor sinks and drain grates are cleaned and debris removed.

_____5. Valve tags are installed.

_____6. Special equipment (water softeners, water heaters, piping systems, etc.,) have been checked and put into service.

_____7. Medical gas systems have been checked and certified.

_____8. Special piping systems have been cleaned and pressure tested.

_____ Fuel Handling
_____ Compressed Air
_____ Natural Gas
_____ Other

_____ Process Piping
_____ Nitrogen
_____ Vacuum
_____ Argon
_____ Medical Gas
_____ Other

_____9. Limestone chips have been installed in acid dilution sumps.

_____10. Plumbing/piping connections have been completed to Owner-furnished equipment and equipment furnished by other Contractors/Subcontractors.

_____11. Exterior wall hydrants have been cleaned.

_____12. Concrete collars have been installed at clean-out to grade, valve box, or other specified plumbing items.

_____13. Drains and relief lines from plumbing and HVAC equipment have been installed and secured in a proper manner.

_____14. All plumbing equipment and areas of equipment have been cleaned and debris removed.

_____15. All plumbing equipment required by the Specifications has been identified and/or numbered.

_____16. Domestic water systems sterilization has been completed.

_____17. Refrigerant piping/system has been charged and tested.

_____18. Strainers/suction diffusers have been cleaned.

_____19. Backflow preventers have been tested.

_____20. Air has been vented from all coils and systems.

_____21. Water treatment systems have been charged and tested.

_____ Chilled Water
_____ Hot Water
_____ Condenser Water
_____ Steam/Condensate

_____22. Ethylene glycol system has been charged with correct mixture and tested.

_____23. Water systems have been cleaned (X) and pressure tested (P)

_____ Chilled Water
_____ Hot Water
_____ Steam
_____ Condensate
_____ Fire Protection
_____ Sanitary Sewer and Vent
_____ Roof and Overflow Drains
_____ Condenser Water
_____ Non-potable Water
_____ Domestic Hot Water
_____ Domestic Cold Water
_____ Acid Waste and Vent
_____ Heat Recovery Piping
_____ Other (list)

_____24. PRVs have been adjusted (water, steam, gases).

FIRE PROTECTION

_____1. Fire protection piping is completed.

_____2. Fire protection system has been certified by the Fire Marshal's office.

_____3. All electrical interlocks between the fire sprinkler components and the fire panel have been checked for operation.

_____4. Spare sprinkler head, wrench and cabinet are installed.

HVAC - EQUIPMENT AND DUCTWORK

_____1. All ductwork has been sealed and insulated.

_____2. Return air paths and transfer openings have been verified.

_____3. Air handlers have been cleaned inside and out and construction filters removed and replaced with final filters.

_____4. All air handling equipment has been started and operated for the specified time.

_____5. All equipment isolators have been adjusted for specified deflection.

_____6. All VAV boxes, fan coils, or fan powered boxes are completed and operational.

_____7. All pump shafts and couplings have been aligned.

_____8. Ductwork, coils, housing, diffusers, registers and grilles have been cleaned.

_____9. Boilers have been fired and certified by the supplier.

_____10. Cooling towers have been started and inspected by the supplier.

_____11. Chillers have been charged, started and certified for operation by the supplier.

_____12. Fire dampers are accessible and fully operational.

_____13. All HVAC equipment has been lubricated.

_____14. HVAC equipment has been labeled in accordance with the Specifications.

_____15. Duct pressure testing is complete and accepted.

_____16. "HAZARDOUS AREA" signs installed where applicable.

_____17. Belt guards installed where applicable.

_____18. Variable frequency drives have been tested by the manufacturer's representative and certified to be in compliance with all of the specified requirements.

_____19. Testing and balancing has been completed, and deficiencies noted have been corrected.

_____20. Special systems have been started and tested, such as: Humidification, laboratory hoods, kitchen hoods, and Owner-furnished items.

TEMPERATURE CONTROLS

_____1. Temperature control panels and devices have been labeled in accordance with the Specifications.

_____2. All control dampers close completely and edge and blade seals form tight seal.

_____3. All control valves have been piped as required by the Drawings.

_____4. Controls systems are completed and all control points are operating and recording properly.

_____5. All temperature control tubing and wiring is installed and secured in accordance with the Specifications and the electrical code.

_____6. Smoke removal fans and/or smoke detectors have been tested for operation and shutdown.

_____7. Freezestats have been tested ensuring fan shutdown and full damper closure.

_____8. Operator training for temperature controls has taken place.

_____9. Refrigerant sensors and equipment room shutdown have been tested.

GENERAL ITEMS

The following specified items have been submitted:

_____1. Record Drawings (to be submitted prior to final payment to the Contractor).

_____2. Operation and maintenance manuals.

_____3. Manufacturer's representative installation check and certification submitted (see list of equipment, Section 23 0500).

_____4. Testing and balancing reports.

_____5. Test kits furnished to Owner.

_____ Flow Measuring Devices
_____ Flow Balance Valves
_____ Flow Control Devices

_____6. Temperature control schematics and sequence of operation.

_____7. Wall-mounted lubrication, valve, and temperature control charts have been installed.

DIVISION 23 SUBSTITUTION REQUEST FORM (SRF)

TO: BRIDGERS & PAXTON CONSULTING ENGINEERS

PROJECT: _____

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

Section: _____ Page: _____ Paragraph/Line: _____ Specified Item: _____

Proposed Substitution: _____

Attach complete product description, drawings, photographs, performance and test data, and other information necessary for evaluation. Identify specific Model Numbers, finishes, options, etc.

1. Will changes be required to building design in order to properly install proposed substitutions? YES □ NO □
   If YES, explain: _____
2. Will the undersigned pay for changes to the building design, including engineering and drawing costs, caused by requested substitutions? YES □ NO □
3. List differences between proposed substitutions and specified item.

Specified Item	Proposed Substitution
_____	_____
_____	_____

4. Does substitution affect Drawing dimensions? YES □ NO □
5. What affect does substitution have on other trades? _____
6. Does the manufacturer's warranty for proposed substitution differ from that specified? YES □ NO □
   If YES, explain: _____
7. Will substitution affect progress schedule? YES □ NO □
   If YES, explain: _____
8. Will maintenance and service parts be locally available for substitution? YES □ NO □
   If YES, explain: _____
9. Does proposed product contain asbestos in any form? YES □ NO □

SUBMITTED BY: Firm: _____ Date: _____

Address: _____

Signature: _____ Telephone: _____

For Engineer's Use Only

Accepted _____	Not Accepted _____	Received Too Late _____
By: _____		Date: _____
Remarks: _____		

LICENSE AGREEMENT FOR CADD DATABASE OR BIM MODEL

PROJECT: _____

LICENSE GRANT: Contractor is granted use of the CADD Database or BIM Model (Database/Model) for the indicated project for the specific purpose of preparing submittal documents for this Project. No other use of the Database/Model is granted. Title to the Database/Model is not transferred to the Contractor. The Database/Model may be of value to the Contractor in preparing submittals, but use of the model does not relieve the contractor of the requirement to verify measurements in the field.

COPYING RESTRICTIONS: Contractor may copy the Database/Model in whole or in part, but only for backup and archival purposes or for use by the Contractor's Subcontractors. Contractor agrees to ensure that any entities that receive the Database/Model from Contractor, either in whole or in part, comply with the terms and conditions of this agreement. Contractor shall safeguard the Database/Model from falling into the hands of parties other than Subcontractors with a legitimate need for it.

WARRANTY: Bridgers & Paxton (B&P) offers this Database/Model without warranty and specifically without express or implied warranty of fitness. If Contractor chooses to use the Database/Model, then he does so at his own risk and without any liability or risk to B&P.

INDEMNITY: Contractor shall to the fullest extent permitted by law, defend, indemnify and hold harmless the Owner, Architect, B&P, their employees and agents from all claims, damages, losses, and attorney fees arising out of or resulting from the use of the Database/Model.

ACKNOWLEDGMENT: Contractor acknowledges that (s)he has read this Agreement, understands it, and agrees to be bound by its terms and conditions.

CONTRACTOR'S REPRESENTATIVE

Signature: _____ Company Name: _____

Name: _____ Address 1: _____

Title: _____ Address 2: _____

Date: _____

SECTION 23 0503
TRENCHING AND BACKFILLING

PART 1 GENERAL

1.01 REQUIREMENTS

A. Conform to applicable provisions of the General Conditions, Supplemental General Conditions and the General Requirements.

1.02 SCOPE OF WORK

A. The work in this section includes the furnishing of all labor, materials, equipment, transportation, hauling and services required in connection with the excavation, backfilling, compaction, grading and removal of earth from the site required for the installation of the HVAC work specified herein under Division 23.

1.03 SAFETY REGULATIONS

A. All work performed under this Section shall conform to the requirements of the General Conditions, Supplemental General Conditions and Safety Requirements for this type of work.

PART 2 PRODUCTS

Not Applicable.

PART 3 EXECUTION

3.01 TRENCHING AND BACKFILLING

A. General Excavation: The Contractor shall perform all excavation of every description and of whatever substances encountered, to the depths indicated on the drawings or as otherwise specified. During excavation, material suitable for backfilling shall be piled in an orderly manner a sufficient distance from the banks of the trench to avoid overloading and to prevent slides or cave-ins. All excavated material not required or suitable for backfill shall be removed and wasted. Berming and grading shall be done as may be necessary to prevent surface water from flowing into trenches or other excavations, and any water accumulating therein shall be removed by pumping or by other approved methods. Sheeting and shoring shall be done as required for the protection of the work and for the safety of personnel.

B. Trench Excavation: Trenches shall be of adequate width for the proper laying of the pipe, and the banks shall be as nearly vertical as practicable and safe for workmen. The bottom of the trenches shall be accurately graded and bedded to provide uniform bearing and support for each section of the pipe at every point along its entire length. Bell holes and depressions for joints shall be dug after the trench bottom has been graded, and bedded in order that the pipe rests upon the prepared bottom for as nearly its full length as practicable. Care shall be taken not to excavate below the depths indicated. Where rock excavation is required, the rock shall be excavated to a minimum overdepth of 4 inches below the trench depths indicated on the drawings or specified. Overdepths in the rock and common excavation shall be backfilled with coarse sand, fine gravel, or otherwise suitable material. Whenever wet or otherwise unstable soil that is incapable of properly supporting the pipe is encountered in the bottom of the trench, such soil shall be removed to the depth required and the trench backfilled to the proper grade with coarse sand, fine gravel, or other suitable materials, as hereinafter specified.

C. The Contractor shall move trucks and equipment on prescribed roads and keep the roads free from mud, dirt and spillage.

D. If additional material is needed for fill on the project, it shall be furnished by the Contractor.

E. Bracing and Bulkheading: In all excavation work the Contractor shall provide necessary underpinning, bracing, or bulkheading to safeguard the work, the present structures, workmen, the public, and the property, and shall assume all responsibility in connection therewith.

F. Backfilling: The trenches shall not be backfilled until all required pressure tests are performed and until the utilities as installed conform to the requirements specified. The trenches shall be carefully backfilled with materials approved for backfilling; free from large clods of earth or stones. The

entire depth of trench shall be backfilled in layers, and each layer shall be spread evenly, wetted to optimum moisture and thoroughly mixed to uniform consistency and compacted to the required maximum density obtainable as the same soil, as determined by ASTM D698.

G. All imported fill required under this section will be furnished by the Contractor. Imported fill will be base course material approved for use by the State Highway Department.

H. Fill material shall be free from trash, lumber or any type of debris which may be detrimental to producing the required density in the fill.

I. The earth beneath all sidewalks and concrete slabs shall be backfilled and compacted to at least 8" below any gravel or sub-base material before the placement of gravel or other base material and shall be coordinated with requirements contained within Division 33.

J. All piping not encased in concrete shall be bedded in sand or fine gravel, without rocks or other foreign material. Bedding material shall be placed around the pipe in accordance with manufacturer's recommendations. The bedding material shall be distributed around pipe to assure full consolidation.

K. In grass and planted areas, the Contractor shall backfill his excavation to approximately 8" below finished grade. Contractor shall coordinate backfill requirements contained in Division 33.

L. The Contractor shall protect from damage all existing underground utilities indicated on the Contract Drawings or field located by an underground utility locator service by the Owner prior to excavation operations. Any damage to such existing utilities shall be repaired by the Contractor without additional costs to the Owner.

M. Provide density test for trench, backfill in accordance with Division 33 requirements.

END OF SECTION 23 0503

SECTION 23 0504
PIPE AND PIPE FITTINGS

PART 1 GENERAL

1.01 REQUIREMENTS

A. Conform with applicable provisions of the General Conditions, Supplemental General Conditions and General Requirements.

B. Lead Ban: All systems and system components, pipe, fittings, and fixtures furnished under Division 23 shall be lead free.

1. Any product designed for dispensing potable water shall meet both the NSF 61 and NSF 372 test standards via third-party testing and certification.

2. Lead free refers to <0.25% weighted average lead content in relation to wetted surface of pipe, fittings, and fixtures in systems delivering water for human consumption, and solder and flux which does not contain more than 0.2% lead.

1.02 RELATED SECTIONS

A. Section 23 0500, Common Work Requirements for HVAC.

1.03 SUBMITTAL DATA

A. Contractor shall furnish complete submittal data for all piping materials, including manufacturer's specifications, certifications, class, type and schedule. Submittal data shall additionally be furnished for pipe hangers and supports, seismic restraints, pipe sleeves including sealing and fire safing materials and installation.

PART 2 PRODUCTS

2.01 PIPE AND PIPE FITTINGS

A. Piping system materials shall be furnished as specified under the Sections describing the various piping systems. Pipe fittings shall be compatible with the piping systems in which they are installed.

B. Pipe fittings for steel piping systems shall be weld, screwed or mechanical couplings. Butt weld fittings shall be manufactured by Weld-Bend, Laddish, or equivalent, standard or extra strong as specified in the applicable Sections of this Specification, conforming to ANSI Standard B16.9. All 90^0 weld elbows shall be long radius unless otherwise specified. Wherever tee connections are required in the piping system, manufacturer's straight or reducing tees shall be utilized. The use of fittings formed from welded pipe or pipe sections will not be permitted. Forged steel "Weld-O-Lets", "Branch-O-Lets", and "Thred-O-Lets", as manufactured by Bonney Forge or equivalent, may be utilized for welded branch and tap connections up to one-half the size of the main. Forged steel half-couplings conforming to ANSI B16.11 may be used for drain, vent and gauge connections. Flanges shall be forged steel weld neck or slip-on, raised face, Class 150 or 300 as specified in the applicable Sections of this Specification with full face or ring type non-asbestos gasket material suitable for the application.

C. Socket weld fittings shall be Schedule 40, 2000 pound or Schedule 80, 3000 pound construction, as specified in the applicable Sections of this Specification, conforming to ANSI B16.11, as manufactured by Grinnell or equivalent.

D. Screwed fittings shall be Class 150 standard or Class 300 extra heavy, black or galvanized, malleable iron or cast iron, as specified in the applicable Sections of this Specification, as manufactured by Grinnell or equivalent. Screwed malleable iron fittings shall conform to ANSI B16.3 and cast iron screwed fittings shall conform to ANSI B16.4. Bushing reduction of a single pipe size or use of close nipples will be permitted.

E. Pipe couplings and fittings as manufactured by Victaulic, Tyco-Grinnell, or equivalent may be utilized for steel piping systems in lieu of butt weld fittings, as specified in the applicable Sections of this Specification. Couplings shall consist of ductile or malleable iron housing, with gasket, and nuts and bolts required to secure the unit. Gaskets shall be molded of synthetic rubber or other

compound as recommended by the manufacturer for the fluid application including required pressure and temperature operating ranges. Fittings utilized in conjunction with Victaulic type piping system shall be manufacturer's full flow cast iron, malleable iron, or steel fittings with grooves designed to accept mechanical couplings. All piping shall be prepared in accordance with manufacturer's specifications, furnished for factory or field installed roll grooves without metal removal. Square cut grooves will not be permitted. Assembly of couplings, fittings and piping shall be in accordance with manufacturer's published instructions. Gaskets, pipe ends, fittings and coupling housings shall be properly lubricated with water-based type lubricant furnished by the coupling manufacturer. Couplings shall be Victaulic Style 07 "Zero-Flex" or equivalent, rigid coupling through 24" size. For applications in conjunction with connections to items of equipment such as boilers, water chillers, cooling towers, etc., Victaulic Style 75 or equivalent couplings shall be utilized. Adapter connections between Class 125 and 150 flanged components and grooved piping system shall be made utilizing Victaulic Style 741 and 742 or equivalent flange adapter. Branch and tap connections up to one-half the size of the main may be made utilizing Victaulic Style 72 or equivalent outlet couplings and Style 920 or 921 or equivalent branch outlet connections.

F. Pipe fittings for copper piping system shall be wrought copper conforming to ANSI B16.22. Cast brass fittings conforming to ANSI B16.23, may be utilized for sanitary drainage, waste and vent systems, HVAC gravity condensate drainage system, and other non-pressure applications.

G. Bronze flanges, Class 125 and Class 150, shall conform to ANSI B16.24.

H. Cast iron fittings for cast iron sanitary soil, waste, and venting piping systems shall be as specified in Division 22.

I. Ductile iron fittings for ductile iron water service piping systems shall be as specified in Division 22.

J. Fittings for special piping systems including acid resistant waste and vent systems, high purity water distribution systems, PVC piping systems, shall be compatible with the piping system requirements and shall be as specified in Division 22.

2.02 FLOOR, WALL AND CEILING PLATES

A. Where uncovered, exposed pipes pass through finished floors, finished walls, or finished ceilings, they shall be fitted with chromium plated spun brass escutcheon plates. Plates shall be large enough to completely close the hole around the pipe, and shall be not less than 1-1/2" or more than 2-1/2" larger than the diameter of the pipes. All plates shall be securely held in place.

2.03 UNIONS

A. Piping 2-1/2" and larger shall be provided with bolted flange union connections. Weld flanges and bolting shall conform to ANSI B16.5. Bronze flanges shall conform to ANSI B16.24. Flange class shall be as specified in the applicable Sections of the Specifications.

B. Malleable iron grooved joint unions with brass to iron seats, Class 125, 250, or 300, as required by the application and compatibility requirements with the piping system fitting classification, conforming to MSS SP-77 and ANSI B16.39, shall be provided in piping systems 2" and smaller. Copper unions conforming to ANSI B16.22 shall be provided in copper piping systems. Union connections shall be installed at all coils, control valves, equipment connections, and at other locations shown on the drawings, and required for proper system operation and maintenance.

2.04 DIELECTRIC FITTINGS

A. Dielectric insulating fittings shall be provided to connect dissimilar metals, such as copper tubing to ferrous metal pipe. Connections 2" and smaller shall be threaded dielectric union conforming to ANSI B16.39. Connections 2-1/2" and larger shall be flange union with dielectric gasket and bolt sleeves, conforming to ANSI B16.42. Insulating fittings will not be required between bronze valves and copper piping, unless otherwise specified.

2.05 PIPE HANGERS AND SUPPORTS

A. All piping shall be rigidly supported from the building structure by means of hanger assemblies properly selected and sized for the application in accordance with the manufacturer's recommendations and specifications. Pipe hangers shall be Grinnell, B-Line, Erico, or equivalent.

B. No attempt has been made to show all required piping supports in all locations, either on the drawings or in the details. The absence of pipe supports and details on any drawing shall not relieve the Contractor of the responsibility for furnishing and installing proper hangers and supports throughout.

C. Piping hangers shall be spaced on the scheduled maximum spacing and shall have hangers not more than one foot from each elbow and other changes in direction or elevation. Provide additional hangers and supports at valves, strainers, in-line pumps adjacent to flexible connections, and other required heavy components. Piping system shall be installed in an approved manner and shall not overload the building structural frame. Contractor shall provide additional hangers and miscellaneous steel supports as may be required to distribute the piping system load over multiple structural members where required or directed. Maximum allowable spacing for steel and copper piping, other than fire protection piping, shall be as scheduled in Table No. 1.

TABLE NO. 1

MAXIMUM SUPPORT SPACING FOR STEEL

AND COPPER PIPING SYSTEMS

Steel Piping	- Maximum Spacing
1/2"	- 5'-0"
3/4" and 1"	- 6'-0"
1-1/4" through 2"	- 8'-0"
2-1/2" through 6"	- 10'-0"
8" through 12"	- 12'-0"
14" and larger	- **[16'-0"] [12'-0"]**

Copper Piping	- Maximum Spacing
1/2"	- 5'-0
3/4" through 2"	- 6'-0"
2-1/2" through 4"	- 8'-0"
5" and larger	- 10'-0"

D. Round rods supporting the pipe hangers shall be of the minimum dimensions as scheduled in Table No. 2. Hanger rods shall be hot-rolled steel, ASTM A-36 or A575, galvanized, all-thread. Provide for controlling level and slope by turnbuckles or other approved means of adjustment and incorporate locknuts.

TABLE NO. 2

HANGER ROD SIZE FOR PIPE HANGER SUPPORTS

1/2" to 2" pipe	- 3/8" rod
2-1/2" to 3" pipe	- 1/2" rod
4" to 5" pipe	- 5/8" rod
6" pipe	- 3/4" rod

8" to 12" pipe	- 7/8" rod
14" and 16" pipe	- 1" rod
18" and 20" pipe	- 1-1/4" rod
24" and 30" pipe	- 1-1/2" rod

E. Cast iron soil, waste and vent piping shall be provided with steel clevis type hangers. Grinnell Fig. 590 at each pipe joint and at each fitting.

F. Hanger spacing for plastic piping system support shall be as scheduled below in Table No. 3 for PVC and CPVC and Table No. 4 for PVDF piping, based on pipe full of liquid with specific gravity of 1.0. See Table No. 5 for specific gravity correction factors. Piping may be continuously supported with a "V" or "U" shaped support made of metal or heat resistant approved plastic material. Hanger supports shall be in accordance with piping system manufacturer's recommendations.

TABLE NO. 3A

MAXIMUM SUPPORT SPACING FOR PVC AND CPVC PIPING SYSTEMS

SCHEDULE 40 PVC - MAXIMUM SPACING

OPERATING TEMPERATURE (DEGREE F)

	PVC AND CPVC				CPVC			
Size	60 & less	80	100	120	140	160	180	200
1/2" and 3/4"	5.5	5	4.5	4	3	3	3	2.5
1" and 1-1/4"	6	5.5	5.5	4.5	3.5	4	3.5	3
1-1/2" and 2"	6	6	5.5	4.5	3.5	4.5	4	3.5
2-1/2" and 3"	7.5	7	6.5	5.5	4.5	5.5	5	4
4"	8	7.5	7	6	4.5	6	5.5	4.5
5" and 6"	8.5	8	7.5	6.5	5	7	6	5
8"	9.5	9	8.5	7	5.5	7.5	6.5	5.5
10"	10	9	8.5	7	5.5	--	--	--
12"	10.5	10	9	8	6	--	--	--

TABLE NO. 3B

MAXIMUM SUPPORT SPACING FOR PVC AND CPVC PIPING SYSTEMS

SCHEDULE 80 PVC - MAXIMUM SPACING

OPERATING TEMPERATURE (DEGREE F)

	PVC AND CPVC				CPVC			
Size	60 & less	80	100	120	140	160	180	200
1/2"	6	6	5.5	4.5	3.5	3	2.5	2
3/4"	6.5	6	5.5	5	3.5	3	2.5	2
1" and 1-1/4"	7	6.5	6	5	4	3.5	2	2.5
1-1/2" and 2"	7.5	7	6.5	5.5	4	4	3.5	3
2-1/2" and 3"	8.5	8	7.5	6.5	5	4.5	4	3
4"	9.5	9	8.5	7	5.5	5.5	5	3.5
5" and 6"	10	9	8.5	7	5.5	6	5.5	4
8"	11.5	11	10	8.5	6.5	6.5	6	4.5
10"	12.5	12	11	9.5	7	--	--	--
12"	13.5	13	12	10	8	--	--	--

TABLE NO. 4

MAXIMUM SUPPORT SPACING FOR PVDF PIPING SYSTEMS

SCHEDULE 80 PVDF - MAXIMUM SPACING

OPERATING TEMPERATURE (DEGREE F)

Size	70 & less	100	140	180	200	250
1/2"	3	3	2.5	2.5	2	2
3/4"	3	3	3	3	2.5	2.5
1"	3.5	3	3	3	2.5	2.5
1-1/4"	4	3.5	3.5	3	3	3
1-1/2"	4.5	4	4	3.5	3.5	3
2"	5.5	5	4.5	4	3.5	3.5
2-1/2"	5.5	5	4.5	4.5	4	3.5
3"	5.5	5.5	5	4.5	4	4
4"	6	6	5.5	5	5	4.5

TABLE NO. 5

SPECIFIC GRAVITY CORRECTION FACTOR FOR PLASTIC PIPING SYSTEMS

Specific Gravity:	1.0	1.1	1.2	1.4	1.6	2.0	2.5	
Correction Factor:		1.0	0.98	0.96	0.93	0.90	0.85	0.80

G. Fire protection system shall be supported in strict accordance with the requirements contained in the applicable NFPA pamphlets and as specified in Division 21, Fire Suppression Systems.

H. Hangers, clamps and other support materials in contact with copper piping shall be copper or copper plated to prevent electrolysis. Hangers for copper piping shall be copper plated adjustable ring type Grinnell Fig. CT-269, adjustable swivel ring, Grinnell Fig. CT69, Fig. CT-65 or adjustable clevis type or equivalent. Provide minimum 10 mil plastic wrap around copper pipe at any ferrous point of attachment including trapeze hangers, clamps, and other supports.

I. Hangers for steel shall be steel clevis type hangers, Grinnell Fig. 260 or equivalent.

J. Where piping is installed side by side, the Contractor may support the piping utilizing trapeze type hanger assemblies. Horizontal trapeze member shall be galvanized steel channel, not less than 1-1/2" x 1-1/2" x 12" gauge, or Unistrut. Contractor shall provide heavier steel members as required for the load to be supported and the distance span. Trapeze hangers shall not be utilized for plumbing drain waste and vent piping. Hanger rods shall be as specified above, properly sized for the load supported but not less than 5/8" diameter. Un-insulated copper piping shall be isolated from the steel trapeze. Individual pipe shall be guided on the horizontal member at every other hanger point with 1/4" U-bolt fabricated from steel rod. Provide full circle galvanized sheetmetal insulation shield for insulated piping at trapeze hangers with U-bolt guide and galvanized sheetmetal insulation half-shield at other trapeze hangers. Insulation shield shall be 18 gauge minimum, Grinnell Fig. 167 or equivalent.

K. Vertical piping shall be supported at each floor level by means of riser clamps, Grinnell Fig. 261 and Fig. G-121, Erico, copper clad for copper piping systems, or equivalent. Proper allowance for the expansion and contraction of the vertical risers shall be provided. Contractor shall submit shop drawings indicating proposed method for support and control of expansion and contraction of vertical piping. See Section 23 0505 for expansion joints, expansion compensators, pipe guide and pipe anchors.

L. The use of pipe hooks, chains, or perforated iron for pipe hanger supports will not be permitted.

M. All insulated piping systems specified in Section 22 0700, Plumbing Insulation and Section 23 0700, HVAC Insulation, shall be provided with individual hangers sized to encircle the insulation**.** See applicable sections for insulation thickness requirements. The specified piping systems where supported by means of trapeze hangers shall not rest directly on the trapeze horizontal members. The insulation at hangers and trapeze hangers shall be protected by means of insulation shield, Grinnell Fig. 167, Erico, or equivalent. Grinnell Fig. 160, Erico, or equivalent, curved steel pipe saddle, shall be provided at roll hangers. Contractor shall provide section of high density calcium silicate insulation or thermal hanger shields as manufactured by Pipe Shields, Inc., or equivalent, at all insulation piping system hanger and support points for piping 1-1/2” or larger.

N. Attachment of piping hangers to the building structure shall be provided in a manner approved by the Architect. The Contractor shall provide concrete inserts in the building construction at the time the concrete is poured and hangers shall be attached to these inserts. Self-drilling expansion anchors, Federal Specification FF-S-325, may be used in concrete construction not less than 4" thick. Applied load shall not exceed manufacturer's approved ratings. Power driven fasteners may be used in existing concrete or masonry not less than 4" thick where approved by the Architect.

2.06 PIPE SLEEVES

A. Pipe sleeves in concrete and masonry construction, footings and beams shall be Schedule 40 black steel pipe through 10”, standard wall thickness for sizes 12” and larger, ASTM A 53, A 106,

or A 120.

1. For sleeve installation below grade in cast in place concrete wall or floor and masonry construction, sleeves shall be GPT type WS sleeves with minimum 2” water-stop collar or equivalent. The sleeves shall be provided free of welding slag. The water stop collar shall be welded all around on both sides to the sleeve at the point on the sleeve that positions it at the midpoint of the wall. Sleeve shall be primed inside and outside with Sherwin Williams Water Base Red Primer, or approved equivalent.

B. Pipe sleeves in gypsum board construction shall be galvanized steel metal, minimum 24 gauge; round tube closed with welded longitudinal joint and flanges on both sides.

C. Pipe sleeves shall be furnished and set by the Contractor and they shall be responsible for their proper and permanent location. Piping will not be permitted to pass through footings, beams or ribs except with written consent of the Architect.

D. Pipe sleeves shall be installed and properly secured in place at all points where pipes pass through gypsum board stud walls, concrete, and masonry construction and at all fire and smoke rated walls and partitions.

E. Where insulated piping is installed, calcium silicate inserts to match the insulation thickness and extending 1" past the sleeve on both ends, shall be provided.

F. Sleeves shall be not less than 1" or more than 2" larger in diameter than the pipe to be installed.

G. Pipe sleeves in floors shall extend 2" above finished floor in chases and equipment room areas unless otherwise approved by the Architect. Openings between piping and sleeves shall be made watertight with plastic cement installed to a minimum depth of 2".

H. Un-insulated piping passing through fire walls, smoke wall, sound control walls and air plenum separations shall be sealed airtight to the adjacent construction by means of UL approved fire stop sealant materials.

I. Insulated piping passing through fire walls and smoke walls shall be provided with Calcium Silicate pre-formed pipe insulation of thickness to match adjacent piping, extending minimum 1-inch beyond sleeve in each direction.

1. For penetrations through concrete or masonry walls/floors, the space between the piping sleeve and insulation shall be sealed airtight with UL approved firestop sealant and packed with minimum 4” thickness mineral wool (minimum 4 pcf density) tightly packed and recessed to accommodate sealant.

2. For penetrations through gypsum board wall construction, both sides of the annular space between the insulation and sleeve shall be sealed with UL approved firestop sealant.

J. Penetrations of gypsum board sound walls and air plenum separators shall be caulked airtight with an approved UL firestop sealant.

2.07 PIPE SLEEVE SEAL SYSTEMS

A. Provide pipe sleeve seal systems by one of the following:

1. Link-Seal Modular Wall Penetration Seal as manufactured by GPT.

2. Metraflex Company

3. Proco Products, Inc.

B. Description: Modular sealing element unit, designed for field assembly, for filling annular space between piping and sleeve.

1. Sealing Elements: EPDM-rubber interlocking links shaped to fit surface of pipe. Include type and number required for pipe material and size of pipe.

2. Pressure Plates: Plastic, reinforced nylon polymer

3. Connecting Bolts and Nuts: Carbon steel with corrosion-resistant coating of length required to secure pressure plates to sealing elements.

C. Pipe sleeve seal system shall be utilized at all exterior wall penetrations.

D. Select type, size, and number of sealing elements required for piping material and size and for sleeve ID or hole size. Position piping in center of sleeve. Center piping in penetration, assemble sleeve-seal system components, and install in annular space between piping and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make a watertight seal.

PART 3 EXECUTION

3.01 PIPING INSTALLATION

A. Provide and erect, according to the best practices of the trade, all piping shown on drawings and required for the complete installation of these systems. The piping shown on the drawings shall be considered as diagrammatic for clearness in indicating the general run and connections, and may or may not in all parts be shown in its true position. The piping may have to be offset, lowered or raised as required or as directed at the site. This does not relieve the Contractor from responsibility for the proper erection of systems or piping in every respect suitable for the work intended as described in the specifications. In the erection of all piping, it shall be properly supported and proper provisions shall be made for expansion, contraction and anchoring of piping. All piping shall be cut accurately for fabrication to measurements established at the construction site. Pipe shall be worked into place without springing and/or forcing, properly clearing all windows, doors, and other openings and equipment. Cutting or other weakening of the building structure to facilitate installation will not be permitted. All pipes shall have burrs and/or cutting slag removed by reaming or other cleaning methods. All changes in direction shall be made with fittings. All open ends of pipes and equipment shall be properly capped or plugged to keep dirt and other foreign materials out of the system. Plugs of rags, wool, cotton waste or similar materials may not be used in plugging. All piping shall be arranged so as not to interfere with removal and maintenance of equipment or filters or devices; and so as not to block access to manholes, access openings, etc. Flanges or unions as applicable for the type of piping specified shall be provided in the piping at connections to all items of equipment including refrigeration machines. All piping shall be so installed to ensure noiseless circulation. All valves and specialties shall be so placed to permit easy operation and access, and all valves shall be regulated, packed and adjusted at the completion of the work before final acceptance. All piping shall be erected to ensure proper draining. Water piping may be run level but shall be free from traps.

3.02 JOINTS

A. Caulked Joints: Caulked joints in hub-and-spigot piping and vent piping shall be packed firmly with white oakum, "Sealite No. 110," or hemp and caulked with pure molten lead not less than 1" deep. Resilient molded gasket joints or "Ty-Seal" may be used in lieu of lead and oakum for sanitary soil, waste and vent piping. No-hub pipe and fittings will be accepted with the exception that no-hub pipe and fittings shall not be allowed for buried installation.

B. Screwed Joints: Shall have American Taper pipe threads. Ream pipe ends and remove burrs after threading. Make up joints using Teflon tape or other approved compound applied to the male threads only.

C. Solder Joints: Copper tubing shall be cut square and burrs removed. Both inside of fittings and outside of tubing shall be well cleaned before sweating. Care shall be taken to prevent annealing of fittings and hard drawn tubing when making connections. Joints for sweated fittings shall be made with a non-corrosive paste flux and solid 95-5 tin-antimony wire solder, unless otherwise specified. Cored solder will not be permitted. 50/50 lead solder shall not be permitted for any applications.

D. Welded Joints: On black steel piping 2-1/2" and above in size, the joints may be welded. Welding shall be done using either gas or electric welding equipment. Certified welders shall be used. Welders shall be certified in accordance with Section IX of ASME Boiler and Pressure Vessel Code, latest edition. All pipe surfaces shall be thoroughly cleaned before welding. Each joint shall be beveled before being welded. Piping shall be securely aligned and spaced, and the width of circumferential welds shall form a gradual increase in thickness from the outside surface to the center of the weld. All fittings used in the welded piping systems shall be standard ASA fittings,

and shall be of standard pipe thickness. The Contractor shall provide a fireproof mat or blanket to protect the structure and adequate fire protection at all locations where welding is done. The use of fittings formed from welded pipe sections will not be permitted.

E. Flanged Joints: Flanged joints shall conform to the American Standard for cast iron flanged pipe fittings, Class 125, 150 or 300 as specified in the applicable Sections of these specifications. Gaskets shall be full face or ring type, non-asbestos, suitable for the service on which used.

3.03 PUMP AND EQUIPMENT CONNECTIONS

A. All piping connecting to pumps and other equipment whether connected utilizing flexible connectors or with solid pipe connectors, shall be installed without strain at the pipe connection of the equipment. The Contractor shall be required, if so directed, to disconnect piping to demonstrate that piping has been so connected.

3.04 EXPANSION AND CONTRACTION

A. The Contractor shall make all necessary provisions for expansion and contraction of piping with offsets or loops and anchors as required to prevent undue strain. Contractor shall provide shop drawings for proposed method and arrangement for control of expansion and contraction of piping. See Section 23 0505 for expansion joints, expansion compensators, pipe guides and pipe anchors.

3.05 PROTECTIVE COATINGS

A. All underground steel pipe shall be wrapped with "Scotchwrap" No. 50 tape or equivalent, to give not less than two complete layers on the entire underground piping system, or piping shall have X-Tru-Coat factory applied plastic protective covering.

3.06 FLUSHING, DRAINING AND CLEANING PIPE SYSTEMS

A. The Contractor shall flush out all water systems with water before placing them in operation. Other systems shall be cleaned by blowing them out with compressed air or nitrogen. After systems are in operation and during the test period, all strainer screens shall be removed and thoroughly cleaned.

3.07 TESTING

A. Before any insulation is installed or before piping is covered or enclosed, all piping systems shall be tested and proven tight at not less than 150% of the maximum service pressure which the piping systems will be required to handle. Piping system tests shall be as specified in the applicable sections of this Specification. All tests shall be witnessed and approved by the Architect.

B. All labor, material, and equipment required for testing shall be furnished by the Contractor. The Contractor shall be responsible for all repairs and retesting as required. All instruments and other equipment whose safe pressure range is below that of the test pressure shall be removed from the line or blanked off before applying the tests. To perform tests, all lines shall be flushed and cleaned.

C. All safety measures required by codes or ordinances or reasonably applicable to the situation shall be provided by the Contractor in conjunction with the testing of the piping systems.

D. Equipment or piping to be pressure tested shall not be insulated, covered, or concealed prior to that test. Underground piping may be partially backfilled prior to pressure test when required for application of the test except that joints shall remain exposed until after the test. Tie rods, clamps etc., shall be in place and fastened.

E. Tests shall not be used to establish pressure ratings.

F. Protect all piping and equipment against over pressure, collapse from vacuum, and hydraulic shock during the filling, testing and draining procedures. Seats of iron valves shall not be subjected to a pressure in excess of the maximum cold working pressure of the valve. Pressure tests against other closed valves shall not exceed twice the normal rating.

G. Apply test pressure only after the system and test medium are at approximately the same temperature, preferably not less than 60^0F. Note that some applicable codes may require testing

above a specified minimum temperature.

H. Remove from the system all pumps, turbines, traps, expansion joints, instruments, control valves, safety valves, rupture discs, orifice plates, etc., which might be damaged by the test. Also remove all items such as orifice plates which might trap air in a system to be hydrostatically tested. Disconnect all instruments and air lines where copper tubing starts.

I. Systems may be separated into sub-systems for testing if such action will expedite or simplify the testing.

J. During hydrostatic testing of lines, provide temporary supports to prevent overstressing supports or hangers. When tests are completed, remove all temporary supports, locks, stops, etc., and adjust supports for their cold load and alignment.

END OF SECTION 23 0504

SECTION 23 0505
PIPING SPECIALTIES

PART 1 GENERAL

1.01 REQUIREMENTS

A. Furnish and install all piping specialties necessary for satisfactory operation of the systems. Conform to applicable provisions of the General Conditions, Supplemental General Conditions and General Requirements.

B. Lead Ban: All systems and system components, pipe, fittings, and fixtures delivering water for human consumption shall be lead free.

1. Any product designed for dispensing potable water shall meet both the NSF 61 and NSF 372 test standards via third-party testing and certification.

2. Lead free refers to <0.25% weighted average lead content in relation to wetted surface of pipe, fittings, and fixtures in systems delivering water for human consumption, and solder and flux which does not contain more than 0.2% lead.

1.02 RELATED SECTIONS

A. Section 23 0500, Common Work Requirements.

B. Section 23 0504, Pipe and Pipe Fittings.

C. Section 23 0523, Valves.

1.03 SUBMITTAL DATA

A. Furnish complete submittal data for all piping specialties including manufacturer's specifications, performance characteristics, ratings, installation instructions, certifications and approval of listing agencies, wiring diagrams, and selection analysis.

PART 2 PRODUCTS

2.01 STRAINERS

A. Strainers suitable for the application shall be furnished and installed on the high pressure side of pressure reducing valves, pressure regulating valves, suction side of pumps, inlet of indicating and control instruments and equipment subject to sediment damage, and as shown on the drawings. Strainers shall be "Y"-type unless basket strainers are indicated. Tee-type strainers will not be accepted. Strainer element shall be removable without disconnecting piping. Screens shall be Type 304 stainless steel with 1/8 inch perforations for water service air and gas services. Every strainer shall be provided with a blow-off connection not less than 1/2" NPT and provided with a ball valve the full size of the strainer outlet tapping. Strainers located outside of mechanical equipment rooms and above ceilings shall be provided with hose connection and cap on the outlet of the blowoff valve. Strainers shall be Spirax Sarco, Armstrong, Febco, Grinnell, Hoffman, Keckley, Metraflex, Mueller, Yarway, or equivalent.

B. Strainers 2" and under for copper piping systems shall be threaded connection, bronze body, 250 PSIG maximum working pressure, suitable for steam, oil, gas and liquid service, Sarco BT or equivalent.

C. Strainers 2" and under for steel piping systems shall be threaded connection, bronze body, as specified above or cast iron body as specified herein, except all strainers in galvanized steel domestic water systems shall be bronze body. Cast iron strainers shall be threaded connection, 250 PSIG maximum working pressure, suitable for steam, oil, gas and liquid service, Sarco IT or equivalent.

D. Strainers 2-1/2 inches or larger shall be standard flanged connection ANSI-125, cast iron body, suitable for steam, oil , gas, and liquid service, 125 maximum working pressure at 353^{o} F maximum temperature, Sarco CI-125, or equivalent.

E. Basket strainers 2" and larger shall be standard flanged ANSI-125, cast iron body bolted cover, Type 304 stainless steel screen, suitable for steam or liquid service, 125 maximum working pressure at 353^{o}F maximum temperature, Sarco 528-B-125, or equivalent.

2.02 SUCTION DIFFUSERS

A. Suction diffusers shall be furnished and installed at the suction of pumps where indicated on the drawings. Suction diffuser outlet shall be not less than pump suction size and suction diffuser system inlet shall be a minimum of one size larger than suction diffuser outlet size. Suction diffuser shall provide for a smooth flow of water into the pump inlet, and shall be complete with strainer, adjustable support leg, and start-up strainer. Start-up strainer shall be removed at the final testing and balancing phase.

2.03 PRESSURE GAUGES

A. 2.5-inch glycerin filled, SS case, 1.5% accuracy, dual scale (PSI & KPA), bronze bourdon tube and 0.25-inch NPT connection, brass snubber with properly selected filter disc for the application, and needle valve with knurled brass or ABS plastic handle. Provide multiple needle valves where a single pressure gauge is used to measure pressure at multiple points. Provide siphon for steam gauges. Winters, Weiss, Marshalltown, Ashcroft, Trerice, Weksler, or equivalent.

B. Select pressure range as indicated on the drawings, or if not indicated select so that the normal operating pressure is approximately 50% of the scale range. Provide compound and vacuum gauges where required by the application.

C. Install gauges so they are easily readable from normal operator level. Where the sensing location is not convenient to the operator, install the gauge and needle valves at a location easily read from normal operator level, extend piping from there to the sensing point on the main pipe, and provide a ball valve for isolation at the main. In addition, provide drain and vent valves to facilitate removing air and water from the sensing line.

2.04 THERMOMETER AND THERMOMETER WELLS

A. Either liquid filled or digital type, vari-angle, 3-1/2" stem for pipe sizes through 6" and 6" stem for pipe sizes 8" and larger, dual scale (degrees F & C), separable brass socket, extension neck where installed in insulated piping, and accuracy 1% of range. Winters, Weiss, Moeller, Trerice, Weksler, Duro, or equivalent.

1. Liquid Filled Type: 9" case, straight form, V-shaped, high pressure die cast aluminum, baked enamel finish, with heavy glass-protected front firmly secured with spring action, and organic liquid filled magnifying lens. Winters 9IT or approved equal.
2. Digital Type: May be used both indoors or in outdoor locations not exposed to sunlight, high impact ABS plastic housing, suitable for operation at 16 Lux. Winters 9IT or approved equal.

B. Ranges: Provide the following ranges except where otherwise indicated:

Heating Water	30-240 degrees F
Chilled Water, Condenser Water, Domestic Cold Water	0-120 degrees F
Domestic Hot Water	30-180 degrees F

2.05 MANUAL AIR VENTS

A. Provide manual air vents at locations indicated on the drawings, at the high point of all liquid piping system and as otherwise required for proper air elimination and liquid circulation.

B. Manual air vents shall be 1/2" brass ball valves as specified in Section 23 0523. Provide brass hose connection and plug on valve outlet.

2.06 AUTOMATIC AIR VENT

A. Provide automatic air vents for all separators, at the high point of all hydronic systems and at locations indicated on the drawings. Automatic air vents shall be 3/4" size, minimum. Provide manual shut-off ball valve between automatic air vent and piping system. Automatic air vents shall be float type, 150 PSIG maximum working pressure, 3/4" NPT system connection,

Amtrol Model No. 720, Taco, Armstrong, Watson-McDaniel, Hofmann, or equivalent.

2.07 MANUAL DRAIN VALVES

A. Provide manual drain valves at locations indicated on the drawings, at the low points of all liquid piping systems, and as otherwise required for proper draining of systems. Manual drain valves shall be sized as shown on the drawings but not less than 3/4" size, brass ball valve, as specified in Section 23 0523. Pipe discharge from drain valves to floor drain, floor sink, or as otherwise directed for indirect discharge into sanitary sewer system. For drain valves located above ceiling or in location outside mechanical equipment areas provide brass hose connection and cap for valve discharge.

2.08 TEMPERATURE AND PRESSURE TEST PLUGS

A. 0.25 or 0.5-inch NPT with brass body, EPDM core, and brass gasketed cap. Winters, Peterson, or approved equal. Supply one pressure/temperature test kit with two 4" Duro #105 pressure gauges of 1% accuracy and ranges as required by application; and two 2" Tel-Tru #39R Bi-metal thermometers with 8" stem, 1% accuracy, and ranges as required by the applications; and a protective carrying case.

2.09 FLOW BALANCE VALVE

A. Furnish and install calibrated balance valve equivalent to Bell and Gossett "circuit-setter," Griswold, Taco, Armstrong, or equivalent at locations indicated on the drawings. Balance valves shall be brass or cast iron body, NPT or sweat connections through 3" size and flanged connections above 4" size, 125 PSIG working pressure minimum. Balance valve shall be equipped with two brass readout valves with integral EPT insert and check valve designed to minimize system fluid loss during balancing and monitoring process. Each valve shall be provided with a calibrated nameplate permitting accurate system balance. Flow balance valves shall be not less than full line size with maximum pressure drop of 10 feet.

2.10 WATER FLOW MEASURING DEVICES

A. Furnish and install cast iron wafer type flow meter equivalent to Bell & Gossett "OP-Series," Griswold, Taco, Armstrong, or equivalent at locations indicated in the drawings. Flow meters shall be equipped with two brass readout valves with integral EPT insert and check valve designed to minimize system fluid loss during monitoring process. Flow meter shall be furnished with a calibrated nameplate specifying the flow range through a range of differential pressures. Water flow measuring devices shall be not less than full line size with maximum pressure drop of 10 feet.

2.11 AUTOMATIC FLOW LIMITING VALVES

A. To maintain constant flow within 5 percent over a range of 2-32 psid. Bronze or cast iron body, stainless steel cartridges, two pressure readout ports with quick disconnect valves and caps, SS identification tag marked with rated flow. Valves through 2 inch size shall be threaded connection, valves over 2 inches shall be wafer type; 150 psig rated. Supply one readout kit including flow meter, hoses and flow charts all contained in carrying case. Size valves for required flows. Griswold, FDI, or approved equal.

2.12 FLEXIBLE CONNECTORS

A. Furnish and install flexible connectors at locations indicated on the drawings and at all piping connections associated with equipment mounted on or hung from vibration isolators. Flexible connectors shall be constructed of multiple ply nylon cord fabric and neoprene, operating pressure 150 PSIG at 220^{O}F through 12" size and operating pressure of 125 PSIG at 220^{O}F for sizes 14" through 24". Provide butyl or Hypolon liner and applications with fluid temperatures in excess of 225^{O}F.

B. Flexible connectors shall be single or twin sphere with Class 150 flange connections for sizes 2-1/2" and larger and threaded connections with galvanized female unions for sizes 3/4" through 2". Mason Industries MFTCR, Hyspan, Metra-Flex, Keflex, Proco, or equivalent. Flexible connectors required for outdoor installation shall be braided stainless steel type.

C. Installation of flexible connectors shall be in strict accordance with manufacturer's recommen-

dations. Spacing between piping system flanges shall be based on the flexible connector's expanded length corresponding to the system's operating pressure. Control rods or cables shall be provided for units installed in unanchored applications where system operating pressure and dynamic forces exceeds manufacturer's recommendations for unrestrained installations.

2.13 EXPANSION TANK

A. Furnish and install diaphragm type, pre-pressurized, ASME code construction 125 PSIG working pressure, expansion tank in horizontal or vertical arrangement as shown on the drawing and required for equipment space allocation. Properly sized expansion tanks shall be provided for all closed circuit hydronic systems. Connect expansion tank to the low pressure side of the piping system with 3/4" minimum line size; provide quarter turn ball valve with handle removed for manual isolation valve. Contractor shall field verify expansion tank air charge and re-charge as required to maintain correct system pressurization and tank expansion volume. Expansion tanks shall be Amtrol, Woods, Armstrong, Taco, or equivalent.

2.14 AIR SEPARATOR

A. Furnish and install air separator, inline or tangential type as shown on the drawings for all closed circuit hydronic system. Inline air separators shall be fabricated of steel or cast iron, 125 PSIG working pressure. Tangential type air separators shall be ASME code construction for 125 PSIG working pressure and shall be furnished with internal perforated stainless steel air collection tube, bottom blow down connection and removable stainless steel strainer element with 3/16" perforations and free area of not less than five times the cross-sectional area of the connecting piping.

B. Each air separator shall be provided with an automatic air vent, 3/4" size, Amtrol Model No. 720 or equivalent, with manual shut-off ball valve between automatic air vent and air separator.

C. Air separators shall be full line size and installed at the high point of the piping system unless otherwise indicated in the drawings.

D. Air separators shall be Amtrol, Woods, Armstrong, Taco, or equivalent.

2.15 WATER PRESSURE REGULATING VALVES

A. Furnish and install water pressure regulating valves, Watts U5B, Bell & Gossett, Amtrol, Cash, Jordan, or equivalent, 3/4" size minimum for water makeup to all hydronic systems and at other locations as shown on the drawings. Water pressure regulating valves shall be brass body, union inlet with integral strainers, 300 PSIG maximum working pressure, with built-in thermal expansion bypass.

B. For high water capacity applications provide Watts 2235B, Bell & Gossett, Amtrol, Cash, Jordan, or equivalent.

C. Provide high or low pressure range depending on application requirements. Set pressure shall be as shown on the drawings, or as required to provide a minimum system pressurization of 12 PSIG at the system's highest point for closed circuit hydronic systems, or as recommended by equipment manufacturers.

2.16 WATER PRESSURE RELIEF VALVES

A. Furnish and install ASME labeled, National Board Stamped, water pressure relief valves, Watts Series 174A or 740, Bell & Gossett, Amtrol, Cash, Jordan, or equivalent, 3/4" size minimum for relief of all water makeup to all closed circuit hydronic systems. Properly sized relief valves shall be provided where required for over-pressure protection on heat exchangers, converters, boiler, and pressure vessels, and other locations as shown in the drawings.

B. Relief valves shall be sized for the full system heating capacity, to match the makeup capacity, or as otherwise required to protect the system from over-pressure conditions. Relief valves shall be factory pre-set for maximum pressure rating shown in the drawings, or for approximately 125% of the system operating pressure, but in no case shall the relief valve setting exceed the maximum safe operating pressure of the system and system components and

equipment.

2.17 WATER TEMPERATURE AND PRESSURE RELIEF VALVES

A. Furnish and install ASME labeled, National Board stamped water temperature and pressure relief valves, Watts, Cash, or equivalent, for all domestic water heaters, domestic water storage tanks, and other locations indicated in the drawings.

B. Water temperature and pressure relief valves shall be sized for the full system heating capacity at 210°F maximum operating temperature and shall be furnished with the required valve thermostat tube extension length.

2.18 WATER REDUCED PRESSURE BACKFLOW PREVENTERS

A. Furnish and install water reduced pressure backflow preventer, as approved and accepted by the City of Rio Rancho, State of New Mexico, Febco Model 825Y, Hersey, Beeco, Watts, or equivalent. 3/4" minimum size shall be provided for water makeup to all required HVAC systems. Backflow preventers shall be provided at other locations as shown on the drawings. Reduced pressure backflow preventer shall include two shut-off gate or ball valves, two check valves, pressure relief valve, and four test cocks. Units shall be factory assembled, tested and certified. Units 2" and smaller shall be brass body, threaded connections, 175 PSIG maximum working pressure. Units 2-1/2" and larger shall be provided with flanged connections.

B. Water reduced pressure backflow preventer installation shall be in accordance with manufacturer's instructions and City of Rio Rancho, State of New Mexico requirements for access for testing and inspection.

C. Backflow protection devices associated with landscaping and irrigation systems shall be furnished and installed under the Site Work sections of these specifications.

2.19 CHEMICAL WATER TREATMENT

A. Chemical water treatment for hydronic systems shall consist of equipment, start-up, testing, chemicals and one-year full service as listed on the Equipment Schedule, shown on the Drawings, and specified under the applicable piping system sections of this Specification.

2.20 FLOW METERS AND INSTRUMENTATION

A. Water meters and instrumentation shall be furnished and installed as shown on the drawings and specified in Section 23 0900.

2.21 SOLENOID VALVES

A. Furnish and install electric solenoid valves as shown on the drawing and as required for the operation of the mechanical systems. Solenoid valves shall be 115 volt single phase, 60 Hz, two-way arrangement, two positions with normally open or normally closed arrangement as required of the application. Solenoid valves associated with safety protection of systems including freeze-protection, drain down, etc. shall be provided such that in the event of a power failure the system shall fail to a safe operating condition. Solenoid valves shall be as manufactured by ASCO, Armstrong, Honeywell, Metrex, or equivalent.

B. See Section 23 0500, Common Work Requirements, and Section 23 0549, HVAC and Electrical Installation Coordination, for requirements associated with electrical control and power wiring for solenoid valves. Furnish hazardous duty enclosure where required by the application.

2.22 FLOW SWITCHES

A. Furnish and install flow switches where required for protection and/or monitoring of mechanical equipment including water chillers, boilers, pumps, etc. and as otherwise shown on the equipment schedule, and the drawings.

B. Flow switches shall be either paddle type or differential pressure type as required by the application and as shown on the drawings, except differential pressure type flow switches shall be utilized for water chillers and other applications where minor pressure fluctuation could cause nuisance tripping of equipment operation.

1. Paddle type flow switch shall be McDonnell and Miller Model FS7-4 Series, or equivalent designed for industrial duty, brass body and trim, 300 PSIG maximum working pressure,

paddle size as required for application, single pole double throw switches, with electrical rating of 7.4 full load amps at 115 VAC. Provide hazardous duty enclosure where required by the application. Flow switches shall be installed in a horizontal pipe with inlet and outlet conditions necessary to provide trouble-free operation.

2. Differential pressure flow switch shall be Honeywell Model 406 Series or equivalent, adjustable pressure differential setting, dustproof mercury switch enclosure, 1/4" NPT bellows connections, single pole, single throw switch, with electrical rating of 7.2 full load amps at 115 vac. Differential pressure switches shall be properly supported on the equipment controlled or wall mounted adjacent to the equipment or piping system.

2.23 ELECTRICAL HEAT TRACING SYSTEM

A. Furnish and install electric heat tracing system for winterizing protection for all liquid piping systems exposed to the outdoor ambient environment and piping systems in the unheated areas of the building.

B. Heating cable shall be self-regulating rapid trace, Type FLX, low temperature, heating cable rated at 150^{o}F maximum maintenance temperature and suitable for 185^{o}F maximum exposure temperature, or Type HTSX medium temperature heating cable rated at 250^{o}F maximum maintenance temperature and suitable for 420^{o}F maximum exposure temperature, as required by the application and as manufactured by Thermon, Chromolux, or equivalent. Heating cable shall be flexible, parallel circuit construction consisting of a continuous self-limiting resistance, conducive inner core material between two parallel copper bus wire, designed for cut-to-length at the job site by the Contractor and suitable for wrapping around piping valves and complex fittings. Self-regulation shall prevent overheating and burnouts even where the cable overlaps itself. Provide end seals for ends of circuits. Wire at the ends of circuits shall not be tied together. Long term stability via service life performance test per IEEE 515 Std; latest edition.

C. Heating Tracing System shall be furnished with all accessories required for the complete installation including the power supply connection fitting and stainless steel mounting brackets with stainless steel worm gear clamp to fasten bracket to pipe, 1/2 inch wide fiberglass reinforced pressure sensitive cloth tape as required to fasten cable to pipe at not greater than 12 inch intervals. End termination, splice and tie kits shall be provided above insulation for maintenance accessibility. 1/2 inch NPT conduit hub, SPST switch with required rating at 115 VAC through 5 KW systems capacity and 277 volt single phase, 60 HZ for system heating capacities in excess of 5 kW. Set thermostat to maintain pipe surface temperature at not less than 34^{0}F. Furnish and install piping labels on systems with electric heat tracing, manufacturer's standard (NEC code), labeled or stamped "ELECTRIC TRACED" labels shall be installed on the insulation pipe jacket at 10 foot intervals along the pipe on alternating sides.

D. Electric Heat tracing system sizing shall be provided as recommended by the manufacturer to maintain pipe surface temperature at 34^{o}F minimum during the winter based upon an outdoor design temperature of 0^{o}F with 15 MPH wind velocity, and the normal system fluid operating temperature. See Section 22 0700, Plumbing Systems Insulation, and Section 23 0700, Mechanical Systems Insulation, for insulation characteristics and thickness associated with electrical heat traced systems. Piping system insulation shall be oversized as required to accommodate the heating cable; coordinate with Section 22 0700 and Section 23 0700.

E. See Section 23 0500, Common Work Requirements, Section 22 0549, Plumbing and Electrical Installation Coordination, and Section 23 0549, HVAC and Electrical Installation Coordination, for requirements associated with electrical control and power wiring. Each heat tracer circuit shall have EPDM style breakers or controllers for ground fault protection.

F. Non-metallic pipe applications shall have one (1) layer of aluminum tape below and above the heater, run longitudinally to enhance heat transfer into non-metallic piping systems.

G. Package heat tapes with integral thermostat and "press-to-test" device may be utilized for small freeze protection systems, subject to review and acceptance by the Architect.

2.24 EXPANSION JOINTS

A. Furnish and install corrugated bellows expansion joint, Hyspan Series 1500, Metra-Flex,

Keflex, Proco, Flexonics, or equivalent, self-equalizing, 150 PSIG working pressure at 850°F, Class 150 ASA flange connections 1-1/2" size and above, single or dual center base configuration as shown on the drawings, constructed of corrugated Type 304 or 321 stainless steel, ring controlled, with integral stainless steel or Monel sleeve, and removable carbon steel external housing to protect bellows and support insulation. Furnish limit rods to prevent expansion joint from exceeding rated travel. Joint design shall be for maximum flexibility over 10,000 cycles minimum.

B. Expansion joint sizing and installation shall be as shown on the drawing and as recommended by the manufacturer.

C. Expansion joints shall be insulated with flexible 2" minimum thickness of high temperature fiberglass blanket insulation furnished with joint and installed under the external protective housing.

D. Contractor shall carefully check expansion joint limit rods and make adjustments as required to ensure proper joint movement and operation.

2.25 EXPANSION COMPENSATORS

A. Furnish and install expansion compensators, Hyspan series 8500, Metra-Flex, Keflex, Proco, Flexonics, or equivalent, stainless steel laminated bellows with stainless steel or carbon steel shroud, 175 PSIG pressure rating at 250°F, 2 inch straight line expansion and 1/2 inch contraction. Furnish copper tube with sweat ends for compensators installed in copper piping systems. Furnish standard wall carbon steel pipe tube for compensators installed in steel piping systems, threaded connectors for sizes 2" and smaller and Class 150 ASA flange connection for sizes 2-1/2" or larger.

B. Expansion compensators sizing and installation shall be as shown on the drawings and as recommended by the manufacturer.

2.26 PIPE ALIGNMENT GUIDES

A. Furnish and install factory fabricated steel pipe alignment guides, Hyspan Series 9500, Metra-Flex, Keflex, Proco, Flexonics, or equivalent, to maintain the longitudinal position of pipe centerline between expansion joints and compensators with axial restraint. Alignment guides shall consist of a bolted two-section outer cylinder and base with two-section guiding spider bolted tight to the pipe guide. Guide and spider shall be sized to clear pipe and pipe insulation and long enough to prevent over travel of spider and cylinder. Guides shall not be used for pipe support.

B. Alignment guides shall be arranged and installed as shown on the drawings and as recommended by the manufacturer.

2.27 PIPE ANCHORS

A. Pipe anchors shall be constructed of welded steel as detailed on the drawings.

B. Pipe anchors shall be arranged as shown on the drawings and as required to properly control/piping system expansion and contraction in conjunction with system flexibility due to off-sets, bends, and loops and expansion joints and compensators.

PART 3 EXECUTION

3.01 INSTALLATION

A. All specialties shall be installed in accordance with the best standard practices and as recommended by the manufacturer.

B. Install thermometers so they are easily readable from operator level.

C. Where thermometers, gauges, vents and test fittings occur in insulated piping systems or on insulated equipment, extension necks shall be provided to extend beyond the insulation.

3.02 AIR VENTS

A. Manual air vents shall be installed as specified herein and at the high points in all piping sys-

tems.

B. Automatic air vents shall be installed as specified herein and at locations indicated on the drawings. Automatic air vents shall be installed level and in accordance with manufacturer's directions to properly vent system, complete with individual isolation valves.

3.03 STRAINERS

A. All strainer screens, including basket strainers and suction diffusers, shall be removed and cleaned prior to commencing testing and balancing work and shall be maintained clean through project final acceptance by the Owner. Suction diffuser start-up strainers shall be removed prior to final system testing and balancing work.

3.04 TEST AND ADJUSTMENT

A. Field adjust all water pressure regulating valves, flow switches, water level controls, and specialties to provide required system operation.

B. Field test and verify the operation of all safety devices including water relief valves and temperature and pressure relief valves.

3.05 RELIEF VALVE DISCHARGE

A. Water pressure relief valve and water temperature and pressure relief valve discharges shall be piped full size to the outside of the building or discharged indirectly in a properly sized building floor drain or floor sink, and as allowed by the Building Mechanical and Plumbing Codes. When the operating discharge temperature is in excess of 212^{o}F, the discharge shall be equipped with a splash shield or centrifugal separator.

B. Water reduced pressure backflow preventer discharge shall be piped full size to the outside of the building or discharged indirectly into a properly sized building floor drain or floor sink as allowed by the Building Mechanical and Plumbing Codes. Provide a bronze air gap funnel with stainless steel fasteners for installation under reduced pressure backflow prevention relief valve. Febco Model AGD or equivalent, 1" discharge pipe size for backflow preventer size through 2".

END OF SECTION 23 0505

SECTION 23 0523
VALVES

PART 1 GENERAL

1.01 REQUIREMENTS

A. All Valves shall conform with current applicable provisions of the General Conditions, Supplemental General Conditions, and General Requirements.

B. All Valves shall meet the current MSS Specifications covering Bronze & Iron Valves. MSS-SP-80, MSS-SP-70, MSS-SP71, MSS-SP-85 where applicable.

C. Lead Ban: All systems and system components, pipe, fittings, and fixtures delivering water for human consumption shall be lead free.

1. Any product designed for dispensing potable water shall meet both the NSF 61 and NSF 372 test standards via third-party testing and certification.
2. Lead free refers to <0.25% weighted average lead content in relation to wetted surface of pipe, fittings, and fixtures in systems delivering water for human consumption, and solder and flux which does not contain more than 0.2% lead.

1.02 RELATED SECTIONS

A. Section 23 0500 for Common Work Requirements for HVAC.

B. Section 23 0523 for Valve Identification.

C. Section 23 0504 for Pipe and Pipe Fittings.

D. Section 23 2313 for Refrigerant Piping System.

E. Section 23 0900 for Automatic Temperature Control Valves.

F. Division 21 for fire suppression system valves and tamper switches.

G. **Division 22 for plumbing system.**

1.03 SCOPE

A. Contractor shall furnish and install all valves and accessories necessary for satisfactory operation of the systems.

1.04 VALVE REQUIREMENTS

A. All Gate, Globe, Check, Ball valves shall be manufactured by Milwaukee, Nibco, Apollo, Stockham, Powell, Crane, Tyco-Grinnell, or equivalent.

B. All lubricated plug valves shall be as manufactured by Rockwell, Walworth, Homestead, or equivalent.

C. Butterfly valves shall be as manufactured by Milwaukee, W. C. Norris, Centerline, Crane, Demco, Keystone, Tyco-Grinnell, Victaulic, Nibco, or Dezurik or equivalent. Butterfly valves may be used for closed circuit chilled water, heating hot water (200^{o}F maximum) run-around coil and heat pump circulating water systems and for condensing water systems. Butterfly valves shall not be used for domestic water or other non-specified service.

D. Ball valves shall be utilized in lieu of gate valves and globe valves for all HVAC and plumbing systems for sizes 2" and smaller

E. Butterfly valves may be substituted for gate, globe and ball valves for specified services, and for other services as may be approved by the Architect.

F. All valves furnished under Division 22 and 23, of the same type, shall be products of a single manufacturer.

G. Provide gate and globe valves with packing that can be replaced with the valve under full working pressure.

PART 2 PRODUCTS

2.01 GENERAL SERVICE VALVES, HVAC AND PLUMBING SYSTEMS

A. Gate Valves - 2" and Smaller, Class 125: Valves 2" and smaller shall be cast of ASTM B-62 bronze, Class 125 construction, solid disc, rising stem, gland packed, non-asbestos packing. Milwaukee 148 (Threaded) or equivalent; Milwaukee 149 (Solder), or equivalent.

B. Gate Valves - 2" and Smaller, Class 150: Valves 2" and smaller shall be cast of ASTM B-62 bronze, Class 150 construction, solid wedge disc, rising stem, union bonnet, gland packed, non-asbestos packing. Milwaukee 1151 (Threaded) or equivalent; Milwaukee 1169 (Solder), or equivalent

C. Gate Valves - 2" and Smaller, Class 300: Valves 2" and smaller shall be cast of ASTM B-62 bronze, Class 300 construction, solid wedge disc, rising stem, union bonnet, gland packed, non-asbestos packing. Milwaukee 1184 (Threaded) or equivalent.

D. Gate Valves - 2-1/2" and Larger, Class 125: Valves 2-1/2" and larger shall be of ASTM A-126 Class B cast iron, flanged ends, Class 125 construction, OS & Y Type, rising stem, bronze trim, non-asbestos packing. Milwaukee F2885 or equivalent.

E. Gate Valves - 2-1/2" and Larger, Class 250: Valves 2-1/2" and larger shall be of ASTM A-126 Class B cast iron, flanged ends, Class 250 construction, OS & Y Type, rising stem, bronze trim, non-asbestos packing. Milwaukee F2894 or equivalent.

F. Globe Valves - 2" and Smaller, Class 125: Valves 2-1/2" and smaller shall be of ASTM B-62, Class 125 construction, bronze trim, gland packed, non-asbestos packing. Milwaukee 502 (Threaded), or equivalent; Milwaukee 1502 (Solder) or equivalent.

G. Globe Valves - 2" and Smaller, Class 150: Valves 2" and smaller shall be of ASTM B-62, bronze, Class 150 construction, bronze trim, composition disc, union bonnet, gland packed, non-asbestos packing. Milwaukee 590 (Threaded) or equivalent; Milwaukee 1590 (Solder), or equivalent.

H. Globe Valves - 2" and Smaller, Class 300: Valves 2" and smaller shall be of ASTM B-62, bronze, Class 300 construction, bronze trim, union bonnet, gland packed, non-asbestos packing. Milwaukee 572 (Threaded) or equivalent

I. Globe Valves - 2-1/2" and Larger, Class 125: Valves 2-1/2" and Larger shall be of ASTM A-126, Class B cast iron, flanged ends, Class 125 construction, bolted bonnet, gland packed, non-asbestos packing. Milwaukee F2981M or equivalent.

J. Globe Valves - 2-1/2" and Larger, Class 300: Valves 2-1/2" and larger shall be of ASTM A-126, Class B cast iron, flanged ends, Class 300 construction, bolted bonnet, gland packed, non-asbestos packing. Milwaukee F2983 or equivalent.

K. Check Valves - 2" and Smaller, Class 125: Valves 2" and smaller shall be cast of ASTM B-62 bronze, Class 125 construction, Y-pattern, swing type design, teflon seat, disc for steam service, Buna-N for water service. Milwaukee 509 (Threaded) or equivalent; Milwaukee 1509 (Solder) or equivalent.

L. Check Valves - 2" and Smaller, Class 150: Valves 2" and smaller shall be cast of ASTM B-62 bronze, Class 150 construction, Y-pattern, swing type design, bronze seat, composition disc, teflon seat disc for steam service, Buna-N for water service. Milwaukee 510 (Threaded) or equivalent; Milwaukee 1510 (Solder) or equivalent.

M. Check Valves - 2" and Smaller, Class 300: Valves 2" and smaller shall be cast of ASTM B-62 bronze, Class 300 construction, Y-pattern, swing type design, bronze regrinding disc. Milwaukee 507 (Threaded) or equivalent.

N. Check Valves - 2 1/2" and Larger, Class 125: Valves 2-1/2" and larger shall be of ASTM A-126 Class B, cast iron, flanged ends, Class 125 construction, bolted bonnet, bronze trim, swing type design. Milwaukee F2974M or equivalent.

O. Check Valves - 2 1/2" and Larger, Class 250: Valves 2-1/2" and larger shall be of ASTM A-126 Class B, cast iron, flanged ends, Class 250 construction, bolted bonnet, bronze trim, swing type design. Milwaukee F2970 or equivalent.

2.02 STEAM SERVICE - ABOVE 80 PSIG TO 125 PSIG, MAXIMUM STEAM PRESSURE

A. Gate Valves - 2" and Smaller, Class 150: Valves 2" and smaller shall be cast of ASTM B-62 bronze, Class 150 construction, solid wedge disc, rising stem, union bonnet, gland packed, non-asbestos packing. Milwaukee 1151 (Threaded) or equivalent.

B. Ball Valves - 2" and Smaller, Class 250: Valves 2" and smaller shall be cast of ASTM B-584 bronze, Class 250 construction, thread connections 316 stainless steel ball and stem, multi-fill PTFE seals and stem packing, adjustable packing gland and blowout-proof stem. Apollo 70-140-64 Series or equivalent.

C. Gate Valves - 2 1/2" and Larger, Class 125:

1. Valves 2-1/2" and larger shall be of ASTM A-126 Class B, cast iron, flanged ends, Class 125 construction, OS & Y Type, rising stem, bronze trim, non-asbestos packing.
2. Provide factory installed glove valve bypass 1/2" size through 4" valve size, 3/4" size for 6" and 8" valve sizes and 1" for valve sizes 10" and larger, conforming to MSS specification SP.45.
3. Provide drilled and tapped hoses for drains conforming to SP-45 where shown on drawings and as required for proper installation.
4. Milwaukee F2885 or equivalent.

D. Globe Valves - 2" and Smaller, Class 150: Valves 2" and smaller shall be cast of ASTM B-62 bronze, Class 150 construction, bronze trim, composition disc, union bonnet, gland packed, non-asbestos packing. Milwaukee 590 (Threaded) or equivalent.

E. Globe Valves - 2-1/2" and Larger, Class 125: Valves 2-1/2" and larger shall be of ASTM A-126, Class B Cast Iron, flanged ends, Class 125 construction, bolted bonnet, bronze trim, gland packed, non-asbestos packing. Milwaukee F2981 or equivalent.

F. Check Valves - 2" and Smaller, Class 150: Valves 2" and smaller shall be cast of ASTM B-62 bronze, Class 150 construction, Y-pattern, swing type design, bronze seats, composition disc, teflon seat disc for steam service, Buna-N for water service. Milwaukee 510 (Threaded) or equivalent.

G. Check Valves - 2-1/2" and Larger, Class 125: Valves 2-1/2" and larger shall be cast of ASTM B-62 bronze, Class B, cast iron, flanged ends, Class 125 construction, bolted bonnet, bronze trim, swing type design. Milwaukee F2974M (Threaded) or equivalent.

2.03 STEAM SERVICE - ABOVE 125 PSIG TO 150 PSIG, MAXIMUM STEAM PRESSURE

A. Gate Valves - 2" and Smaller, Class 150: Valves 2" and smaller shall be bronze Class 150 construction, threaded connections. Milwaukee 1151 or equivalent as specified herein or equivalent.

B. Gate Valves - 2 1/2" and Larger, Class 250:

1. Valves 2-1/2" and larger shall be of ASTM A-126 Class B, cast iron, flanged ends, Class 250 construction, OS & Y Type, rising stem, bronze trim, non-asbestos packing.
2. Provide factory installed glove valve bypass 1/2" size through 4" valve size, 3/4" size for 6" and 8" valve sizes and 1" for valve sizes 10" and larger, conforming to MSS specification SP-45.
3. Provide drilled and tapped hoses for drains conforming to SP-45 where shown on drawings and as required for proper installation.
4. Milwaukee F2894 or equivalent.

2.04 STEAM CONDENSATE VALVES

A. Gate Valves - 2" and Smaller, Class 150: Valves 2" and smaller shall be bronze, Class 150 construction. Milwaukee 1151 (threaded), Milwaukee 1169 (solder), as specified herein or equivalent.

B. Gate Valves - 2-1/2" and Larger, Class 125: Valves 2-1/2" and larger shall be cast iron, Class 125 construction, OS & Y pattern. Milwaukee F-2885, as specified herein or equivalent.

C. Check Valves - 2 1/2" and Smaller, Class 150: Valves 2-1/2" and smaller shall be bronze, Class 150 construction, threaded connections, Milwaukee 510, as specified herein or equivalent.

D. Check Valves - 2 1/2" and Larger, Class 125: Valves 2-1/2" and larger shall be cast iron, Class 125 construction, flanged connections. Milwaukee F2974M, as specified herein or equivalent.

2.05 BOILER FEED WATER PUMP DISCHARGE AND RECIRCULATING VALVES (HIGH PRESSURE)

A. Gate Valves - 2" and Smaller, Class 300: Valves 2" and smaller shall be cast of ASTM B-62 bronze, Class 300 construction, 600 PSI W.O.G., solid wedge disc, rising stem, stainless steel seats and wedge, union bonnet, gland packed, non-asbestos packing, threaded connections. Milwaukee 1184M or equivalent.

B. Gate Valves - 2 1/2" and Larger, Class 250: Valves 2-1/2" and larger shall be cast iron, Class 250 construction, 500 PSI W.O.G., flanged connections, OS & Y Type. Milwaukee F-2894 as specified herein or equivalent.

C. Check Valves - 2" and Smaller, Class 300: Valves 2" and smaller shall be cast of ASTM B-62 bronze, Class 300 construction, 600 PSI W.O.G., Y-pattern, swing type design, bronze regrinding disc, threaded connections. Milwaukee 507 or equivalent.

D. Check Valves - 2-1/2" and Larger, Class 250: Valves 2-1/2" and larger shall be cast of ASTM A-126, Class B cast iron, flanged ends, Class 250 construction, 500 PSI W.O.G., bolted bonnet, bronze trim, swing type design. Milwaukee F-2970 or equivalent.

2.06 BOILER FEED WATER PUMP DISCHARGE & RECIRCULATING VALVES (LOW PRESSURE)

A. Gate Valves - 2" and Smaller, Class 150: Valves 2" and smaller shall be bronze, Class 150 construction, 300 PSI W.O.G., threaded connections. Milwaukee 1151 as specified herein or equivalent.

B. Gate Valves - 2 1/2" and Larger, Class 125: Valves 2-1/2" and larger shall be cast iron, Class 125 construction, 200 PSI W.O.G., OS & Y Type. Milwaukee F-2885, as specified herein or equivalent.

C. Check Valves - 2" and Smaller, Class 150: Valves 2" and smaller shall be bronze, Class 150 construction, 300 PSI W.O.G., threaded connections. Milwaukee 510, as specified herein or equivalent.

D. Check Valves - 2 1/2" and Larger, Class 125: Valves 2-1/2" and larger shall be cast iron, Class 125 construction, 200 PSI W.O.G., flanged connections, OS & Y Type. Milwaukee F-2974M, as specified herein or equivalent.

2.07 BUTTERFLY VALVES

A. Valves 2-1/2" and larger shall be full lug pattern, ASTM A-126, Class B cast iron body, 416-SS stems, aluminum/bronze disc, EPDM liner and seats (-30^{o}F to 275^{o}F) w/rigid phenolic cartridge, 200 PSIG working pressure with Bubble tight shut-off. Valves shall be for mounting between flanges with lugs drilled and tapped so that pipe may be disconnected on either side of valve with opposite end remaining under pressure. Milwaukee ML-123-E or equivalent.

B. Valves 4" and smaller shall be provided with level handler operator with spring loaded lock stops. Valves 5" and larger shall be furnished with manual gear operator with hand wheel.

C. Valves installed for insulated services shall be provided with extensions, as required, such that operator does not interfere with insulation or insulation jacketing.

D. Butterfly valves furnished for use in grooved piping system shall meet the material specification requirements as specified herein.

2.08 BALL VALVES

A. Valves 2" and smaller shall be cast of ASTM B-62 bronze, Class 150 construction, 600 PSI W.O.G. Two-piece body, chrome plated ball, blowout proof stem, reinforced TFE seats, non-asbestos packing. Milwaukee BA-100 (threaded) or equivalent. Milwaukee BA-150 (solder) or

equivalent.

B. Valves installed on insulated services shall be provided with extensions, as required, such that operator does not interfere with insulation or insulation jacketing. Cutting or notching of the insulation or bending of handles shall not be permitted.

2.09 BALANCE VALVES

A. Valves 2" and smaller: Ball valve, bronze, Class 150 construction, 600 PSI W.O.G., Two piece body, Milwaukee BA-100 (threaded). Milwaukee BA-150 (soldered), as specified herein or equivalent.

B. Valves 2-1/2" and larger: Lubricated plug valve, cast iron construction, 175 PSI W.O.G., Class 125 flange connections, level handle for valves 4" and smaller, manual gear operator with handle wheel for valve 5" and larger. Walworth No. 1797F or equivalent.

C. Valves 2-1/2" and larger:

1. Butterfly valve, full lug pattern, as specified herein.
2. Furnish level handle with infinite throttling positions and locking device for securing handle in any position for valves 4" and smaller and manual gear operator with hand wheel for valves 5" and larger

D. Flow control and Flow Balance Valves: For calibrated flow balance valves and automatic flow control valves, see Specification Section 23 0505, Piping Specialties.

2.10 NATURAL GAS VALVES

A. Valves 3/4" and Smaller: Bronze natural gas cock, Walworth No. 590 (square head), Walworth 591 (flat head) or equivalent.

B. Valves 3" and Smaller: Ball valve shall be cast of ASTM B-584 bronze, Class 250 construction, threaded connections, chrome plated big ball and stem, RDTFE seat and stem packing, blow-out proof stem, UL Listed for natural gas service, Apollo 80-100 Series or equivalent.

C. Valves 4" and Larger: Lubricated plug valve, cast iron construction, 175 PSIG W.O.G., threaded connection for valves 2" and smaller, Class 125 Flange connections, level handle operator. Walworth No. 1797F (Flanged) or equivalent.

2.11 MANUAL AIR VENTS AND DRAIN VALVES

A. For manual air vents and drain valves, see Specification Section 23 0505, Piping Specialties.

2.12 BOILER SPECIALTY VALVES

A. For boiler stop-check valves blow-down valves, and relief valves, see Specification Section 23 2213, Steam and Condensate System.

2.13 NON-SLAM SILENT CHECK VALVE

A. Check valves for pump discharge and other required non-slam silent operation, shall be center guided, suitable for vertical or horizontal installation position, cast iron in semi-steel body, bronze disc and trim, stainless steel spring, Buna-N seats, Class 125 or 250 construction, as required by the application, wafer or globe flanged pattern for valves 2" through 10" size and flanged pattern for valves 12" and larger. Milwaukee 1400 Series (wafer) or equivalent. Milwaukee 1800 Series (globe) or equivalent.

2.14 TRIPLE DUTY VALVE

A. At the Contractor's option, triple duty valve may be utilized at pump discharge in lieu of non-slam check valve and balance/shut-of valve, see Specifications Section 23 0505, Piping Specialties.

PART 3 EXECUTION

3.01 INSTALLATION

A. All valves shall be installed in locations which will allow easy operation and facilitate maintenance.

B. Gate and Globe valves shall be installed with stems horizontal.

END OF SECTION 23 0523

SECTION 23 0548

VIBRATION AND SEISMIC CONTROLS FOR HVAC

PART 1 GENERAL

1.01 REQUIREMENTS

A. Conform with the applicable provisions of the General Conditions, Supplemental General Conditions, and General Requirements.

1.02 RELATED SECTIONS

A. Section 23 0500, Common Work Requirements for HVAC.

B. Section 23 0504, Pipe and Pipe Fittings.

1.03 SCOPE

A. It shall be understood that the requirements for seismic restraints are in addition to other requirements as specified elsewhere for the support and attachment of equipment and mechanical services, and for the vibration isolation of same equipment. Nothing on the project drawings or specifications shall be interpreted as justification to waive the requirements for seismic restraint as specified herein, shown on the drawings and required by Code.

B. The work under this section shall include furnishing all labor, materials, tools, appliances and equipment, and performing all operations necessary for the complete execution of the installation of seismic snubber restraint assemblies as shown, detailed and/or scheduled on the drawings and/or specified in this section of the specifications.

C. The materials and systems specified in this section shall be provided by the Contractor from a single Seismic Snubber Restraint Materials Manufacturer to assure sole source responsibility for the performance of the seismic restraints used.

D. The seismic snubber restraint materials manufacturer shall be responsible for detailed design for seismic supports, including calculation for size and attachment, signed and sealed by registered State of New Mexico Structural Engineer.

1.04 SUBMITTALS

A. See Section 23 0500 for general requirements for submittal materials. In addition to the requirements contained in Section 23 0500, provide submittal information for all products and materials covered under this Section of the Specifications as listed herein.

B. Furnish complete catalog data on all vibration isolators, restraints, and equipment vibration bases to be utilized for the project in order to establish compliance with the plans and specifications and all code requirements.

C. Furnish complete shop drawing information including construction details for all vibration bases; support points and anchor bolt requirements and locations; method of support for piping and ductwork; method of isolation for piping and ductwork passing through the building structure; and location and arrangement of seismic restraints.

D. Manufacturers not listed as approved in ‘Part 2 - Products’ of this section must submit for prior approval in accordance with provisions contained in Section 23 0500.

E. Drawings shall be reviewed and certified by a registered Professional Engineer, with a minimum of five (5) years working experience in this field, certifying that the submitted seismic restraint system design and anchorage details complies with all specification requirements and applicable codes.

1.05 CODE REQUIREMENTS

A. Seismic restraints shall be provided for equipment, materials and systems furnished and installed under Division 23 of this Specification in accordance with the requirements of the 2006 International Building Code; and NFPA No. 13 for fire protection system as adopted and interpreted by the State of New Mexico for Seismic Zone D, Risk Category IV.

1.06 SEISMIC RESTRAINT REQUIREMENTS

A. The Contractor shall submit calculations prepared by a State of New Mexico licensed Structural Engineer to substantiate that all items of mechanical equipment, ductwork and piping systems are properly supported to resist earthquake forces as required herein.

B. All mechanical equipment mounted on vibration isolators shall be provided with seismic restraints securely anchored to the building structure capable of resisting horizontal forces of 100% of their weight and/or in accordance with IBC Requirements for Seismic Zone D.

C. All items of mechanical equipment required for life safety including the fire pump and fire protection systems shall be provided with seismic restraints securely anchored to the building capable of resisting horizontal forces of 100% of their weight and/or in accordance with IBC Requirements for Seismic Zone D.

D. All items of mechanical equipment, except as specified above, and all piping and ductwork furnished and installed under Division 23 shall be provided with seismic restraints securely anchored to the building capable of resisting horizontal forces of 50% of their weight.

E. Seismic restraint/snubber manufacturer shall be responsible for the structural design of attachment hardware as required to attach seismic restraints/snubbers to both the equipment and supporting structure on vibration isolated equipment, or to directly attach equipment to the building structure for non-isolated equipment.

F. The Contractor shall furnish a complete set of approved shop drawings of all mechanical and electrical equipment which is to be restrained to the seismic restraint manufacturer, from which the selection and design of seismic restraint devices and/or attachment hardware will be completed. The shop drawings furnished shall include, at a minimum, basic equipment layout, length and width dimensions, installed operating weights of the equipment to be restrained and the distribution of weight at the restraint points.

PART 2 PRODUCTS

2.01 VIBRATION ISOLATORS

A. Floor mounted vibration isolators shall be either spring isolators designed for seismic restraint application or pre-compressed molded fiberglass or ribbed neoprene units as specified herein and in the Mechanical Equipment Schedule on the drawings. All vibration isolated equipment shall employ seismic snubbers having an approved "R" rating issued by the State of New Mexico.

B. Hanger type vibration isolators shall consist of steel springs in series with neoprene element as scheduled and specified on the drawings.

C. All vibration isolation devices shall be furnished by a single manufacturer to assure sole source responsibility for the proper performance of the materials used.

D. Vibration isolators shall be provided to maintain a minimum of 1-inch operating clearance.

E. Vibration isolators shall have a minimum static deflection as specified on the drawings. Isolators shall be selected by the manufacturer for non-resonance with the equipment forcing frequency and the building structure's natural frequencies. Isolators shall be provided for suitable mounting to equipment and supporting structure.

F. Vibration isolators shall be furnished by Kinetics Noise Control, Mason, or equivalent.

2.02 EQUIPMENT BASES

A. Vibration isolation bases shall be supplied by the vibration isolation manufacturer as indicated on the drawings and as required for the application. Concrete for inertia bases shall be furnished and installed by the Contractor and shall comply with Division 3 requirements.

B. Structural steel bases shall be designed and supplied by the isolator manufacturer. Kinetics Noise Control Type SFB, or equivalent. Bases shall be designed with isolator brackets to reduce the mounting height of the equipment. To assure adequate stiffness, the height of the members shall be a minimum of 8% of the longest span between isolators, or at least 6 inches. Where thinner sections are necessary, due to head room limitations, etc., the section modules of the members selected shall equal or exceed the section modules of wide flange steel members whose thickness

is 8% of the longest span between isolators.

C. Reinforced concrete inertia bases shall be designed by the isolation manufacturer who shall furnish the steel framework, Kinetics Noise Control, CIB, or equivalent. The Contractor shall furnish and install concrete, poured into the welded steel frame. The steel framework shall incorporate pre-located equipment anchor bolts, 1/2" diameter reinforcing bars on nominal 8" centers each way, and recessed isolator mounting brackets to reduce the mounting height of the equipment, but yet remain within the confines of the base. The thickness of the base shall be a minimum of 8% of the longest span between isolators, at least 6", or as indicated on the drawings. Where inertia bases are used to mount pumps, the bases shall be wide enough to support piping elbows. Provide a minimum of 1-inch clearance between the bottom of the base and floor on housekeeping pad with equipment in place, in operation and with spring isolators properly adjusted.

2.03 FLEXIBLE CONNECTIONS

A. Flexible connections for piping systems shall be as specified in Section 23 0504. Flexible connection for fan equipment and flexible ductwork shall be as specified in Section 23 3000.

2.04 SEISMIC SNUBBER TYPES

A. Reference: ASHRAE (American Society of Heating, Refrigerating and Air-Conditioning Engineers, Inc.) Handbook, 2007 HVAC Applications, Chapter 54 'Seismic and Wind Restraint Design'.

B. Type A: Coil Spring Isolator Incorporated within a Ductile Iron or Cast Aluminum Housing:

1. Cast iron or aluminum housing are brittle when subjected to shock loading and are therefore not approved for seismic restraint applications.

C. Type B: Coil Spring Isolator Incorporated within a Steel Housing:

1. Spring isolators shall be seismic control restrained spring isolators, incorporating a single or multiple coil spring element, having all of the characteristics of free standing coil spring isolators as specified in the vibration isolation portion of this specification. Springs shall be restrained using a housing engineered to limit both lateral and vertical movement of the supported equipment during an earthquake without degrading the vibration isolation capabilities of the spring during normal equipment operating conditions.
2. Vibration isolators shall incorporate a steel housing and neoprene snubbing grommet system designed to limit motion to no more than 1/4" in any direction and to prevent any direct metal-to-metal contact between the supported member and the fixed restraint housing. The restraining system shall be designed to withstand the seismic design forces in any lateral or vertical direction without yield or failure. Where the capacity of the anchorage hardware in concrete in inadequate for the required seismic loadings, an adapter baseplate to allow the addition of more or larger anchors will be fitted to fulfill these requirements. In addition to the primary isolation coil spring, the load path will include a minimum 1/4" thick neoprene pad.
3. Spring elements shall be color coded or otherwise easily identified. Springs shall have a lateral stiffness greater than 1.2 times the rated vertical stiffness and shall be designed to provide a minimum of 50% overload capacity. Non-welded spring elements shall be epoxy power coated and shall have a minimum of a 1,000 hour rating when tested in accordance with ASTM B-117.
4. To facilitate servicing, the isolator will be designed in such a way that the coil spring element can be removed without the requirement to lift or otherwise disturb the supported equipment.
5. Spring isolators shall be Model FHS or FMS Isolator/restraint as manufactured by Kinetics Noise Control, or by other manufacturer's who can meet the requirements as specified herein.

D. Type C: Coil Spring Isolator Incorporated within a Steel Housing:

1. Spring isolators shall be seismic control restrained spring isolators, incorporating one or more coil spring elements, having all of the characteristics of free standing coil spring isolators per the vibration isolation section of this specification, for equipment which is subject to load variations and/or large external forces. Isolators shall consist of one or more laterally stable

steel coil springs assembled into fabricated welded steel housings designed to limit movement of the supported equipment in all directions.

2. Housing assembly shall be made of fabricated steel members and shall consist of a top load plate complete with adjusting and leveling bolts, adjustable vertical restraints, isolation washers, and a bottom load plate with internal non-skid isolation pads and holes for anchoring the housing to the supporting structure. Housing shall be hot dipped galvanized for outdoor corrosion resistance. Housing shall be designed to provide a constant free and operating height within 1/8".
3. The isolator housing shall be designed to withstand the project design seismic forces in all directions.
4. Coil spring elements shall be selected to provide static deflections as shown on the vibration isolation schedule or as indicated or required in the project documents. Spring elements shall be color coded or otherwise easily identified. Springs shall have a lateral stiffness greater than 1.2 times the rated vertical stiffness and shall be designed to provide a minimum of 50% overload capacity. Non-welded spring elements shall be epoxy powder coated and shall have a minimum of 1,000 hour rating when tested in accordance with ASTM B-117.
5. Spring isolators shall be Model FLSS as manufactured by Kinetics Noise Control, or by other manufacturers who can meet the requirements as specified herein.

E. Type D: Coil Spring Isolator Incorporated within a Steel Housing:

1. Spring isolators shall be lateral restrained spring isolators, incorporating a single coil spring element, having all of the characteristics of free standing coil spring isolators as previously specified. Springs shall be assembled into a welded steel housing engineered to limit lateral movement of supported equipment during an earthquake without degrading the vibration isolation capabilities of the spring during normal operating conditions.
2. Vibration isolators shall incorporate a steel angle and plate motion limiting assembly and steel coil spring, designed as a system to accept a force in any lateral direction in excess of the design seismic requirement for the isolator without yield or failure. Isolator shall limit lateral movement of the equipment to less than 1/4" in any direction. The lateral limit stop shall incorporate a neoprene grommet to prevent the potential for metal-to-metal contact. The vibration isolation element shall include a 1/4" thick ribbed neoprene noise stop pad, positioned outside of the housing anchorage path. The housing shall incorporate drilled holes for attachment to the supporting structure.
3. Spring isolators shall be Model FYS as manufactured by Kinetics Noise Control, or by other manufacturers who can meet the requirements as specified herein.

F. Type E: All Direction Neoprene Isolator:

1. Vibration isolators shall be neoprene, molded from oil resistant compounds, designed to operate within the strain limits of the isolator so to provide the maximum isolation and longest life expectancy possible using neoprene compounds. Isolators shall include encapsulated cast-in-place top steel load transfer plate for bolting to equipment and a steel baseplate with anchor holes for bolting to the supporting structure. Ductile iron or cast aluminum components are not acceptable alternatives and shall not be used due to brittleness when subjected to shock loading.
2. Isolator shall be capable of withstanding the design seismic loads in all directions with no metal-to-metal contact.
3. Isolator shall have minimum operating static deflections as shown on the project vibration isolation schedule or as otherwise indicated in the project documents and shall not exceed published load capacities.
4. Neoprene isolators shall be Model RQ as manufactured by Kinetics Noise Control, or by other manufacturers who can meet the requirements as specified herein.

G. Type F: All Direction External Seismic Snubber Assembly:
   1. Equipment shall be restrained against excessive movement during a seismic event by the use of 3-axis resilient snubbers, designed to withstand the project required seismic forces.
   2. Snubbers shall be of welded steel construction and shall be attached to the equipment structure and equipment in a manner consistent with anticipated design loads. Snubbers shall limit lateral and vertical equipment movement at each snubber location to a maximum of 1/4" in any direction.
   3. Snubbers shall include a minimum of 1/4" thick resilient neoprene pads to cushion any impact and to avoid any potential for metal-to-metal contact. Maximum neoprene bearing pressure shall not exceed 1500 pounds/Sq. Inch. Snubber shall be installed only after the isolated equipment is mounted, piped, and operating so as to ensure that no contact occurs during normal equipment operation.
   4. Three-axis seismic snubbers shall be Model HS-5/7 as manufactured by Kinetics Noise Control, or by other manufacturer's who can meet the requirements as specified herein.

H. Type G: All Direction Lateral External Seismic Snubber Assembly:
   1. Equipment shall be restrained against excessive lateral movement during a seismic event by the use of 2-axis horizontal resilient snubbers, designed to withstand the project required seismic forces.
   2. Snubbers shall be of welded steel construction and shall be attached to the equipment structure and equipment in a manner consistent with anticipated design loads. Snubbers shall limit lateral equipment movement at each snubber location to a maximum of 1/4".
   3. Snubbers shall include a minimum of 1/4" thick resilient neoprene pads to cushion any impact and to avoid any potential for metal-to-metal contact. Snubber shall be installed only after the isolated equipment is mounted, piped and operating so as to ensure that no contact occurs during normal equipment operation.
   4. Two-axis lateral seismic snubbers shall be Model HS-2 as manufactured by Kinetics Noise Control, or by other manufacturer's who can meet the requirements as specified herein.

I. Type H: Two-Axis External Seismic Snubber Assembly:
   1. Equipment shall be restrained against excessive vertical and horizontal movement during a seismic event by the use of 2-axis resilient snubbers, designed to withstand the project required seismic forces. A minimum of four (4) snubbers are to be used at each equipment installation, oriented to effectively restrain the isolated equipment in all three directions.
   2. Snubbers shall be of welded steel construction and shall be attached to the equipment structure and equipment in a manner consistent with anticipated design loads. Snubbers shall limit lateral and vertical equipment movement at each snubber location to a maximum of 1/4" in any direction.
   3. Snubbers shall include resilient neoprene pads within a minimum thickness of 1/4" to cushion any impact and to avoid any potential for metal-to-metal contact. Snubber shall be installed only after the isolated equipment is mounted, piped, and operating so as to ensure that no contact occurs during normal equipment operation.
   4. Two-axis seismic snubbers shall be Model HS-4 as manufactured by Kinetics Noise Control, or by other manufacturer's who can meet the requirements as specified herein.

J. Type I: Single-Axis External Seismic Snubber Assembly:
   1. Equipment shall be restrained against excessive horizontal one-axis movement during a seismic event by the use of single-axis resilient snubbers, designed to withstand the project required seismic forces. A minimum of four (4) snubbers are to be used at each equipment installation, oriented to effectively restrain the isolated equipment in all lateral directions.
   2. Snubbers shall be of welded steel construction and shall be attached to the equipment structure and equipment in a manner consistent with anticipated design loads. Snubbers shall limit lateral equipment movement at each snubber location in the direction of impact to a

maximum of 1/4".

3. Snubbers shall include resilient neoprene pads within a minimum thickness of 1/4" to cushion any impact and to avoid any potential for metal-to-metal contact. Snubber shall be installed only after the isolated equipment is mounted, piped, and operating so as to ensure that no contact occurs during normal equipment operation.
4. Single-axis seismic snubbers shall be Model HS-1 as manufactured by Kinetics Noise Control, or by other manufacturer's who can meet the requirements as specified herein.

K. Type J: Cable Restraints for Suspended Piping and Ductwork:

1. Seismic wire rope cable restraints shall consist of steel wire strand cables, sized to resist seismic loads, arranged so to offer seismic restraint capabilities for piping, ductwork, and suspended equipment in all lateral directions.
2. End connection fittings shall be designed to swivel in order to ensure proper cable alignment and to avoid bending of rope. Protective thimbles shall be used at connection points so to eliminate bending cable across sharp edges.
3. Anchoring hardware at each end of the cable shall be designed so to exceed the working project design load of the wire cable by a minimum of 50 percent.
4. Seismic cable restraints shall be Model SCR as manufactured by Kinetics Noise Control, or by other manufacturer's who can meet the requirements as specified herein.

2.05 SEISMIC RESTRAINTS

A. Seismic restraints shall be furnished and installed as specified herein and as required. Installation of all seismic restraint materials specified herein shall be accomplished following the manufacturer's written instructions. Installation instructions shall be submitted to the Engineer for approval prior to the beginning of the work.

B. All mechanical equipment not mounted on spring isolators shall be provided with seismic restraints, as specified and detailed on the drawings, designed to restrain movement in vertical and horizontal directions during a seismic condition.

C. All ductwork, piping systems, and suspended equipment including air terminal units shall be supported to resist seismic forces in accordance with SMACNA guidelines or by means of an approved bracing system equivalent to Kinetics, Pipe Shields Incorporated, or Mason. The seismic restraint manufacturer shall provide documentation on maximum restraint spacing for various cable sizes and anchors, as well as worst case reaction levels at restraint locations.

D. All seismic snubber restraint assemblies shall meet the following minimum requirements:

1. Impact surface should have a high quality elastomeric facing so to ensure that no metal-to-metal contact can occur.
2. Resilient material should be easy to visually inspect for damage and be replaceable if necessary.
    a. Resilient material used in snubber assemblies to be a minimum of 0.25" thick.
    b. Resilient material used in snubber grommets to be a minimum of 0.12" thick.
3. Assembly must be designed to offer seismic restraint in all directions, unless otherwise noted below.
4. Clearance between resilient material and contacting isolated equipment surface must not exceed 0.25".
5. Seismic restraints capacities to be verified by an independent test laboratory or certified by a registered State of New Mexico Structural Engineer who is experienced in seismic restraint design to ensure that the design intent of this specification is realized.

E. The Contractor shall ensure that all housekeeping pads used are adequately reinforced and are properly attached to the building structural flooring, so to withstand anticipated seismic forces. In addition, the size of the housekeeping pad is to be coordinated with the seismic restraint manufacturer so to ensure that adequate edge distances exist in order to obtain desired design

anchor capabilities.

PART 3 EXECUTION

3.01 GENERAL

A. All mechanical equipment scheduled on the drawings shall be isolated from building structure by means of resilient vibration and noise isolators supplied by a single manufacturer to the Contractor. The isolator manufacturer shall submit a tabulation of the design data on the isolators including spring O.D., free operating and solid heights of springs, free and operating heights of neoprene isolators. Static deflection scheduled is the minimum acceptable and represents the static deflection required based on the combined weight of the equipment; motor bases and any other accessories specified in the mechanical equipment schedule. Isolation bases shall be furnished by the Vibration Isolator Manufacturer. Vibration isolation system shall have a maximum lateral motion under equipment start-up and shutdown conditions of 1/4-inch. Restrain excess motion by spring type mountings. Connections to equipment shall allow for deflections equal to or greater than equipment deflections.

B. Seismic restraints shall be in accordance with the State of New Mexico requirements and the Uniform Building Code, and shall be designed to resist seismic forces of magnitudes as specified herein. Installation of seismic restraints shall follow SMACNA guidelines.

C. The Contractor shall coordinate the installation of the vibration isolation and seismic restraint devices with all trades and subcontractors. Contractor shall verify with the Architect that the devices and supports are adequate as intended and do not overload the building structural components in any way. The exact method and means of connection of the mechanical system to the building structural system shall be approved by the Architect.

D. Installation of all seismic restraint materials specified in this section shall be accomplished as per the manufacturer's written instructions.

E. Upon completion of installation of all seismic restraint materials and before start up of restrained equipment, all debris shall be cleaned from beneath all protected equipment, leaving equipment free to contact snubbers.

F. No rigid connections between the equipment and the building structure shall be made which degrades the seismic restraint system herein specified. All electrical conduit to restrained equipment shall be looped to allow free motion of equipment without damage to the electrical wiring.

3.02 EQUIPMENT CONNECTIONS

A. No rigid connections between equipment and building structure shall be made that degrades the noise and vibration isolation system herein specified.

B. Electrical circuit connections to isolated equipment shall be looped to allow free motion of isolated equipment; see Division 26.

C. Coordinate work with other trades to avoid rigid contact with the building. Inform other trades following work, such as plastering or electrical, to avoid any contact which would reduce the vibration isolation.

3.03 EQUIPMENT ISOLATORS

A. The minimum operating clearance between the equipment frame or the equipment vibration base frame and the housekeeping pad or floor shall be 1".

B. The equipment vibration base shall be placed in position and supported temporarily by blocks or shims, as appropriate, prior to the installation of the machine or isolators.

C. After the entire installation is complete and under full operational load, the isolator shall be adjusted so that the load is transferred from the blocks to the isolator. When all isolators are properly adjusted, the blocks or shims shall be free and shall be removed.

D. Isolator static deflection shall be (minimum) as specified or scheduled on the Drawings.

E. Position all corner or side seismic restraints with equipment operation for proper operating

clearance and weld or bolt seismic restraint to seismic anchor plates in housekeeping pad.

F. Install equipment with flexibility in piping and wiring connections.

G. Verify all installed isolators and mounting systems permit equipment motion in all directions. Adjust or provide additional resilient restraints to limit start-up equipment lateral motion to 1/4".

H. Prior to start-up, clean out all foreign matter between bases and equipment. Verify that there are no isolation short circuits in the base, isolators or seismic restraints.

3.04 SEISMIC RESTRAINT FOR PIPING

A. Seismically restrain all piping listed below. Use Type 'J' cable restraints for all piping supported by vibration isolation hanger assemblies, including:

1. Natural gas piping, medical gas piping, vacuum piping, petroleum based liquid piping, and compressed air piping equal to or greater than 1" in inside diameter.
2. All piping located within mechanical equipment and service rooms equal to or greater than 1-1/4" in inside diameter.
3. All other piping equal to or greater than 2-1/2" in inside diameter.

B. Type 'J' cable seismic restraint sizes, quantities, locations and mounting details per SMACNA (Sheet Metal and Air Conditioning Contractors National Association, Inc.) 'Seismic Restraint Manual Guidelines for Mechanical Systems,' Latest Edition.

3.05 SEISMIC RESTRAINT FOR DUCTWORK

A. Seismically restrain all ductwork listed below. Use Type 'J' cable restraints or equivalent for all ductwork, including.

1. All rectangular and oval ducts with cross sectional area equal to or greater than 6 square feet.
2. All round ducts with diameters equal to or greater than 28".
3. Type 'J' cable seismic restraint sizes, quantities, locations and mounting details per SMACNA (Sheet Metal and Air Conditioning Contractors National Association, Inc.) 'Seismic Restraint Manual Guidelines for Mechanical Systems', Latest Edition.

3.06 SEISMIC RESTRAINT FOR FIRE PROTECTION PIPING

A. Fire protection, sprinkler piping and related equipment is considered as 'Life Safety Equipment' and shall be seismically restrained per guidelines as published by NFPA (National Fire Protection Association) as specified in Division 21.

3.07 PIPING, DUCTWORK AND CONDUIT EXCLUSIONS

A. Per the IBC (International Building Code), piping and ductwork which have diameter or cross sectional areas less than those noted in Sections 3.4, 3.5, and 3.6 do not require additional seismic restraint over and above the normal suspension hardware.

3.08 INSPECTION

A. The Contractor shall notify the local representative of the seismic restraint materials manufacturer's representative prior to installing any seismic restraint devices. The Contractor shall seek the representative's guidance in all installation procedures.

B. The local representative of the seismic restraint and snubber materials manufacturer shall conduct periodic inspections, minimum of monthly during construction period for equipment, piping and ductwork seismic restraint system installation. Inspection reports shall be in writing to the Contractor any deviations from good installation practice observed. These reports shall be forwarded to the Architect for review.

C. On completion of installation of all seismic restraint and vibration isolation devices herein specified, the vibration isolation manufacturer shall inspect the completed system and submit an inspection report to the Architect. This report shall identify any installation error, improperly selected isolation devices, or other problems that could affect the performance of the system. The manufacturer's report shall include recommendations for any actions required to properly complete

the vibration isolation and seismic restraint work. The cost of the inspection shall be included in the contractor's bid price.

D. The installing Contractor shall submit a final report to the Project Architect and/or Engineer, including the manufacturer representative's final report, certifying that all seismic restraint material has been properly installed, or steps to be taken by the Contractor to properly complete the seismic restraint work per the specifications.

END OF SECTION 23 0548

SECTION 23 0549

HVAC AND ELECTRICAL INSTALLATION COORDINATION

PART 1 GENERAL

1.01 REQUIREMENTS

A. Conform with applicable provisions of the General Conditions, Supplemental General Conditions and General Requirements.

1.02 RELATED DIVISIONS AND SECTIONS

A. Section 23 0500, Common Work Requirements for HVAC.

B. Section 23 0900, Facility Management System.

C. Division 26 for Electrical.

D. Division 28 for Electronic Safety and Security.

1.03 SCOPE

A. It is the intention of this section to summarize the coordination of effort defined in the related sections and divisions of this specification.

B. If there is a conflict between this Section and other Sections and Divisions of this specification, this Section shall be the governing and decisive Section.

C. Make all connections to motors and controls for equipment supplied and/or installed under Division 23 according to Table 1 on the following page.

PART 2 PRODUCTS

Not Applicable.

PART 3 EXECUTION

3.01 INSTALLATION

A. No work shall be performed until the reviewed and marked submittal data have been reissued to the Contractor, unless written permission is obtained from the Architect.

TABLE 1

Item or System	Note	Supplied By (3)	Installed By (3)	Powered By	Control Field Wiring By
Equipment Motors		Div. 23	Div. 23	Div. 26	N/A
Motor Control Center Including Starters, Pilot Lights, Heater, Switches, Auxiliary Contacts, and Internal Control Wiring		Div. 26	Div. 26	Div. 26	Div. 23
Stand Alone Motor Starters (outside motor control centers)	(1)	Div. 26	Div. 26	Div. 26	Div. 23
Variable Frequency Drives (VFD's)		Div. 23	Div. 23	Div. 26	Div. 23
Fused and Non-Fused Disconnects	(1)	Div. 26	Div. 26	Div. 26	N/A
Control Relays & Control Transformers	(1)	Div. 23	Div. 23	Div. 26	Div. 23
Central Plant/Refrigeration Equipment Room Emergency Shutdown & Ventilation		Div. 23	Div. 23	Div. 26	Div. 23
Cooling Tower Vibration Switches		Div. 23	Div. 23	Div. 26	N/A
Boilers		Div. 23	Div. 23	Div. 26	Div. 23
Refrigeration Gas Monitor		Div. 23	Div. 23	Div. 26	Div. 23
Kitchen Make-up System & Hood Exhaust Fans		Div. 23	Div. 23	Div. 26	Div. 26
Kitchen Exhaust Hoods & Lab Fume Hoods		Div. 23	Div. 23	Div. 26	N/A
Kitchen Hood Fire Protection System		Div. 23	Div. 23	Div. 26	N/A
Kitchen Hood Natural Gas Shut-Off Valve		Div. 11	Div. 23	Div. 26	N/A
Fan Coil Units Including		Div. 23	Div. 23	Div. 26	Div. 23
Water Chillers		Div. 23	Div. 23	Div. 26	N/A
Min. Outside Air Units Including Mixing Dampers		Div. 23	Div. 23	Div. 26	Div. 23
Rooftop A/C Units Including Mixing Dampers		Div. 23	Div. 23	Div. 26	Div. 23
HVAC Unit Smoke Detectors		Div. 28	Div. 23	Div. 28	Div. 28
Fire/Smoke Control Dampers & Smoke Dampers		Div. 23	Div. 23	Div. 26	Div. 28
Fan Coil Unit Condensate Float Switches		Div. 23	Div. 23	N/A	Div. 23
Supply, Return & Exhaust Fan with unit mounted 115 VAC 2-position damper actuators interlock with fan motor/starter		Div. 23	Div. 23	Div. 26	N/A
Non-FMS Control Devices Including Wall Switches, Timers, Thermostats		Div. 23	Div. 23	Div. 26	Div. 26
Chemical Treatment Systems		Div. 23	Div. 23	Div. 26	N/A
Cooling Tower Sand Filter Units		Div. 23	Div. 23	Div. 26	N/A
Facility Management System (FMS)	(2)	Div. 23	Div. 23	Div. 23	Div. 23
Facility Management System - Light Controls		Div. 26	Div. 26	Div. 26	Div. 26
Fire Alarm System & Interface w/HVAC System		Div. 28	Div. 28	Div. 28	N/A

TABLE NOTES:

1. Unless specified to be supplied with the equipment

2. Division 26 shall provide 120 VAC power to each mechanical space and the central plant as indicated on the drawings. Any additional power, transformers, and distribution shall be provided by the Section or Division indicated.
3. Division 23 indicates the HVAC contractor or their designated representative including equipment suppliers, sub-contractors, etc.

END OF SECTION 23 0549

SECTION 23 0593

TESTING, ADJUSTING AND BALANCING OF MECHANICAL SYSTEMS

PART 1 GENERAL

1.01 GENERAL

A. Conform with applicable provisions of the General Provisions and the General Requirements.

B. Testing, adjusting and balancing (TAB) shall be performed by a TAB Agency which is independent of the Mechanical Contractor.

C. The TAB Agency's efforts shall be paid for by the Contractor and included in the mechanical contract price.

D. Unless specifically noted, all work specified in this section shall be included in the scope of the TAB Agency's work. But some work described in this section is to be performed by the mechanical contractor, controls contractor, or others, and that work is specifically noted to be by these entities.

1.02 SCOPE

A. Provide TAB for the systems and equipment installed under Division 23, including but not limited to:

1. Supply and exhaust air systems including process and kitchen systems.
2. Return air where specifically noted.
3. Hydronic systems including domestic HW return systems.

B. Provide all labor, instruments, and tools necessary to test, adjust and balance the systems shown on the drawings and/or described in these specifications. Check equipment performance, take measurements, adjust systems and equipment to provide specified performance, and report results. Submit reports to keep all parties posted on the progress of the TAB work.

C. Where the TAB effort indicates deficiencies in system performance, TAB Contractor shall take the lead in a collaborative effort to trouble-shoot and resolve these deficiencies. Engage the assistance of others where necessary, starting with the Mechanical Contractor and Controls Subcontractor. Take additional measurements as required to identify the cause of the deficiencies, perform additional TAB as required to bring the system in compliance with the design intent. Engage the assistance of the Engineer and others where necessary. Indicate final setpoints and readings in a final TAB report.

D. Include three days of effort on site for tests and/or balancing as directed in writing by the Owner's Representative beyond that described herein, but prior to substantial completion.

E. Include two days on site for TAB efforts as directed in writing by the Owner's Representative after substantial completion.

1.03 STANDARDS AND DEFINITIONS

A. Perform all work in accordance with these specifications and the latest edition of the NEBB Standards.

B. Air Handling Unit: Where the term Air Handling Unit (AHU) is used in this spec section, it shall include any factory fabricated or field erected unit that includes a fan and other components which filter, heat, cool, humidify or dehumidify the air stream. But the term AHU, where used in this section, does not include fan powered terminal units, fan coil units, unit heaters, cabinet unit heaters, etc.

C. Air Handling System: A fan or AHU and ductwork.

D. Hydronic System: A system in which a liquid is used to convey heat.

E. Record or Report: Where used as a verb, these terms mean to include in the TAB report.

1.04 QUALIFICATIONS

A. TAB agencies shall meet the following qualifications:

1. Membership in the Associated Air Balance Council (AABC), National Environmental Balance Bureau (NEBB) or the Testing, Adjusting and Balancing Bureau (TABB).
2. An office located within a 100 mile radius of the project site.
3. A minimum of five (5) years experience in the TAB field.

B. The following TAB Agencies are prior approved:

NEW MEXICO

1. Energy Balance & Integration
2. Kirk Air Co.
3. Native Air
4. N-Demand Test and Balance LLC
5. Air Moving Equipment Company

1.05 SUBMITTALS

A. Mechanical Contractor shall submit the name of the proposed TAB agency prior to the TAB agency performing any services.

1. Submit a list of proposed personnel, including resumes with related project experience and certifications.
2. Submit proposed TAB procedures, instrumentation and measurement equipment including calibration data, and proposed sample TAB report forms.

B. Pre-Construction Report: Prior to the Mechanical Contractor installing the systems, the TAB Agency shall submit a letter indicating whether the design includes all devices the TAB Agency will need to successfully perform the TAB work. If any additional balancing devices are needed, the TABB Agency shall so note this in the pre-construction report.

C. Submit TAB reports as noted herein. Reports shall be in both hard copy and PDF format.

1.06 TAB PREPARATION AND COORDINATION

A. Mechanical Contractor shall perform the following in a timely fashion:

1. Provide the TAB Agency with the project documentation (drawings, specifications, bulletins, submittals, shop drawings, etc.) necessary to perform the TAB services.
2. Install, fill, pressure test, start up, clean, and the vent systems to be tested and balanced.

B. Controls Subcontractor shall perform the following in a timely fashion:

1. Install and make operational all necessary control systems and equipment, including computers and computer programs.
2. Provide qualified personnel to operate the systems as necessary to support the TAB effort. Provide the TAB contractor with the computer software necessary to facilitate the TAB effort.
3. Assist as required to resolve problems which become evident due to TAB work, and as required to obtain specified system performance.

PART 2 PRODUCTS

2.01 EQUIPMENT

A. Provide all equipment and instruments necessary to perform the work specified herein. Calibrate and maintain instruments per NEBB Standards. Provide not less than the following:

1. Pitot tubes and draft gauges.
2. Flow hood.

3. Velometer.
4. Thermometers.
5. Pressure gauges.
6. Flow meter test kit.
7. Ampere – voltmeter.
8. Speed indicator.
9. Sound meter to measure eight octave bands.

PART 3 EXECUTION

3.01 GENERAL

A. Review and inspect the mechanical systems for conformance with design documents. Test, adjust and balance all system flows under design conditions and under other conditions where part load testing is specified. Comply with measurement tolerances per NEBB. Balance to within 10% of design flows unless otherwise specified.

B. Visually mark the final settings of balancing dampers, balancing valves, fan speed controls, etc.

C. Comply with NEBB Standards. The descriptions included herein are a guide to the minimum information needed.

D. Troubleshooting: In the event that any areas fail to get proper flow, take the lead in troubleshooting the system. Measure pressures, flows, etc. at various points throughout the systems as required to identify the cause of the deficiencies and identify upgrades which will resolve these deficiencies. Coordinate any remedial efforts directly with mechanical and controls contractors and re-test as required.

3.02 TEST AND BALANCE REPORT

A. Report shall be 8-1/2" x 11" bound into a complete and coherent report, except that drawings may be larger size, but still bound into the report. All forms shall be typewritten or legibly handwritten.

B. Include the following sections in the order indicated:

1. Cover sheet with the Project Name, Location, and the names of the Mechanical Contractor and Engineer
2. Table of Contents
3. Summary indicating the highlights of the report and summarizing any deficiencies and recommendations
4. Test results including the names of the persons performing the tests and dates the tests were performed
5. Drawings
6. Description of the test procedures used
7. List of instruments used along with their calibration data
8. Qualifications of personnel

C. Submit five copies and a PDF of the complete TAB report minimum two weeks before the first O&M instruction session. One copy will be returned to the Contractor with review comments.

3.03 BASIC AIR HANDLING SYSTEM TESTING, ADJUSTING AND BALANCING

A. General

1. Test all fans and air handling systems. Balance systems to achieve specified air flows while minimizing throttling losses.
2. Air Flow Measurements: Fan and AHU flow rates may be determined by pitot tube traverse or by measuring fan speed, suction and discharge pressures, and comparison

with the fan curve. Measure duct air flows using pitot tube traverses. Measure air flows of grilles, registers and diffusers using either capture hoods or pitot tube traverses in the connected ductwork. Make such other tests as may be required to demonstrate that systems perform per the design requirements.

3. Air Flow Measuring Stations: Calibrate each air flow measuring station which is provided as part of the construction contract. Use duct pitot tube traverses or other appropriate means to measure air flows. Coordinate with the flow measuring station supplier, and enter calibration coefficients into the FMS. Record the results of this effort.
4. Alert Mechanical Contractor and Engineer if any fan or air handling unit (AHU) appears to be operating in an improper or unsafe condition.
5. Seal all test holes in ductwork once testing is complete. Repair insulation jackets to maintain the integrity of the vapor barrier.
6. Include in the report copies of ductwork drawings with test points indicated.
7. Variable Flow Systems: Verify proper fan tracking from full flow to 50% flow.

B. Fans: Perform the following for all fans, including those provided as part of an AHU.

1. Fan Nameplate: Record unit number per the equipment schedule, manufacturer, model, size, and serial number.
2. Performance Data: Measure air flow and adjust fan speed to achieve required flow. Record air flow, static pressure rise and fan speed.
    a. Advise when belt and/or sheave changes are required to achieve the design flows. Mechanical contractor shall make the necessary changes as part of the mechanical contract. Approximately 25% of fans may require a sheave and/or belt change.
3. Current and Voltage: Record motor nameplate and measured voltage and amperage. Advise if motor amps exceed rated load amps.

C. Air Handling Units:

1. Outside Air: Test outside air flows using a pitot tube traverse and balance as required. If a traverse is not practical, use the mixed air temperature method if the inside and outside temperature difference is at least 20 deg F, or use the difference between pitot tube traverses of the supply and return air ducts.
2. Static Pressure: Measure and record the static pressure at the inlet and outlet of each AHU component, including louvers, dampers, filters, coils, etc, and at each inlet and discharge duct connection.

D. Coils: Measure and record air and water flows and pressure drops.

E. Air Distribution Systems:

1. Zone, Branch and Main Ducts:
    a. Adjust to within 10% of design air flows. Balance so that at least one zone balancing damper is wide open. Balance multi-diffuser branch ducts so that at least one outlet or inlet damper is wide open.
2. Air Terminal Units:
    a. Calibrate flow sensors and enter design maximum and minimum flow setpoints into FMS.
    b. Record terminal unit number, size, specified flow, agency measured flow, FMS measured flow, and DDC flow correction factors.
3. Diffusers, Registers and Grilles:
    a. Test, adjust, and balance each diffuser, grille, and register to within 10% of specified design requirements. Record the size of each grille, diffuser, and register, initial flow measurement, and final measured flow.

b. Where rooms are indicated to be maintained at either positive or negative pressure, balance air flows to achieve these conditions under design flow conditions, and verify proper pressurization at minimum flow.

F. Fan Coil Units, Unit Heaters, Cabinet Unit Heaters, Air Curtains, Door Fans, Fan Powered Terminal Units and other devices with fans and coils:

1. For each unit, record unit number, manufacturer, model, size, motor HP, voltage and rated load amps and design air flow.
2. Measure and record initial air flows, along with final air flows, unit inlet and outlet static pressures, voltages, and motor amps.
3. Measure and record initial and final water flows and pressure drops.

G. Energy Recovery Units:

1. For each unit, record unit number, manufacturer, model, size, motor HP, voltage and rated load amps and design air flow.
2. Measure and record initial air flows, along with final air flows, unit inlet and outlet static pressures, voltages, and motor amps.

H. Duct Leakage Testing

1. Specification Section 23 3000 describes the requirements for duct leakage testing. Provide all instrumentation and labor to take the required measurements.
2. The Mechanical Contractor shall provide the fans and all other required work.
3. **Submit test report. Retest until ductwork complies with specified leakage criteria.**

3.04 HYDRONIC SYSTEMS

A. General:

1. Prior to commencing hydronic balance:
   a. Set valves to proper position per the sequence of operation. Open all coil valves to full open position. Set 3-way valves to full flow through system component.
   b. Check pump rotation.
   c. Verify that system is adequately pressurized.
   d. Set temperature controls so all system components deliver maximum flow.
   e. Balancing may be done in sections.
2. Pumping Systems: Measure flows and determine operating characteristics of hydronic systems with pumps operating both independently and in parallel (where applicable). Make measurements at maximum flow.
3. Balance systems to minimize throttling out in the distribution, and to instead throttle at the pump discharge. Recommend impeller trimming if appropriate.
4. Measure and report performance readings on all pumps, coils, heat exchangers, heating and cooling water generating equipment, flow measurement devices, heat rejection equipment, etc. Measure and record the following for each item of hydronic equipment:

Eqpt Type		Pumps (Note 1)	Chillers	Air Cooled Condensers	Cooling Towers	Hot Water Boilers	Steam Boilers	Heat Exchangers	Coils			
Tag No.		X	X	X	X	X	X	X	X			
Nameplate Data	Mfgr	X	X	X	X	X	X	X	X			
	Model	X	X	X	X	X	X	X	X			
	Serial	X	X	X	X	X	X	X	X			
	Volts	X	X	X	X	X	X					
	RPM	X	X	X	X	X	X					
	HP	X			X							
	FLA	X	X	X	X	X	X					
	Refrigerant		X	X								
Scheduled	GPM1	X	X		X	X		X	X			
	Press Drop	X	X		X	X		X	X			
	GPM2		X					X				
	Press Drop		X					X				
Measured	GPM1	X	X		X	X		X	X			
	Inlet Press	X	X		X	X		X	X			
	Outlet Press	X	X		X	X		X	X			
	Press Drop	X	X		X	X		X	X			
	GPM2	X	X					X				
	Inlet Press	X	X					X				
	Outlet Press	X	X					X				
	Press Drop	X	X					X				
	Volts	X	X	X	X	X	X					
	Amps	X	X	X	X	X	X					

Notes

1 For pumps measure pressure rise instead of pressure drop. Measurements for GPM2 shall be at shutoff conditions.

5. Domestic HW return system: Balance to ensure HW availability throughout the system. Where balancing valves are provided, record flow and balance to provide flow in each circuit.

3.05 LIMIT DEVICES AND SAFETY CONTROLS

A. Limit Devices: Check all limit devices to verify proper operation, including, freezestats, flow switches, etc. Include in the TAB report a list of all such devices and the results of their tests.

B. Fire and Smoke Dampers

1. Test each fire damper, smoke damper, and fire/smoke damper to ensure proper operation. Record test results.

2. Fire Dampers: Open access door, disconnect fusible link or activate thermal link, and

verify that damper closes smoothly and completely. Reset damper and access door.

3. Smoke Dampers: Open access door, activate damper, observe whether it closes smoothly and completely, and measure closing time. Reset damper and verify it opens completely. Close access door and record test results.

C. Life Safety Controls: Test and record life safety control operation of the HVAC systems. Verify the installation of required smoke detectors in air handling equipment, and verify operation of the smoke detector by activating the smoke detector and observing air handler shutdown or other required functions as described on the control drawings and sequence of operation. With assistance from the contractors for mechanical, temperature controls and electrical work, verify the operation of interconnected systems, such as the smoke detector's activation of the fire alarm system and the alarm system's activation of the life safety control sequence.

3.06 SOUND TESTING

A. Measure sound level in approximately ten percent of rooms as directed by Engineer.

1. Shut off mechanical equipment and measure background sound level in each octave band.
2. Start mechanical equipment and measure sound level in each octave band.
3. Submit a plot of measured data against noise criteria (NC) curves.

B. Where measured sound levels are deemed by Owner to be unacceptable, work with Engineer and Mechanical Contractor to reduce actual levels, and retest as required.

3.07 AIR HANDLING SYSTEMS – SPECIAL APPLICATIONS

A. Rooms Requiring Air Flow Tracking and/or Active Room Pressure Control:

1. Calibrate flow sensors for all supply and exhaust air devices serving the room, and enter design maximum and minimum flow setpoints into FMS.
2. Calibrate room pressure sensor.
3. Verify proper air flow tracking and room pressure control as the system operates from maximum to minimum, and back to maximum flow.
4. Submit a separate sheet in the report for each such room. Include an air flow diagram showing each device in the air flow and control system, and record all pertinent design and measured data on this sheet, including but not limited to:
    a. Air valves: Tag number, size, specified flow, agency measured flows and FMS measured flows at various flow conditions, and DDC flow correction factors.
    b. Offset air flows and room pressures at various flow conditions.

B. Rooms to be Balanced to a Positive or Negative Pressure (Without the Use of Air Flow Tracking or Active Pressure Controls):

1. Balance supply and return air flows as required
2. Crack open the door and use a smoke puffer to demonstrate the direction of air flow. Test under maximum and minimum flows. Record test results.

C. Room Tightness Testing:

1. Where a room tightness test is specified, provide the instrumentation and labor to perform such test.
2. The Mechanical Contractor shall provide the fans and associated ductwork for the test.
3. Submit test report. Retest until room complies with room leakage criteria.

D. Fume Hoods and Biological Safety Cabinets: Test exhaust airflow by duct pitot tube traverse, and adjust exhaust air valve to control to within 5% of design flow. Balance makeup air flows as specified above. Test for turbulence and proper air flow patterns at the face and inside hoods using a smoke puffer or other approved smoke-emitting device. Document the test results, and advise of any concerns and recommendations.

E. Building/Zone Pressurization: Test and adjust building/zone pressurization by setting the design flows to meet the required flow direction and pressure differential. For positive pressure areas, set the supply air to design flow, and gradually reduce the exhaust air rate to obtain the required flow or pressure difference. For negative pressure areas, set the supply air to design flow, and gradually increase the exhaust air rate to obtain the required flow or pressure difference.

END OF SECTION 23 0593

SECTION 23 0700
MECHANICAL SYSTEMS INSULATION

PART 1 GENERAL

1.01 REQUIREMENTS

A. Conform with applicable provisions of the General Conditions, Supplemental General Conditions and General Requirements.

1.02 RELATED SECTIONS

A. Section 23 0500, Common Work Requirements for HVAC.

B. Section 23 0504, Pipe and Pipe Fittings.

C. Section 23 3000, Air Tempering System and Equipment.

1.03 SCOPE

A. Field insulation of piping: see drawings and Part 3 of this specification.

B. Field insulation of ductwork: See drawings, Table 23 0700-1, and Part 3 of this specification.

C. Field insulation of equipment supplied and/or installed under Division 23: See drawings and Part 3 of this specification.

D. Factory-insulated equipment and materials are described on the equipment schedule, on the drawings, and in other sections of this specification.

1.04 SUBMITTALS

A. Submit products to be used including insulation, jackets, miscellaneous products, and products for special applications. Review each application and advise if any product is either not suitable for, or not recommended for the application.

B. Verify that each submitted product meets all requirements for that product as specified herein. Include literature that clearly shows products meet all aspects of the spec. Include a cover sheet or letter with the following statement:

> "Each product submitted here meets all specified requirements for that product except as follows:" followed by a list of any discrepancies.

C. Submit schedules showing the type of product and thickness for each application. Indicate products to be used on valves and fittings. Indicate where vapor barriers will be provided and what jackets will be used.

D. D-5, D-6 & D-7 insulation: If one of these insulations is specified, submit documentation indicating that the submitted materials are approved for the intended service.

E. Submit a description of the application techniques to be used.

1.05 QUALITY ASSURANCE

A. Comply with the latest edition of the National Commercial & Industrial Insulation Standards, as published by the Midwest Insulation Contractors Association.

B. Part 3 and Table 23 0700-1 give the system temperatures for various applications. Supplier shall review these temperatures and confirm the suitability of all components for the specified applications.

C. Test piping and ductwork in accordance with applicable specification sections before insulation is applied.

PART 2 PRODUCTS

2.01 GENERAL

A. All materials must be 100% asbestos-free and 100% formaldehyde-free, NO EXCEPTION.

B. All materials must be GreenGuard Gold Certified.

C. Smoke and Fire Ratings: All materials shall have a composite fire and smoke hazard rating not exceeding flame spread 25, fuel contribution 50, smoke developed 50, when tested as assemblies per ASTM Standard E-84 or NFPA 255.

D. Thermal conductivities: Per ASTM C518. Do not exceed the conductivities indicated. Units listed herein for conductivity are Btuh-in/SF-F. Resistance shall not be less than the values specified herein. Units for resistance are SF-F/Btuh.

E. Noise Reduction Coefficients: Per ASTM C423 based on Type A mounting. NRC shall not be less than as specified.

F. Jackets: Maximum 0.02 perm water vapor transmission per ASTM E96 Procedure A.

1. ASJ: All service jacket per ASTM C1136 Type I, paintable white kraft paper outer surface reinforced with glass fiber yarn and bonded to aluminum foil, with self-sealing longitudinal lap and butt strips, breach puncture min. 50 oz-in/in tear per ASTM D781, tensile strength min. 30 lb/in per ASTM D828.
2. FSK: Foil skim kraft per ASTM C1136 Type II.

G. Fiberglass insulation: Inorganic fibers bonded with thermosetting resin.

H. Approved Manufacturers: Owens Corning, Johns Manville, Knauf, Certain-Teed, Kflex, Armacell, Unifrax -Insulfrax, Industrial Insulation Group, Pittsburgh Corning. Where the term OAE is used herein, this refers to these manufacturers only. No other manufacturers are approved for this project.

2.02 PIPE INSULATION

A. General

1. Valves, Fittings, and Accessories: Use the same insulation materials and thickness as the pipe insulation, except as noted.

B. Type P-1, Fiberglass Pipe Insulation: Factory assembled insulation and ASJ. Pre-formed fiberglass per ASTM C547 Type I, suitable for use on surfaces from 0–850^{o}F, with thermal conductivity 0.23 at 75^{o}F or 0.33 at 250^{o}F, and minimum 3 pcf density. ASJ shall have self-sealing lap at end and along length, with pressure sensitive tape lap sealing system. Owens Corning SSL II Pipe Insulation, Johns Manville Micro-Lok, Knauf Pipe Insulation.

1. Where Type P-1 insulation is used, insulate fittings, valves and accessories using one of the following:
    a. Fiberglass pre-formed fitting insulation complying with the specification for P-1 pipe insulation, Johns Manville Hi-Lo Temp insulation inserts, Hamfab, OAE. Finish with Type J-2 fitting covers.
    b. Where pre-formed fitting insulation is not available, the following may be used: minimum 0.75 pcf density fiberglass per spec for D-1 insulation except without FSK. Finish with Type J-2 fitting covers or with two coats of fitting mastic with fiberglass fitting tape embedded between coats.

C. Type P-2, Fiberglass Pipe and Tank Insulation: Similar to Type P-1 insulation and jacket, except with fibers oriented to allow insulation to be wrapped onto curved surfaces, with conductivity 0.30 at 100^{o}F, or 0.55 at 400^{o}F. Johns Manville Pipe & Tank Insulation, Owens Corning Pipe and Tank Insulation or Knauf Pipe and Tank Insulation.

1. Alternate: Fiberglass board insulation similar to Type D2, scored for application on curved surfaces, with ASJ.

D. Type P-3, Calcium Silicate Pipe Insulation: Rigid calcium silicate per ASTM C533, Type 1, asbestos-free, suitable for use on piping up to 1200^{o}F, conductivity 0.55 at 700^{o}F, compressive strength min. 200 psi at 5% compression. Industrial Insulation Group OAE.

1. Fittings, valves and accessories: Insulate with mitered Type P-3 insulation or Type D-7 insulation.

E. Type P-4, Elastomeric Foam Pipe Insulation: Pre-formed elastomeric foam, ASTM C534 Type 1 flexible, closed cell, suitable for use up to 220^{o}F, UV protected, not to exceed flame spread 25 and smoke developed 50 based on 0.75-inch thickness, conductivity 0.30 at 75^{o}F. Kflex, Armacell OAE.

1. Fittings, valves and accessories: Insulate using either Type P-4 insulation pre-formed for use on fittings and valves, or cut sections of P-4 pipe insulation to match the shape of the fitting or valve, taped on using PVC tape.

2.03 DUCTWORK INSULATION

A. Type D-1, Fiberglass Blanket: Factory fabricated insulation and FSK jacket assembly suitable for applications from 40-250ºF, 3/4 pcf fiberglass, ASTM C553 Type I or II, with thermal resistance not less than the following for 2-inch thickness: 6.8 out of the box, 5.6 installed with 25% compression. Johns Manville Microlite XG Duct Wrap, Owens Corning Soft R Duct Wrap, Knauf Friendly Feel Duct Wrap, Certainteed Soft Touch Duct Wrap.

B. Type D-2, Fiberglass Board: Similar to Type D-1 except rigid board type, 3 pcf density, thermal conductivity 0.23 at 75ºF, NRC 1.36, suitable for unfaced side at up to 450ºF and faced side at up to 150ºF. Johns Manville 800 Series Spin Glas, Owens Corning 700 Series Board, Knauf Insulation Board, Certainteed Certra Pro Commercial Board

C. Type D-3, Acoustic Lining (roll type): Organic fiber or fiberglass duct liner bonded with thermosetting resin, with factory-applied acrylic surface coating treated with anti-microbial agent, and factory-applied or shop-applied edge coating.

1. Properties: Minimum 1.5 pcf density, thermal conductivity 0.24, 6000 FPM rated per UL 181, NRC 0.70 at 1-inch thick and .95 at 2-inch thick. The product (fiberglass, resin, coating, microbial agent and adhesive) as an assembly shall be suitable for surfaces and gases up to 250ºF, and shall comply with ASTM C1071 (Type I), G21 and G22.

2. Lining surface shall be cleanable using commercially available duct cleaning equipment when performed by qualified technicians using procedures established and recommended by the North American Insulation Manufacturer's Association (NAIMA) Duct Cleaning Guide.

3. Johns Manville Linacoustic RC, Owens Corning Acoustic R duct liner, Knauf EM duct liner, Certainteed ToughGuard R Duct Liner.

D. Type D-4, Acoustic Lining (board type): Similar to Type D-3 and complying with all aspects of the spec for Type D-3 insulation, except 3 pcf density rigid board with NRC 0.75 at 1-inch thick and 1.0 at 2-inch thick. Johns Manville Permacote Linacoustic R-300. Owens Corning Duct Liner Board, Knauf Rigid Plenum Liner, Certainteed Rigid Liner Board.

E. Type D-5, Grease Duct Applications: High temperature, foil-encapsulated inorganic blanket, 8 pcf. Insulfrax Fyre Wrap Max 2.0, Johns Manville Fire Temp, OAE. Product shall meet the following when applied as 2-layers around a grease-duct:

1. Tested and listed for zero clearance to combustibles across the entire surface of the blanket material per internal fire test AC101 or ASTM E2336 - Internal Fire Test – 2 Hr Grease Duct Enclosures.

2. Rated as a 2-hr fire resistive enclosure assembly per ASTM E-119, Engulfment Fire Test for 2-hr Grease Duct Enclosure.

F. Type D-6 –Combustible Materials within Plenum: For use on combustible materials located within supply or return air plenums, foil-encapsulated 8 pcf high-temperature ceramic fiber blanket suitable for service up to 1800ºF. Unifrax Fyre-Wrap 0.5 plenum insulation.

G. Type D-7 – Fire Rated Ductwork: Suitable for continuous operation at 1800ºF, 6-pcf, foil-encapsulated inorganic blanket to provide a 2-hour rating per ISO 6944 when applied in a single 1.5-inch thick layer. Insulfrax FyreWrap 1.5 OAE.

H. Type D-8 – Polystyrene Insulation: Rigid cellular square edge insulation per ASTM C578, waterproof, thermal conductivity 0.20, compressive strength 25 psi. Dow Styrofoam or Owens Corning Foamular.

I. Type D-9 – Fiberglass Ductboard: Listed per UL 181 as a Class 1 Rigid Air Duct; conforming to ASHRAE Std. 62, NFPA-90A and 90B, ASTM G-21 & G-22; rated for 2-in. wg; constructed of fiberglass bonded with a thermosetting resin, with double density slip joints pre-molded in the board; FSK jacket; thermosetting acrylic polymer interior surface, and black interior surface color. Thermal conductivity 0.23, and NRC 0.70 at 1-inch thick and 1.0 at 2-inch thick. Johns Manville Superduct 475 or 800, Owens Corning Quiet R Duct Board, Knauf Duct Board M, Certainteed ToughGard Duct Board

2.04 EQUIPMENT INSULATION

A. E-1, Removable Insulating Blanket: Factory fabricated, one-piece, removable and re-usable insulating blanket with fiberglass insulation completely enclosed within a silicone coated fiberglass cloth with

draw cords of SS or PTFE coated glass fiber, and stainless steel clips. Insulation thickness shall be as specified elsewhere, but not less than 1-inch. Energy Systems Inc. “Q-Master” OAE.

2.05 INSULATION JACKETS

A. Type J-1, Metal Jacket: 0.010-inch smooth Type 304 stainless steel or 0.016-inch smooth or embossed aluminum per ASTM B-209, with minimum 1-mil polyethylene film with protective layer of 40 Lb virgin kraft paper, continuously laminated to full width inside jacket. Childers OAE.

1. Where jacket diameter is 16–96 in: 0.016-in. SS or 0.020 in. aluminum.
2. Equipment heads and all surfaces where jacket is greater than 96-inch OD: 0.020-inch SS or 0.024 inch aluminum.
3. Fittings and Accessories: Provide the same jacket material as for pipe.

B. Type J-2, PVC Jacket: Minimum 20 mil sheets and 30-mil pre-molded fitting covers, ASTM D1784, Class 16354-C. Accessories include solvent weld solution, stainless steel tacks, and tape. All components shall be white, UV resistant, with paintable exterior surface, and suitable for use at –20 to +150^{o}F. Johns Manville System 2000 (sheets), Zeston 300 (fitting covers), and Perma-Weld (solvent cement), OAE.

C. Type J-3, Canvas Jacket: 10 x 10 fiberglass mesh.

2.06 MISCELLANEOUS PRODUCTS

A. General:

1. Tapes: Aluminum, pressure sensitive, UL 181A-P listed and embossed, minimum 2.5-inch wide, Nashua 324A OAE.
2. Duct Liner Adhesives: Water-based, complying with ASTM C916.
3. Solvent Cement for PVC Jackets: Johns Manville Perma-Weld OAE.
4. Staples: Outward clinching, 0.5-inch galvanized steel

B. Piping Systems:

1. Pipe Hanger Insulation Inserts: Mechanical Pipe Shields Inc. “Snapp ltz” OAE.

C. Ductwork Systems:

1. Duct Liner Edge Sealer, Surface Sealer, Coatings & Adhesives: To meet ASTM C916. Johns Manville Superseal OAE.

2.07 SPECIAL APPLICATIONS

A. Handicap Lavatory Insulation Kit: Handi-Lav-Guard insulation kit per ANSI A117.1 with flexible vinyl finish.

PART 3 EXECUTION

3.01 GENERAL

A. Delivery, Storage and Handling: Deliver and store insulation materials in factory-supplied containers. Protect from moisture. Do not install any materials that have gotten wet, regardless whether they are subsequently dried.

B. Store and apply materials in accordance with manufacturers’ recommendations, but not less than the following minimum temperatures. Ensure surfaces are clean and dry prior to application, and for minimum two hours after application:

1. Sealers, coatings, solvents and adhesives: 40^{o}F.
2. Tapes 50^{o}F.

C. Install in accordance with manufacturer’s recommendations, NAIMA recommendations, and this spec. Provide good ventilation.

D. Where vapor barriers are specified, ensure that the entire system is vapor sealed.

E. Protect materials from water damage. Replace any materials that are water-damaged prior to substantial completion.

3.02 PIPING INSULATION

A. General: Insulate piping as indicated herein and/or on the drawings. Except as noted, insulate all valves, fittings, and accessories with the same material and thickness specified for the pipe. Where piping is specified with a separate insulation jacket provide this same jacket for valves, fittings and accessories. Vapor seal cold piping systems.

1. Where insulation terminates, provide insulating cement beveled for a neat finish. For vaporsealed piping, coat with insulating mastic prior to applying insulating cement.
2. Strainers and Suction Diffusers: Either Type P-1 or P-3 insulation. Make provisions to easily remove and re-install insulation.
3. Pipe Supports: Provide high density calcium silicate insulation or insulation inserts as specified. Maintain pipe jacket and vapor barrier at supports. If necessary, apply a heavy coating of vapor barrier mastic material to prevent condensation from forming on supports. Provide galvanized steel insulation shields to protect insulation and jackets at supports.
4. Penetrations Through Building Construction: Insulation shall be continuous where piping passes through walls, floors, and other construction. Where insulated piping passes through fire and/or smoke rated construction, provide a section of UL approved fire safing insulation to match the required insulation thickness, or provide an insulated pipe sleeve as manufactured by Pipe Shield, Inc., OAE.
5. Mechanical Couplings: Where mechanical couplings are permitted, insulate them as specified for fittings.
6. Steam Traps: Do not insulate.
7. Retrofit Projects: Match the thickness of existing insulation where new insulation adjoins existing. Integrate new vapor barrier with existing so the insulation barrier is continuous for both new and existing piping.
8. All voids formed by support saddles or other mounting or support hardware shall be filled with insulation**.**

B. Application:

Temp Range	Temp (F)	Insulation Type	Vapor Sealed	Pipe Size				
				Under 1	1 - 1.5	Over 2 - 3	4 & 6	8 & Larger
TR-1	60&Less	P-1 or P-4	Yes	1.5	1.5	1.5	1.5	1.5
TR-2	61 – 104	P-1	Yes	0.5	0.5	0.5	0.5	0.5
TR-3	105 - 140	P-1	No	1.0	1.0	1.0	1.0	1.0
TR-4	141 - 200	P-1	No	1.5	1.5	2.0	2.0	2.0
TR-5	201 - 250	P-1	No	1.5	1.5	3.0	3.0	3.0
TR-6	251 - 350	P-1	No	1.5	2.5	3.0	3.0	3.0
TR-7	Over 350	P-1	No	2.5	3.0	3.0	4.0	4.0

1. Temperature Range TR-1: Chilled water, refrigerant suction, condenser water (outdoor piping subject to freezing).
2. Temperature Range TR-2: Domestic cold water, makeup water, soft water, industrial water, process water of any type, non-potable water, HVAC make-up water (except insulation is not required for evap cooler makeup piping outdoors), interior horizontal roof drain and overflow bowls and piping, condensate drains indoors.
3. Temperature Range TR-3: Domestic hot water (including non-circulating HW within interior walls and chases) and domestic HW return except as noted.
4. Temperature Range TR-4: Heating water supply and return, low pressure steam condensate, pumped condensate return, engine cooling water.

C. Special Applications

1. Handicap Lavatories: Insulate domestic hot and cold water piping and P-traps exposed below handicapped lavatories with insulation kit specifically designed for the application.

D. Type P-1 & P-2, Fiberglass Insulation: Install in accordance with manufacturer's recommendations.

E. Type P-3, Calcium Silicate Insulation: Adhere to pipe or equipment using stainless steel wire. Provide removable J-1 jacket.

F. Type P-4, Elastomeric Foam: Seal all butt ends and longitudinal joints with Halstead Adhesive. When exposed to the weather, protect flexible tubing insulation with two coats of exterior weatherproof coating as recommended by manufacturer.

G. Jacketing: In addition to the finish and jacket specified for the particular type of insulation, provide the following:

1. Indoor piping exposed to physical damage — Type J-2, PVC
2. Mechanical Eqpt Spaces: Exposed piping
   less than 8 ft above floor or operator platform — Type J-2, PVC

3.03 DUCTWORK INSULATION

A. General:

1. Insulate all ducts except those specified to be uninsulated. The following ductwork need not be field insulated:
   a. Factory insulated ductwork and plenums.
   b. Ducts with acoustic lining, provided the lining thickness matches or exceeds the required insulation thickness.
   c. Exhaust ducts, except where noted.
   d. Return air ducts, except where noted.
2. See Table 23 0700-1 for additional information.
3. Ensure that ductwork is leakage tested prior to applying insulation. Inspect ductwork and repair any deficiencies prior to applying insulation. Do not apply insulation over deficient ductwork or plenum construction.
4. Ensure that ductwork is clean and dry before applying insulation.
5. For ductwork with acoustic lining the drawings indicate the "clear inside duct dimension" required. Over-size ducts as required to provide the required air flow area.

B. Type D-1, Fiberglass Blanket Insulation: Measure and cut insulation. Install so insulation is not excessively compressed at corners. For rectangular and flat oval ducts 24-inches and wider, provide stick pins and speed clip washers 18-inches on centers on the bottom, and clip off excess length of stick. Firmly butt insulation ends and longitudinal joints. Overlap jacket minimum 2-inches at end joints and longitudinal joints, staple on 6-inch centers, and continuously seal jacket. Provide vapor barrier mastic where ducts are indicated to be vaporsealed. Should gaps or fishmouths occur, re-staple and seal them with mastic. Use FSK tape and vapor barrier mastic to seal all penetrations of the FSK jacket, such as pins, tears, and hangers. Neatly trim and seal insulation at access doors, ends, damper rod controls etc. Verify proper damper operation.

C. Type D-2, Fiberglass Board Insulation: Attach with mechanical fasteners 12" on centers.

D. Type D-3 & D4, Acoustic Lining: Ductwork dimensions indicated on the drawings are net air flow dimensions inside liner. Increase duct size to accommodate liner. Completely line the inside surfaces of ducts and plenums specified and indicted. Comply with the NAIMA Fibrous Glass Duct Liner Standard (FGDLS), manufacturer's recommendations, and this spec. Adhere liner with minimum 90% coverage of adhesive, and secure with mechanical fasteners and washers per FGDLS and manufacturer's recommendations. Fastener length shall be sufficient to limit compression of liner to 1/8" maximum. Coat all cut edges and surface penetrations with edge sealer. Provide metal nosing for liner leading edges at fan discharge and for all ducts with air velocities exceeding 3,000 FPM. Maintain minimum 18-inch clearance from electric resistance heaters. Interrupt liner at dampers and apply external insulation at these locations.

1. Provide Type D-3 insulation for the 10 feet upstream of roof exhaust fans except in wet air streams.

E. Type D-5: Install insulation in a 2-layer system per manufacturer's instructions, including the use of mechanical fasteners for the underside of ducts, butting or overlapping of joints, and offsetting of joints on outer layer.

F. Type D-6: Install in accordance with manufacturer's instructions. Overlap seams and joints minimum 2-inches, affix with SS wire minimum 18-inches on centers, but not less than per manufacturer's recommendations, and tape seams and joints with aluminum tape.

G. Type D-7: Install insulation in a single-layer system per manufacturer's instructions. Mechanical fasteners for the underside of ducts shall be adhered to the duct in a manner suitable for the operating temperatures (welded or other suitable method). Butt or overlap joints per manufacturer's recommendations.

H. Type D-8: Wire in place with SS wire minimum 12-inches on centers, and provide J-1 jacket.

I. Type D-9: Install per manufacturer's recommendations, NAIMA standards, and SMACNA Fibrous Glass Duct Construction Standards. Provide ship lap seams and joints.

3.04 EQUIPMENT INSULATION

A. General: Where specified elsewhere, equipment will be factory insulated. Insulate all equipment as noted herein except portions of equipment that are factory insulated.

1. Fiberglass Board Insulation: Score, bevel, or miter to provide tight joints and secure in place with mechanical pin and clip fasteners and insulation bonding adhesive applied to underside surfaces, or with bands. Fill joints with insulation material and provide corner beads to protect edges of insulation.

2. Cold Tanks and Equipment: J3 jacket with two coats of approved vapor barrier mastic.

3. Factory Packaged Equipment: Field insulate the equipment and piping on factory-fabricated assemblies as if they were field installed, unless such items are factory insulated.

B. HW Pumps: Do not insulate.

3.05 JACKETING

A. Type J-1, Metal Jacketing:

1. Ducts: Slope jacketing to shed rain.

2. Pipes: Install with seams at the 3 o'clock or 9 o'clock position to shed water. Band 12" on centers.

3. Joints and Seams: Overlap joints minimum 2-inches. Caulk with a weatherproof caulk when located outdoors.

B. Type J-2, PVC Jacketing: Secure in place with tacks and solvent welded joints. White PVC tape may be used indoors.

C. Type J-3, Canvas Jacket: Apply mastic at a rate of 60 to 70 sq. ft. per gallon, embed fiberglass mesh, smooth all wrinkles and apply finish coat of Sealfas, or equivalent.

END OF SECTION 23 0700

TABLE 23 0700-1 – DUCTWORK INSULATION

Service	Location	Condition	Insulation Type	Insulation Thickness (in)	Notes
Supply Air, Makeup Air, Outside Air	Indoor	Concealed	D1	1.5	1, 6
Supply Air, Makeup Air, Outside Air	Indoor	Exposed	D2	1.5	
Supply Air, Makeup Air, Return Air	Outdoor	All	D8	2	2, 4, 7
Supply Rectangular Ductwork downstream of Terminal Units, Fan Coil Units, Heat Pumps, Blower Coils and Low Velocity AHU's	Indoor	All	D1	1.5	1, 3
Return Rectangular Ductwork upstream of Fan Coil Units, Heat Pumps, Blower Coils and Low Velocity AHU's	All	All	D1	1.5	1, 3
Ductwork indicated to be lined	All	All	D3	1	5
Ductwork indicated to be lined with 2-inch acoustic lining	All	All	D3 or D4	2	5
Single Wall Lined Plenums	All	All	D4	2	
Transfer Air Ducts	All	All	D3 or D9	1	
Exhaust Ductwork	Indoor	Concealed	D1	1.5	8
Exhaust Ductwork	Indoor	Exposed	D2	1.5	8
Kitchen Exhaust Ductwork	Indoor	All	D5	2-layers	
Plastic Piping and Ductwork within RA Plenums	Indoor	Concealed	D6	0.5	
Fire-Rated Ductwork Other than Kitchen Exh	Indoor	All	D7	1.5	
Boiler Breeching & Stack	Indoor	All	P1 or P2	3	
Boiler Breeching & Stack	Outdoor	Exposed	P1 or P2	3	4, 7

Notes:

1 Includes Supply Air Duct from Energy Recovery Units and Evaporative Coolers.
2 Provide acoustical liner as indicated on the drawings.
3 Delete Type D1 insulation if acoustical liner is indicated by plan notes or shown on the drawings.
4 Provide J1 Jacket.
5 In hospitals do not provide acoustical lining in supply ductwork or plenums downstream of the final filter.
6 Vaporseal ducts conveying cold air.
7 Seal outdoor ductwork to prevent ingress of moisture.
8 Insulate only the portion of exhaust ductwork between isolation damper and outside.

SECTION 23 3000
AIR TEMPERING SYSTEM AND EQUIPMENT

PART 1 GENERAL

1.01 REQUIREMENTS

A. Provide all products, labor and services necessary to construct and demonstrate proper functionality of the HVAC and exhaust systems indicated on the drawings and specified herein.

B. Conform with applicable provisions of the General Conditions, the Supplemental General Conditions and General Requirements.

C. See Sections 23 0500, 23 0548, 23 0549, 23 0593, 23 0700, and 23 0900 for additional requirements.

D. Comply with the Equipment General Requirements in Spec Section 23 0500.

1.02 SCOPE

A. Install control dampers supplied under Section 23 0900. Adjust dampers for smooth operation.

B. Equipment provided by others: Provide ductwork to serve equipment provided by others, including fume hoods, etc, where that equipment requires ducted supply or exhaust.

1.03 SUBMITTALS

A. Submit the following for review and approval:

1. All equipment shown on the equipment schedule and elsewhere on the drawings. Submit evidence or certification that equipment complies with ASHRAE Std. 90.1.
2. Ductwork construction standards, sheet metal, plenums, ductwork accessories, etc.
3. Flues and vents: Materials of construction and accessories. For vents with horizontal offsets or expansion joints, submit layout for review.
4. Dampers for fire and smoke control: For each type of damper proposed, submit manufacturer's literature demonstrating compliance with all aspects of the specifications and drawings. Submit manufacturer's installation instructions.
5. Air Filters and Filter Gauges
6. Grilles, Registers & Diffusers: Configuration, materials of construction, finish, mounting details, and performance data including throw, static-pressure drop, and noise ratings. Submit for type only, but supplier shall check and verify that the indicated diffuser type and sizing are appropriate for each area. Advise of any concerns in any areas.
7. Terminal Units:
    a. Submit the following for each type of unit: Unit construction, materials, and wiring diagrams.
    b. Submit the following for each size unit: Dimensional data, recommended flow ranges, and performance data (pressure drop and sound data) at maximum flow.
    c. Submit a schedule showing the following for each terminal unit indicated on the drawings: Tag number, max & min CFM, size, pressure drop, and heating system performance.
8. Layouts of systems covered by this section of the specifications. Layouts shall be at a scale appropriate for the areas shown. Include large scale sections as appropriate.

1.04 QUALITY ASSURANCE

A. Comply with the following codes & standards:

1. UMC 2015 Chapter 6 – Duct Systems
2. UMC 2015 Standard 6-2, Standard for Metal Ducts

3. SMACNA 2005 HVAC Duct Construction Standards – Metal and Flexible, including Addendums
4. SMACNA Round Industrial Duct Construction Standards – 1999
5. SMACNA Rectangular Industrial Duct Construction Standards – 2004
6. NFPA-90A-2002 - Standard for the Installation of Air-Conditioning and Ventilating Systems

B. Component Characteristics

1. All components within ducts and plenums shall be non-combustible or shall have a flame spread less than 25 and smoke developed less than 50 when tested as a composite product per NFPA 255, ASTM E84, or UL 723, except where specifically permitted by the UMC and noted in the drawings or specs.

1.05 SOUND LEVELS

A. Sound levels attributable to mechanical equipment are designed to result in sound levels of NC 40 for offices, conference rooms, and NC 35 for classrooms, etc., measured within the rooms. Mechanical equipment that has been substituted for the specified equipment shall perform within the specified equipment sound limitations, or will be replaced or adjusted as required. Sound levels attributable to duct vibration that result in noticeable noise or vibration to duct hangers, lighting fixtures, ceiling tees or diffusers shall be re-supported or adjusted until the disturbing noise is brought within acceptable limits.

1.06 DIMENSIONS

A. Compare all drawings and verify all dimensions both on the drawings and in the field before laying-out, cutting, and fabricating the work.

B. Refer to Section 23 0500, Common Work Requirements for HVAC, for coordination drawing requirements.

PART 2 PRODUCTS

2.01 DUCTWORK AND PLENUMS

A. Materials: Construct all ducts, casings, plenums etc. from galvanized steel sheets except as indicated. Sheets shall be free of blisters, slivers, pits, and imperfectly galvanized spots. Reinforcing angles and bars, and duct support materials shall be same material as ductwork if exposed to the air stream, or galvanized steel if not exposed to the air stream.

1. Galvanized Steel: Per ASTM A653/A653M Standard Specification for Steel Sheet, Zinc-Coat (Galvanized) by the Hot Dip Process G90 coating designation.
2. Aluminum: Alloy 3003-H14
3. Stainless Steel: 340SS, provide No. 2B finish in exposed areas
4. Fiberglass Ductwork (Ductboard): Use only where specifically noted. Minimum 1-inch thick, 3 lb. density rigid fiberglass ductboard with glass fiber reinforced vapor barrier, UL Class 1, labeled on each board per UMC-06 Standard 6-5.
   a. Properties:
      1) Thermal conductivity for 1-inch thickness shall not exceed 0.22 Btuh/SF-F at 75 deg F
      2) Noise reduction coefficient of 0.80 on Mounting No. 6.
   b. Tape: 3-inch "Hardcast" mineral impregnated woven fiber tape with an actuator/adhesive applied in accordance with the manufacturer's directions, or thermlok heat sensitive tapes. Pressure sensitive tapes will not be accepted.
   c. Owens-Corning Fiberglass, Johns Manville, Certain-Teed or equivalent. Flexural rigidity (E.I.) average shall not be less than 475.
5. Polyvinyl Coated Galvanized Steel: Minimum 4 mil polyvinyl coating. Foremost Manufacturing Company, Southfield, Michigan. Model PCD 4 by 1 for exterior coating

only, or Model PCD 4 by 4 for both interior and exterior coating.

B. Flexible Ducts: Factory fabricated, listed as a Class 1 Air Duct per UL 181 with aluminum foil interior liner, corrosion resistant helix mechanically locked to fabric to ensure dimensional stability, helix separated from air stream, R-5 fiberglass insulation, and metalized outer vapor barrier. Ducts shall be rated at 10-inch positive pressure, 5-inch negative pressure, 0.1 perm per ASTM E96, and -20 to +250°F. Flexmaster Type 3M, Thermaflex M-KC, OAE.

C. Ductwork Accessories

1. Sealers: Water based, for use on galvanized steel and with the other materials specified herein, suitable for use at -20 to +200°F and duct pressures to 10 inches wg, dry to the touch within 12 hours, sufficiently flexible to pass a 0.25-inch mandrel test, listed per UL-181A & 181B, and suitable for storage and application at 40–110°F. Approved Manufacturers: Carlisle Coatings & Waterproofing “Hardcast,” Foster, RCD, AM Conservation Group, OAE.
2. Tapes: 4” woven cotton fiber impregnated with mineral gypsum and modified acrylic/silicone activator to react exothermically with tape to form hard, durable, airtight seal. Water, mold, and mildew resistant for indoor and outdoor service. Sealant shall be modified styrene acrylic.

2.02 SHEET METAL ACCESSORIES

A. Dampers: Factory fabricated, suitable for use with air at -20 to +240°F, galvanized steel housing and blades except as noted, rated for indicated pressures in either direction and performance rated per AMCA-500.

1. Shafts: Square or hexagonal steel, 3/8-inch or 1/2-inch, continuous through damper, mechanically fastened to damper blade, and extending through frame as required for actuator or standoff bracket and locking quadrant as required by table below.
2. Bearings: Provide for each side of each shaft, molded synthetic or stainless steel sleeve type.
3. Multi-blade dampers: Except as indicated, provide parallel-blade for 2-position applications and opposed blade for modulating applications. Provide jackshafts as required to drive large dampers.
4. Air pressure drop shall not exceed:
   a. Dampers rated at 1500 FPM: ____ in wg at 1500 FPM
   b. Dampers rated at 4000 FPM: ___ in. wg at 4000 FPM
5. The dampers described in this section are assigned Type Numbers D1 through D23. The following table summarizes key characteristics of each type of damper. Drawings and Part 3 – Execution, indicate which type of damper to use in each application.

Type	Shape	Blade	Max Size (inches)	Multiple Sections	Rated Velocity (FPM)	Rated Shutoff Press. (in. wg)	Seals	Leakage (CFM/SF @ 1 in. DP)	Notes	Ruskin Model
D1	Rect	Flat	36 x 12	No	1500	2.5	No	--	1	MD15
D1	Rect	3V	48 x 48	No	1500	2.5	No	--	1	MD15
D2	Rect	Flat	36 x 12	No	1500	2	No	--	1	MD25
D3	Rect	3V	48 x 48	Yes	1500	2	No	80	1	MD35
D4	Rect	3V	48 x 72	Yes	1500	2.5	No	40		CD35
D5	Rect	3V	48 x 72	Yes	1500	2.5	Yes	4		CD36
D6	Rect	Airfoil	60 x 72	Yes	4000	6	Yes	2	2	CD50

D7	Rect	Airfoil	60 x 72	Yes	4000	6	Yes	2		CD60
D20	Round	Flat	20	No	1500	2	No	40	1	MDSR25
D21	Round	Double	40	No	4000	10	Yes	4		CDR25
D22	Round	Double	24	No	4000	6	Yes	6		CDSR25
D23	Oval	Double	72 x 24	No	4000	10	Yes	4		CDO25

Note 1: Provide locking hand quadrant and 2-inch standoff bracket

Note 2: Aluminum Construction

B. Flexible Connectors: Except as noted flexible connectors shall be heavy fiberglass cloth; coated to be air tight, water tight, fire retardant; suitable for temperatures of -20 to +200° F; rated for 10 in. wg positive or negative; with tensile strength minimum 450 lb/inch in the warp and 340 lb/inch in the filling. Provide flexible connectors in 3-3-3 configuration, with 3-inch galvanized steel strip along each edge and 3-inches of flexible fabric in the center.

1. Standard Applications: Flame spread 20, smoke developed 40, Ventfabrics Ventglas OAE
2. Applications Exposed to Sun and Weather: Double coated with du Pont Hyphalon, Ventfabrics Ventlon OAE.
3. Applications from 200 – 500° F: Tensile Strength 285 lb/inch in the wrap and 185 lb/inch in the filling. Ventfabrics Ventsil OAE
4. Corrosive Applications: Teflon coated, Ventfabrics Ventel OAE.

C. Duct and Plenum Access Doors: Galvanized steel, gasketed. Size as required to properly inspect and service components located within the ductwork. Ruskin, Acudoor, Ductmate, OAE.

1. Rectangular ducts up to 2-inch positive or negative SP: Minimum 22 gauge frame and door thru 12-inch size, 20 gauge door for larger sizes, double gasketed (between door and frame, and between frame and duct) with cam locks, either hinged or removable. Ruskin ADH22, ADC22, ADHW22, or ADCW22, Ventfabrics, OAE
2. Round or Rectangular Ducts to 12-inch Positive Pressure: Removable oval sandwich style with gasketed inner door, insulated outer door, and large hand knobs. Ruskin ADR and ADF.
3. Ducts to 12-inch Negative Pressure: Ruskin ADHP-3.
4. Plenum Access Doors: Factory fabricated frame and door rated to 4-inch positive or 8-inch negative pressure. Provide mill finish and neoprene seals to limit leakage to less than 0.1 CFM/inch perimeter with door closed. Doors shall open against air pressure.
   a. Frame: Extruded aluminum with 1.5-inch flange and mitered corners
   b. Door: Extruded aluminum mitered frame, double wall 24-gauge galvanized steel panel with minimum R-5 insulation isolated from the air stream, full-length piano hinge and two heavy-duty latches similar to Ventlok 310.
   c. Approved Manufacturers: Ruskin GPAD or approved equal.

D. Turning Vanes:

1. Single wall: Per SMACNA HVAC Duct Construction Standards Figure 2-3 & 2-4.
2. Double wall: Airfoil shape with smoothly rounded entry nose and extended trailing edge, minimum 2” x 3” vane crossection, hot dipped galvanized steel, 26-gauge vanes, 24-gauge runner, each vane double pinned to each runner, field adjustable to required elbow aspect ratio. Performance shall not exceed the following for a 24 x 24 elbow at 2000 FPM average: Air pressure drop 0.105 in. wg; aound generated 54 dB re 10^-12 watts. Aero/Dyne Co. Model HEP, Airsan, Elgen, or equivalent.

E. Roof Curbs and Equipment Support Rails: Factory fabricated, minimum 12-inch high, galvanized steel, configured to account for roof pitch where pitch exceeds 1/4-inch/ft or where required by manufacturer of supported equipment. Coordinate with roofer and provide cant and step if needed to match roof construction.

1. Roof Curbs: 1.5-inch fiberglass insulation with nominal 2" x 2" wood nailer. Provide damper tray where a damper is indicated. Thycurb TC, Greenheck, OAE.
2. Equipment Support Rails: Nominal 2" x 4" wood nailer. Thycurb TEMS, Greenheck OAE

F. Louvers: 4-inch extruded 6063-T5 aluminum alloy frame and blades with flange, mill finish, and 1/2-inch galvanized steel bird screen.

1. Structural: Designed and furnished to carry wind load of not less than 20 psf. Intermediate mullions and supports if provided as part of louver, shall not be visible from the exterior.
2. Air Pressure Drop: Less than 0.20 in wg at 1000 FPM over free area (8.58 square feet), intake or exhaust per AMCA 500 based on 48 x 48 test sample.
3. Moisture Penetration: Less than 0.01 oz/sf over 15 minute test per AMCA-500 at 873 FPM intake over free area based on 48 x 48 test sample.
4. Ruskin ELF375DX OAE.

G. Acoustic Louvers

1. Ruskin ACL 1245, 12 inches deep, with 45 degree blade angle, 22 percent free area (48" x 48" typical unit with .15 inch w.g. maximum pressure drop, at 4277 cfm air flow). Frame and blade material shall be galvanized steel. Free field noise reduction shall be:

Band Frequency (Hz)	63	125	250	500	1000	2000	4000	8000
Reduction (db)	14	13	15	20	23	22	20	20

2. Provide bird-screen, steel channel frame, Ruskatherm blanket insulation, and perforated steel interior surface that covers insulation.

H. Thermometers: As specified in Section 23 0505.

I. Barometric Pressure Balance Dampers: Air Balance, Inc. units with adjustable counter weight, aluminum air foil design blades, nylon bearings. Match frame assembly to wall or duct.

2.03 FLUES AND VENTS FOR FUEL-FIRED EQUIPMENT

A. General: Factory-built metallic vent system, UL Listed components. Each component shall bear indication of its UL listing.

1. Heat Resistant Paint: Glidden, Metallite OAE.
2. Approved Vent Manufacturers: Metal Fab, Metalbestos, Schebler, Ampco, OAE.

B. Type B Vent: Listed per UL 441 for use with UL Listed Category I (gas or propane fired, negative pressure, non-condensing) appliances to 530° F, round or flat oval as indicated, double wall with aluminum alloy inner wall, galvanized steel outer wall, both walls hemmed to eliminate sharp edges, minimum 1/4-inch air space for sizes 6-inches and smaller and minimum 1/2-inch air space for sizes 7-inches and larger, with guides to maintain air space. Provide UL Listed vent cap. Metal Fab Type M.

1. Barometric Draft Regulator: UL Listed, double acting type.

C. Type III Vent: For use with Category III appliances or other positive pressure, non-condensing appliances including oil-fired or solid-fuel equipment not exceeding 1200° F exhaust temperature. Listed per UL-103 for use with gas, liquid or solid fuels per NFPA-211 which produce gases up to 1400° F continuously and 1800°F intermittently. Double wall with spacers to maintain alignment, rated for 10-inch clearance to combustibles, 4-inch clearance to noncombustibles, and zero clearance to fire-rated or non-combustible chase.

1. Inner Pipe: Connected with V-bands of same material as inner pipe, and sealed with silicone sealant appropriate for the exhaust gas temperature. Pressure tight to 60 inches water.
2. Outer Pipe: Seal with V-band of same material as outer pipe. Provide silicone sealant for portions exposed outdoors.
3. Expansion Joints: Bellows type.
4. Options and Accessories:
   a. Inner Wall: 304 SS
   b. Outer Wall: 304 SS.
   c. 12-year warranty against defects in materials and workmanship

D. Type IV Vent: For use with Category II or Category IV appliances (natural gas or propane-fired, positive or negative pressure, condensing, not exceeding 550° F exhaust temperature). Listed per UL-1738, double wall with 1-inch clearance and spacers to maintain alignment.
1. Inner Pipe: AL2904C superferritic SS manufactured by Allegheny Ludlun, with welded seams, connected with V-bands, and sealed with high temperature silicone sealant. Rated at 6 inches water. Thickness: 0.015-inch through 12-inch size; 0.024-inch for 14-inch and larger sizes.
2. Outer Pipe: Seal with V-band of same material as outer pipe. Provide silicone sealant for portions exposed outdoors. Thickness: 0.018-inch through 12-inch size; 0.024-inch for 14-inch and larger sizes.
3. Options and Accessories:
   a. Outer Wall: 304 SS.
4. Metal Fab Type CG

2.04 DAMPERS FOR FIRE AND SMOKE CONTROL

A. General: Factory assembled and UL listed as an assembly, suitable for horizontal or vertical air flow and for ducted or un-ducted applications. Fire dampers (FDs) shall be listed per UL 555, smoke dampers (SMDs) shall be listed per UL 555S, and fire/smoke dampers (FSDs) shall be listed per UL 555 and UL 555S. Units shall be galvanized steel except as noted. Approved manufacturers: Greenheck, Ruskin, Potorff, or approved equal.

B. Combination Fire/Smoke Dampers: Factory assembled complete with damper, actuator, thermal link, and all specified accessories, all mounted on a sleeve.
1. Construction: Round blades, rectangular parallel blades and rectangular opposed blades are acceptable, except dampers shall be rectangular opposed blade type when installed in any of the following conditions: within 10 diameters of a fan or supply register, within 3 diameters of an elbow. Internal frames in rectangular FSDs shall be low profile type for ducts 17”H and less.
2. All components factory installed and wired, including actuator, thermal link, position switches, temperature over-ride (if specified), test switch (if specified), etc. Mount all such components on outside of FSD sleeve to the side of duct (not top or bottom) except where indicated or approved. FSDs must be suitable for rotating the unit 180-degrees so these components can be on either side of the duct.
3. Air pressure drops shall be certified per AMCA 500D. Pressure loss coefficient C_o shall not exceed the following when tested per AMCA Figure 5.3:

Size (in)	3-V Blade	Airfoil Blade	Round
12 x 12	2.41	2.01	NA
24 x 24	0.65	0.60	NA
36 x 36	0.44	0.27	NA
12 x 48	0.76	0.91	NA
12 Round	NA	NA	0.33
24 Round	NA	NA	0.23

4. Listed for installation within wall, floor or ceiling assemblies as indicated on drawings.
   a. Ratings, except as noted: 1.5-hr Fire Rated, Leakage Class 1, 350°F, 4-inch Static Pressure, Dynamic.
      1) Up to 1600 FPM: Greenheck FSD-211 (3-V blade type), OFSD-211, or FSDR-511 (round).
      2) Up to 3000 FPM: Greenheck FSD-311 or 311V (airfoil blade) or OFSD-311.
   b. 3-Hr Rated Walls: Greenheck FSD-231.
   c. Stainless Steel: Greenheck SSFSD-211 or SSFSDR-511 (round).
5. Actuators: Electric 2-position, 115/1/60 (provide factory wired transformer if required), normally closed, spring return, NEMA-1 except as noted. Actuator shall fully re-open damper when power is restored after any power interruption.
6. Accessories
   a. Transitions: Provide round-to-rectangular, oval-to-rectangular, or rectangular-to-rectangular transitions as appropriate for the application.
   b. Thermal Link: Provide re-settable bi-metallic thermal link to initiate closure when the air temperature within the duct rises to 165° F. Where indicated provide thermal links for operation at 212° F, 250° F, or 350° F. Thermal link shall be easily resettable from outside the duct.
   c. Position Switches: Provide dry contacts for remote monitoring of damper open and closed positions.
   d. Retaining plates and angles: Provide as required. Galvanized steel specifically designed for the particular FSD and included as part of the UL Listed assembly.
   e. Installation decals: Provide installation decals on the sleeve which give the installer clear installation instructions.
   f. Temperature Override Control: Provide controls so that the thermal link can be over-ridden and the FSD opened for smoke control, even if the air temperature exceeds the setting of the thermal link, provided the temperature does not exceed 350° F.

C. Smoke dampers: Similar to fire/smoke dampers noted above, except as follows:
1. Smoke dampers shall comply with UL 555S, but need not comply with UL 555.
2. Smoke dampers need not have a fire rating.
3. The thermal link and temperature override are not applicable.
4. Suitable for installation within a wall, floor or ceiling assemblies as indicated.
   a. Ratings, except as noted: Leakage Class 1, 350° F, 4-inch Static Pressure, Dynamic.
      1) Up to 1600 FPM: Greenheck SMD-201 (3-V blade type) or SMDR-501 (round).
      2) Up to 3000 FPM: Greenheck SMD-301, 301V (airfoil blade) or SMDR-401.

b. 6-inch pressure rated: Similar to Greenheck SMD-401

c. Stainless Steel: SSSMD-201 & SSSMDR-501 (round).

D. Fire Dampers: Dynamic rated, suitable for closing against 8-inch differential pressure. Curtain type with sleeve and 165°F replaceable fusible link, resettable. Provide round-to-rectangular, oval-to-rectangular, or rectangular-to-rectangular transitions as appropriate.

1. 1.5-hr rated: Greenheck DFD-155
2. 3-hr Rated: Greenheck DFD-355.
3. Provide 212° F fusible links for high temperature applications.

E. Ceiling Radiation Dampers: UL Classified for use with fire rated floor/ceiling assemblies, with 165°F fusible link replaceable through the damper assembly, 1.5-hr rated except as noted. Greenheck CRD-1, CRD-2 (round), CRD-60, or CRD-60X. Provide 212° F fusible link and 3-hr rated dampers where indicated.

2.05 FILTERS AND FILTER GAUGES

A. Rated per ASHRAE Std. 52.1; Class 1 or 2 per UL Std. 900; glass fiber media; suitable for operation from -20° F to +170° F; corrosion resistant; suitable for installation with pleats either horizontal or vertical, and for air flow horizontal, vertical upflow, or vertical downflow; suitable for face velocity up to 625 FPM. Unless specified elsewhere, pre-filters shall be MERV-7, and final filters (where specified) shall be MERV-14. AAF, Camfil Farr, or approved equal.

		MERV RATING						
		7	11	14	11	14	11	14
Description							High Capacity	
Configuration		2-inch or 4-inch	12-inch Cartridge		6-inch Cartridge		12-inch Cartridge	
Initial Resistance	in. wg.	0.26	0.25	0.58	0.39	0.58	0.29	0.49
Rated Velocity	FPM	500	500	500	500	500	500	500
Max Velocity	FPM	625	625	625	625	625	750	750
Recommended Final Resistance	in. wg.	0.7	1.5	1.5	1.5	1.5	1.5	1.5
Gross Media per 24 x 24 Filter	SF	14 Pleats per foot	62	62	105	125	175	175
Housing		Cardboard	Polystyrene or Aluminized Steel	Polystyrene or Aluminized Steel	Polystyrene or Aluminized Steel			
Frame		Channel	Gasketed		Gasketed		Gasketed	
AAF Model		Perfect Pleat	VariCel RF		VariCel M-Pak		VariCel V	
Camfil Farr Model		3030	RigaFlow					

B. Filter Gauges: Provide a filter gauge for each bank of filters. Gauges shall be magnehelic type with static pressure tips and inter-connecting piping. Ranges shall be 0-1 inch w.g. for all filters except bag filters which shall have a range of 0-2 inches w.g.

2.06 TERMINAL UNITS

A. General: Factory packaged unit with casing, air valve, air flow sensor. If the following sections are specified or required, provide them as part of the factory package: heating section, fan, and sound attenuator. Terminal units (TUs) shall be suitable for variable volume operation over the scheduled air flow ranges. Air flow and sound performance shall be rated per ARI 880. All materials in the air stream shall comply with the requiements of UL-181 and NFPA-90A.

1. Unit Construction:

a. Casing: Minimum 22-gauge galvanized steel with round inlet collar, rectangular outlet collar, 3/4-inch acoustic lining with cut edges coated with sealant.

b. Air Valve: Heavy gauge metal damper, shaft to extend through casing, self-lubricating bearing, with leakage not to exceed 2% of rated air flow when closed with 3-inch inlet pressure.

c. Air Flow Sensor: Cross configuration located at inlet of assembly, accurate to within 5% with 90^{o} elbow directly at inlet connection. Provide

d. Sound Attenuator: Galvanized steel with acoustic lining. Provide aluminum liner if specified for casing.

e. Heating Section:

1) HW Coils: Copper tubes, aluminum fins, galvanized steel casing, sweat connections, ARI rated, minimum 300 psi rated. Size heating coils for the capacities indicated on the equipment schedule. Provide single row coils wherever they can do the specified heating duty. Provide 2-row coils where indicated and where required for the indicated heating capacity. Do not exceed 0.5-inch static pressure drop for the entire unit (terminal unit, heating coil and sound attenuator). Where necessary to limit pressure drop, either over-size unit or provide a separate, larger (lower pressure drop) heating coil to be installed in the discharge ductwork.

2) Electric Heaters: Factory installed and wired with all necessary safety controls, UL listed as an assembly, with galvanized steel enclosure, 80/20 nickel chrome heater elements, electronic modulating control with 4-20 mA input signal from DDC system, air flow switch, access door with door interlock disconnect switch, automatic reset primary thermal cutout switch, manual reset secondary thermal cutout, 24-V control transformer, NEMA-1 enclosure for all electrical components with hinged access door with wiring diagram. Controller shall be solid state type to minimize electrical interference and for silent operation.

2. Sound Data: The equipment schedules show maximum allowable NC levels based on unit sound power measured per ARI-885, and sound attenuation per ARI-885 Appendix E with a Type 2 ceiling. Do not exceed the scheduled sound levels.

3. Controls: Controls will be supplied by the controls contractor for installation by terminal unit (TU) supplier. Coordinate with controls contractor who will ship controls to TU manufacturer. TU manufacturer shall install controls onto terminal units.

4. Approved Manufacturers: Price, Anemostat, Titus, Krueger, or approved equal.

B. VAV Reheat: Single duct type with reheat as indicated, Price SDV.

C. Fan Powered: Parallel flow type with backdraft damper at fan discharge. Electric heating coil may be in total air stream, but HW coil must be in secondary air section. Capable of providing heating to space with primary air system shut down. Provide collar to allow ducting the secondary air inlet. Price FDV or approved equal.

1. Fan: Forward curved, steel, dynamically balanced, direct drive, ECM motor with permanently lubricated bearings and thermal overloads.
2. Electrical:

D. Dual Duct: With separate air flow sensor and air valve for hot and cold air streams, and ari flow sensor in the mixed outlet air stream, suitable for variable volume operation, Price DDQ.

2.07 GRILLES, REGISTERS AND DIFFUSERS

A. General: Performance rated per ASHRAE Std 70, *Method of Testing for Rating the Performance of Air Outlets and Inlets*, steel with baked white enamel finish except as noted, for installation on a fixed surface or a lay-in T-bar ceiling as indicated on architectural drawings, rigidly constructed, vibration free, with inlet collar of sufficient length to connect inlet ductwork, sized as shown on drawings. Where frames are provided for installation in fixed surfaces, frames shall be approximately 1-1/8" wide. Sound performance rated per ADC and based on room absorption of 10dBre10^{-12} Watts and one diffuser.

1. Approved Manufacturers: Price, Krueger, Titus, Anemostat, OAE

B. Types as follows. See also the Grille and Diffuser Schedule on drawings.

1. Square Ceiling Diffusers: Louvered type, 4-way pattern, 1-piece smooth aerodynamic surfaces with no corner joints, three louvers for 12-inch sizes, four louvers for 24-inch sizes, removable louver assembly, round neck, to provide stable, horizontal air flow without dumping down to 75 FPM inlet velocity for ceiling applications, and down to 20% of maximum air flow for non-ceiling applications. Price SCD.
2. Round Ceiling Diffusers: Louvered type, 360-degree distribution, four separate 1-piece smooth aerodynamic louvers, adjustable air flow pattern (horizontal vs. vertical), round neck. Price RCD.
3. Ceiling Return, Exhaust and Transfer Grilles: 1/2" x 1/2" x 1/2" egg crate type, steel frame for surface mounting or T-bar ceiling per application, aluminum grid. Price Series 80.
4. Ceiling Rectangular Directional Diffusers: Louvered type, directional pattern as indicated on drawings, with removable louver assembly. Price SMD.
5. Sidewall Supply Registers: Double deflection with ganged horizontal front bars, individually adjustable vertical rear bars, 3/4" bar spacing and surface mounting frame. Price 520.
6. Sidewall Return, Exhaust and Transfer Grilles: Fixed horizontal bars on 3/4" centers set at 30-45 degrees, surface mounting frame. Price 530.
7. Ceiling or Sidewall Linear Supply Diffusers: Extruded aluminum with baked white enamel finish, frame suitable for lay-in or surface mounting as per the architectural drawings, all aluminum construction, flat black interior surfaces, air flow deflection vanes to provide each slot with individually and fully adjustable 180^{o} air pattern from horizontal to vertical or in between, self-aligning devices to ensure proper alignment where multiple sections are required, and corner pieces as necessary for a continuous appearance. Provide galvanized steel side inlet plenum matched to diffuser, with plenum extension if necessary to match adjacent construction. Performance data is based on 3/4-inch slots unless otherwise indicated. See plans for required air flow, diffuser length, and number of slots. Price SDS with SDA or SDB plenum, Krueger 1910, or equivalent.
8. Ceiling or Sidewall Linear Return Registers: As specified for sidewall linear supply diffuser except without air flow deflection vanes. Price SDS.
9. Stainless Steel Sidewall Return/Exhaust Registers: Fixed horizontal blades at 1/2" spacing and 45^{o} deflection, flange for surface mounting, and SS 90^{o} quick-release fasteners to mount grille to frame. Provide mill finish for blades and No. 4 finish for flanges. Price Model 735H.

10. Stainless Steel Slot Diffuser: Consist of a 0.037", 304 stainless steel plenum with continuous welded joints and chamfered corners to facilitate cleaning. The diffuser face shall be stainless steel construction with slots and fixed pattern deflectors. Plenums shall have stainless steel inlet collars complete with removable dampers from plenum face. The removable dampers shall be opposed blade type, constructed of stainless steel. Damper shall be adjusted without removing face of diffuser. The diffuser face shall be attached by stainless steel 90° quick-release fasteners and safety cable to open easily. The diffuser face, mounting frame, face and interior surface of plenum shall have a #4 finish. Krueger Model HORDSS or equivalent.
11. Laminar Flow Diffuser: Extruded aluminum construction and plated steel to inhibit corrosion. The perforated face plate, damper deflector, interior baffles and diffuser back pan plenum assembly shall be of 0.040 aluminum. The perforated face plate shall open easily with 90° quick-release fasteners and safety cable for easy cleaning and damper adjustment. B11 Sterile White-Thermal Setting finish. Krueger Model LFD or equivalent.

2.08 FANS

A. General
   1. Construction
      a. Factory fabricated fan, motor, drive and accessories, listed per UL, with air flow rated per AMCA 211 and sound rated per AMCA 301.
      b. Fan wheel: Statically & dynamically balanced, with shaft sized so first critical speed is minimum 25% above maximum operating speed.
      c. Motor and Drive: Premium efficiency ODP motor per Spec Section 23 0500, direct drive or belt driven as indicated in schedule on drawings, bearings with 100,000 hr L-10 life.
         1) Variable Speed Applications: Provide Class F insulation.
      d. Belt Drives: Adjustable pitch sheave up to 5 Hp, fixed pitch above this Hp, cast and machined pulleys with all components sized for 150% of motor Hp.
      e. Dampers:
      f. Accessories:
         1) Roof Curb: Minimum 12-inch galvanized steel, fiberglass insulated, with wood nailer, damper tray and flange. Provide cant and step if needed for proper seal with roof.
   2. See Section 23 0548 for Vibration Isolation requirements.

B. Centrifugal Roof Exhaust Fans
   1. Leakproof construction.
   2. Housing: Spun aluminum construction, reinforced wind band welded to one-piece curb cap with mounting holes on the side and integral spun venturi, spun aluminum motor compartment with readily removable cover and breather tube. All other structural components shall be galvanized steel.
   3. Fan wheel: Backward inclined, centrifugal, non-overloading.
   4. Motor and Drive: Motor out of the air stream, cooled with ambient air. Motor, drive and fan wheel resiliently mounted on neoprene isolators.
   5. Electrical: Disconnect NEMA-1 if protected from the weather, or NEMA-3R if exposed to the weather, wired to motor, with all wiring and components per NEC and either UL Listed or UL recognized.
   6. Accessories: Stamped aluminum nameplate, hinge kit to allow tilting fan up to inspect wheel, retaining chains, conduit chase and roof curb.
   7. Approved Manufacturers: Greenheck Type, G, GB, CUE or CUBE as indicated. Cook, ACME, OAE.

C. Laboratory Exhaust Fan

1. General: Factory fabricated, weatherproof for rooftop installation, with inlet plenum, fan assembly, bypass damper and discharge assembly, listed per UL 705.
   a. Heavy gauge welded steel, powder costed, chemical and UV resistant, designed for wind speeds up to 125 MPH without guy wires,
   b. Intake Plenum: With bypass dampers (low leakage airfoil type, corrosion resistant, similar to Greenheck), intake hood with bird screen, access panel, and roof curb.
   c. All driveline components (motor, belt, drive, bearings, etc) located outside the contaminated air stream, and replaceable without exposure to the contaminated air stream. Belts & drives sized for 200% of motor HP, bearings sized for 200,000 hr L-10 life, shaft seal, AMCA Class B or C spark resistant construction,
2. Mixed Flow Fan Style: Mixed flow fan with fan, motor and drive resliently mounted on neoprene-in-shear isolators.
3. Centrifugal Fan Style: Backward inclined fan, housing with access door, fan and motor mounted on rigid steel frame, spring isolators with minimum 1-inch static deflection, and fabric inlet flexible connector.
4. Accessories: Color as selected by architect from among manufacturer's standard colors, windband acoustic attenuator, double wall plenum, isolation damper, roof curb, and factory wired electrical disconnect.
5. Approved Manufacturers: Greenheck Model MD or CD, Strobic Air, OAE.

2.09 COILS

A. Galvanized steel casing, copper tubes and aluminum fins except as noted, with tubes mechanically expanded into fins, circuited to allow completely draining and venting coil, drain and vent connections, with performance rated per ARI. Do not exceed scheduled air or water pressure drops by more than 5 percent.

2.10 AIR HANDLING AND AIR CONDITIONING UNITS

A. General

1. Acoustical performance shall be established per ARI 260 rating procedures. Measurements will be taken in an ANSI 12.32 qualified room using a calibrated reference source per ARI 250. Sound data supplied shall meet or be less than requirements established later in this Specification. (Data presented in dBA, sones, Bels is not acceptable.)

B. Packaged AC Units, 2 – 12.5 Tons

1. General: Factory fabricated with ductwork connections as indicated on the drawings, suitable for rooftop installation, UL listed, ARI rated, factory piped and wired requiring only a single field power connection, factory run-tested, with casing, cooling section, gas heating section, fan section, accessories and controls.
2. Casing: Heavy gauge galvanized steel, weatherproof with exterior surfaces phosphatized and finished with baked enamel, hinged or removable panels for access to all components, water and air-tight seals for access panels, minimum 1/2-inch insulation, and hoods for intake and relief air. Provide a location for locating a fused disconnect on exterior of unit.
3. Cooling Section: Suitable for operation down to 55^{o} F ambient, hermetic compressors, evaporator and condenser coils with copper tubes mechanically expanded into aluminum fins, all necessary refrigerant accessories, all necessary safety and operating controls, and double-pitched condensate pan. Provide fan guard for condenser fans.
4. Heating Section: Gas-fired, SS burner, corrosion resistant heat exchanger, direct spark ignition, forced draft or induced draft fan, all necessary safety and operating controls,

complying with California requirements for low NOx emissions.

5. Fan Section: Forward curved centrifugal, direct drive, with thermally protected motor, resiliently mounted.
6. Economizer: May be field installed, automatic motorized intake damper for 0 – 100% outside air intake, dry bulb type, with relief damper.
7. Accessories: 2-inch MERV 7 filters, 12-inch insulated roof curb with wood nailer and with cant and/or step if required to coordinate with roof.
8. Controls: Factory wired 24V microprocessor controls with controls transformer and thermostat for wall mounting.
9. Approved Manufacturers: Trane, Carrier, York, OAE.

C. Packaged AC Units 15 – 130 tons

1. General: Factory assembled, piped, wired, charged and run tested; packaged unit with casing, fan/motor/drive, refrigeration system, heating section, controls, and options and accessories as indicated; UL listed, cooling performance rated per ARI 360 and sound performance rated per UL 1995 Standards and ARI 210/240 or 360. Comply with the Equipment General Requirements specified in Section 23 0500.
2. Casing: Steel construction, configuration as shown on drawings, corrosion resistant finish to withstand a 1000-hour salt spray test per ASTM B117, weather-tight, roof pitched to shed water.
3. Fan, Motor and Drive(s): Centrifugal, 200,000 Hr L-50 bearings, V-belt drive.
4. Refrigeration System:
   a. Compressor: Hermetic scroll type resistant to damage from slugging, with complete oil system including pump, sight glass, provisions for filling and testing oil, and crankcase heater.
   b. Condenser: Coil with sub-cooling circuit. Fans: vertical direct drive propeller type, statically balanced, bearings with weather-tight slingers, motors with inherent thermal overload protection, resiliently mounted with fan guard.
   c. Cooling Coil: With thermal expansion valve and distributor.
   d. Refrigerant Piping System: Provide complete refrigerant piping system with piping, charging valve, compressor suction and discharge valves, and all necessary accessories.
5. Heating Section:
   a. Gas Heat: Minimum 18-gauge heat exchanger factory pressure tested, heat exchanger cleanout door, fire tested prior to shipment.
   b. Electric Heat: Heavy duty nickel chromium elements with maximum 40 watts per square inch, air flow switch, silent contractors and overcurrent protection.
   c. Hot water heating coil.
6. Controls: Factory wired and tested with all necessary safety controls and all controls for fully automatic operation per the sequence of operations on the drawings. AC unit must be capable of fully automatic operation in a local mode in the event that communication with the FMS is lost. See controls drawings for the intended sequence of control and for the points associated with the FMS.
   a. Include the necessary functionality to allow all user interface (for both initial setup and ongoing operation) to be through the FMS, and to accomplish the following through a BACNET or other approved open protocol interface:

Function	What's by the AC Unit	What's by the FMS
Supply Temperature	Unit Control (Note 1)	Reset supply temp setpoint
Space Temp Control	Unit Control (Note 3)	Monitor & Reset Setpoint
Fan Speed Control	Unit Control (Note 3)	Monitor duct SP, and reset SP control setpoint
Economizer	Unit Control	Monitor
Return/Relief Damper Control	Control	None
OA Damper Control (Note 2)	Unit Control	Setpoint adjustment
Units 25 Tons & Larger	All Measurement & Control	
Measure OA Supply		
15 – 20 T Units	NA	Only if shown on Controls Drawings
25 – 130 T Units:	Measure & transmit to FMS Read	
Scheduling	Unit operation	User interface, unit start/stop
Morning Warmup/Cooldown	Unit Control	Signal to initiate and terminate
Unoccupied Control	Unit Control	Signal to initiate and terminate
Duct Static Press Safeties	Unit Control	Measure & Monitor
System Alarms	Unit Control	Monitor & Reset Alarms

Note 1 It is acceptable to control the AC Unit heating and cooling systems based on return air temperature, provided the controls result in stable and reliable supply temperatures.

Note 2 OA supply reset (based on room CO_2 levels) may be implemented either initially or at some point in future. Include all functionality so the AC Unit can reset the minimum OA supply setpoint based on CO2 levels measured and transmitted through the FMS.

Note 3 For single zone applications only.

b. Include the necessary functionality to exchange all points with the FMS as indicated on the controls drawings and sequence of operations.

c. Provide remote-mounted human interface panel to allow diagnosing and programming unit in the event that FMS connection has failed, and without having to go to unit.

d. Ventilation Over-ride Control: To increase to 100% OA, initiated through the FMS and the Human Interface Panel.

e. Work with the FMS contractor to integrate the AC unit controls with the FMS controls.

f. Work with the FMS contractor for installation of all field-mounted controls supplied with the AC Unit.

D. Options & Accessories:

1. Casing: minimum 1-inch interior insulation minimum 14-inch roof curb, special sound curb, SS drain pan.
2. Electrical and Control: Unfused disconnect, convenience receptacle, remote human interface panel
3. Refrigeration: R-134a, R-410a, automatic hot gas bypass, low ambient controls and all components to allow operating refrigerant system down to $0^{o}F$
4. Gas Heat: Minimum 80% efficient, 4:1 modulating control, SS heat exchanger
5. Filters: As specified elsewhere in this spec section, 2-inch MERV 8 Filters shall be located within the unit, not within the curb.

6. Fan(s): Fan and motor mounted on common steel base with seismically restrained spring isolators sized for minimum 2-inch static deflection. Provide supply and relief or return/relief relief fan with VFD with three contactor bypass. Provide extended lube lines.
7. Air Economizer: Automatic air-side economizer with OA damper and controls to fully modulate OA from 0 – 100%.
    a. Controls: Dry bulb type
    b. Relief Air: Variable speed relief fan with modulating return and relief air dampers.
    c. OA and motorized relief damper: Leakage not to exceed 2.5% at 1-inch wg per AMCA Std. 575. OA and relief dampers: Air flow measuring type accurate to within 5% from 25% - 100% of scheduled air flows.
8. Approved Manufacturers: Trane Intellipak, York/Johnson Controls Series 20 through 100, McQuay, Carrier, OAE

E. Rooftop Semi-Custom CHW/HW Type
1. Factory assembled, horizontal type, weatherproof for outdoor installation, configured as indicated on drawings.
2. Casing: 2-inch double wall construction, minimum G-90 galvanized steel except as noted, with construction not less than the following: 16 ga exterior, 18 ga interior, 16 ga. floor. Provide 2-inch, 3-lb density fiberglass insulation completely separated from air stream, thermal break, perforated interior panels for sections upstream of cooling coil, solid interior panel for cooling coil, and perforated downstream of cooling coil. Panels shall be individually sealed. Maximum 0.5% deflection on perimeter and at section splits, with structural members under all concentrated loads. Design for minimum 6-inch negative SP upstream of fan, and 6-inch positive pressure downstream of fan. Safe off to prevent bypass around all unit components
3. Units shall be tested to a maximum leakage rate of 1% at 4-inch positive pressure
4. Provide access door and switched light in each accessible section. Provide access doors or removable panels to allow removal of all components, including dampers, filters, coils, fans, motors and drives. Access doors shall be double wall construction, min. 16-ga exterior and 22-ga interior, double sealed, hinged, with minimum 2 Ventlok 310 latches. Access doors shall open against air pressure. Provide window in door to mixing section, fan sections. Lights shall be marine type, factory installed and wired with switches, suitable for a single electric service connection at 115/1 phase, with minimum 2 switches
5. Provide vestibule adequately sized for installation and servicing all piping connections. Vestibule shall have floor at same level as unit. Provide continuous roof curb around entire periphery of unit and vestibule
6. Fans: Plenum type, airfoil blades, statically and dynamically balanced, with inlet cone and removable expanded metal screen with doors for access to bearings, accessible 200,000 hour L-10 pillow block bearings with extended lubrication lines, premium efficiency inverter duty ODP motor per Section 23 0500, all components mounted on a rigid welded steel frame with spring isolators of minimum 2-inch static deflection. The fans are to be balanced to within a tolerance of 3 mil/second in all three axes. Provide V-belt drive sized for 150% of motor hp, with fixed sheaves, one replacement set of sheaves to be installed after balancing, and one spare set of belts
    a. Note: Pressure drop through clean filters shall be included within AHU, not in external pressure drop
    b. Sound data shall be certified per ARI standard 260 and reported as sound level for the air-handler (not just the fan)
7. Coils: Certified per ARI. Heating Coil: Water type, drainable, 1/2" or 5/8" OD copper tubes, return bends, aluminum fins, galvanized steel casing, vent and drain connections, with capacities as scheduled. Water and air pressure drops shall not exceed those shown by 10 percent. Coil connections are same end. Provide holes through casing for

piping connections. Cooling Coil: Refrigerant type with distributor, but the intent is to replace the cooling coil with CHW at some point in future, so include adequate space to allow for such future changeout. Provide SS drain pan for cooling coil, double pitched to eliminate standing water, sized to collect carryover, with threaded connection for field piping. Provide intermediate drain pans at each individual coil, with piped drain down to main drain pan

8. Filters: MERV 7 per Section 23 3000.
9. Dampers: Provide dampers as indicated on drawings. Configure dampers to maximize the mixing of RA and OA. Provide jackshaft linkages for dampers more than 4 ft long.
10. OA damper: Low leakage, parallel blade type with integral airflow monitor, Ruskin IAQ. Return air damper: Parallel blade type, Ruskin CD-50. Relief air damper: Low leakage, opposed blade type with integral airflow monitor, Ruskin IAQ
11. Approved manufacturers: York, Temtrol, Trane, Air Enterprises Akron, Ohio, Industrial Sheet Metal Rockingham, NC, Haakon, or Marcraft Div of Johnson - Marcraft St. Louis, Mo. Scott Springfield, Pace, or Energy Labs

F. Rooftop Direct-Fired/Evap Cooled Makeup Air Unit

1. General: Factory fabricated, packaged rooftop, direct-fired with evap cooling, ETL Listed to ASNI Z83.4-1999, factory wired and tested (gas train, electrical components and air flow controls),
2. Unit Construction: Heavy gauge G90 galvanized steel casing with corrosion resistant fasteners, weatherproof with standing seam where roof panels are joined, all metal-to-metal surfaces sealed where exposed to the weather, 1-inch fiberglass insulation, discharge configuration as indicated on drawings, access doors or removable panels for ready access to all components, and lifting lugs.
3. Heating Section: Direct fired with cast aluminum burner, for use with natural gas at 900 – 1000 Btu/SCF HHV, SS mixing plates, Maxitrol or equivalent controls with 25:1 turndown, IRI or FM gas train, and all necessary safety and operating controls.
4. Cooling Section: Evaporative type, SS module construction, 12-inch media with 90% cooling effectiveness, with float-type makeup, 120V pump with discharge piping and corrosion-resistant distribution header, drain & overflow connections.
5. Fan Section: AMCA rated for both performance and sound, centrifugal type statically and dynamically balanced, permanently lubricated bearings with 100,000 Hr L-10 life at maximum cataloged speed, belt driven with drive sized for 150% of motor HP, pulleys with machined surfaces, adjustable sheaves for 15 Hp and less, motor per Section 23 0500, fan discharge flexible connection, and with fan and motor mounted on common base.
6. Electrical and Controls: Factory wired for service from a single-point power connection, with all necessary power and control components mounted in accessible and weather-protected enclosures, all wiring per the NEC, control transformer with secondary fusing, contacts for remote start/stop and monitoring of fan status, and discharge temperature sensor with all components necessary for discharge temperature control. All components UL listed, recognized, or classified where applicable.
7. Approved Manufacturers: Greenheck Model DGX, Spec Air, Trane, Reznor, or approved equal

PART 3 EXECUTION

3.01 DUCTWORK AND PLENUMS

A. Ductwork

1. Construct ductwork with wall thicknesses and reinforcing per the SMACNA HVAC Duct Construction Standards, Second Edition, 1995, and UMC 2006 Chapter 6,
2. Pressure Classes: Construct ductwork to the following pressure classes:

Duct Element Description	Relative Pressure	Pressure Class
From Outside Air Louver to Filter:	N	1"
From Air Handling Unit to Terminal Unit:	P	4"
From Single Zone AHU to Diffuser	P	2”
From Terminal Unit to Diffuser:	P	1"
From Return Grille to Fan:	N	1"
From Return Fan to Relief Louver:	P	1"
From Exhaust Register to Exhaust Fan:	N	2"

3. Minimum thickness for sheet metal ductwork: 26 gauge.
4. Sealing: Seal ductwork and plenums as follows:

Location	Seal Class: Supply Ducts ≤2 in. wg	Seal Class: Supply Ducts ≥2 in wg	Seal Class: Exhaust	Seal Class: Return
Outdoors	A	A	C	A
Unconditioned Spaces	B	A	C	B
Conditioned Spaces including RA Plenums	C	B	B	C

Seal Class	Description
A	All transverse joint, longitudinal seams and duct wall penetrations.
B	All transverse joints and longitudinal seams.
C	Transverse joints

   a. Apply duct sealer to inside of seams and joints. Do not use pressure sensitive tape as the primary sealant.
5. Clearance to earth: Maintain minimum 4-inch separation between ductwork insulation and earth.
6. Openings in Ductwork: During installation protect the open ends of ducts to prevent debris and dirt from entering.
7. Provide turning vanes in square elbows of low velocity supply and exhaust ductwork.
8. Collars: Where exposed ducts pass through walls, floors, or ceilings, provide a tight-fitting, flanged sheetmetal collar around duct and tight against finished surface to cover opening and present a neat appearance. Lock collar to duct.
9. Cross Breaking: Cross-break low velocity rectangular sheetmetal ducts on all four sides. Cross break sheet metal between standing seams or reinforcing angles. The center of cross break shall be of the required height to assure surfaces being rigid. Do not cross-break high velocity plenum panels.
10. Grilles Registers and Diffusers: Install plumb, affix to general construction as appropriate, make air-tight connection to ductwork, and adjust air flow pattern to achieve

appropriate velocities in the occupied zones. Request direction from Engineer if any question exists regarding proper air flow adjustment.

11. Duct Thermometers: Provide thermometers to indicate mixed air, outside air, and supply air of indoor air handling units over 2,500 cfm and where shown on the Drawings.
12. Test Holes: Provide test holes in ducts at locations where testing is required per Section 23 0593 and as requested by the T&B agent. Close test holes with rubber plugs. Reseal all insulated ductwork with the same insulation, jacket and vapor barrier material after T&B is complete.
13. Closure Systems:
    a. Rigid Air Ducts: Comply with UL 181A – Standard for Closure Systems for Use with Rigid Air Ducts and Air Connectors.
    b. Flexible Air Ducts: Comply with UL 181B – Standard for Closure Systems for Use with Flexible Air Ducts and Air Connectors.
14. Factory Made Air Ducts: Install in accordance with the terms of their listing and the manufacturer's recommendations.
15. Acoustic Insulation: See Section 23 0700, HVAC Insulation. Fabricate ductwork so the dimensions indicated on the drawings are the clear dimensions for air flow inside the acoustic insulation.
16. Coordination with Building Construction
    a. General: The drawings show the general intended configuration of the ductwork. Provide additional offsets where necessary to coordinate with the building construction or with the work of other disciplines. Transition ductwork as required at no change in contract price. Where this is necessary, submit for review and maintain the indicated flow areas.
    b. Ductwork is frequently routed through bar joists and between bar joists. Coordinate duct locations with joist submittals prior to fabrication.

B. Special Applications
1. Moisture Laden Ductwork: Stainless steel with all joints liquid-tight by continuous external welding. Welds shall be free from pits, runs, spatter and other imperfections. Pitch horizontal ductwork downward to intake opening. Where traps occur that collect water, provide a 1/2-inch half coupling welded to the bottom of the duct and pipe to spill over nearest drain. Include a properly sized trap in the drain piping.
2. Fume Hood Ductwork: Stainless steel with seams and joints continuously welded on the exterior. Spiral lock seam is not acceptable.
3. Shower Room Exhaust Ductwork: Aluminum
4. Ducts Handling Corrosive Vapors: Either stainless steel or galvanized steel with internal polyvinyl coating constructed and sealed as noted.
5. Underslab Ductwork: Galvanized steel, polyvinyl coated on the exterior, constructed and sealed for 2-inch SP, insulated per Section 23 0700, and concrete encased. Concrete thickness shall be as indicated on the drawings, but not less than 2-inch thick.
    a. Take care to prevent damaging ductwork when concrete is poured. Work with and provide guidance to the contractors responsible for pouring concrete and responsible for installing the building moisture protection system.
    b. Anchor ductwork not more than 4-ft on centers to prevent floating. Use minimum 12-gauge wire or 16-gauge straps. Protect openings in ductwork with wood or metal blocking.
    c. Pour concrete in maximum 12-inch lifts with each layer being allowed to set before pouring the next. Do not use power vibrators shall not be used in placement of concrete on or around ducts.

6. Fiberglass Ductwork (Ductboard)
    a. Provide fiberglass ductboard only where specifically indicated on the drawings and in this specification.
    b. Install per UMC-06 Standard 6-05 – Standard for Installation of Factory-Made Air Ducts and SMACNA Standard 1884-2003 – Fibrous Glass Duct Construction Standard.
    c. The drawings indicate required clear inside dimensions for air flow.
    d. Where a duct constructed of ductboard penetrates a wall or floor which requires a fire damper, smoke damper, or fire/smoke damper, install the FD, SMD or FSD in the wall per its listing, make sheet metal connections to the damper if required, and then transition back to ductboard.
7. Exterior Ductwork: Install ductwork as specified herein and insulate per Section 23 0700. Then enclose the exposed top and sides of ductwork with 28 gauge galvanized steel or 26-guage aluminum to protect the insulation. Repair any damage to the insulation jacket. Slope sheet metal enclosure to shed water.

C. Hangers and Supports
1. Securely support ducts per SMACNA and UMC Table 6-7. Provide support at each concentrated load and at each change in direction. Provide supports on each side of rectangular ducts and equipment. Where vertical ducts pass through floors or roofs, support with angles or other steel members attached to minimum two opposite sides of duct. Size supports to rigidly support the ductwork. Provide lateral support.
2. Hangers for terminal units: Minimum four 1" x 1/8" galvanized steel straps or two angle trapeze supports.
3. Horizontal Round Ducts: 30 inches and larger in diameter: Provide 2" x 2" x 1/8" black steel rolled angle ring on 6-ft centers, and support from angle.

D. Plenums
1. Single Wall Plenums: Shop fabricated minimum 16 gauge galvanized sheet steel. Horizontal and vertical panels are to be fabricated of 2' x 10' sheets. Unless otherwise dimensioned on the Drawings, access door frames are not to exceed 16-3/4 inch width. Where door width exceeds 16-3/4 inches, vertical panels shall be fabricated around 2" x 2" x 1/4" angle. If the plenum height or width exceeds 9 feet, provide a 2-1/2" x 1/8" continuous galvanized steel strip between each horizontal and vertical seam. Provide high velocity cement at each joint during panel assembly. Panels are to be bolted as shown on the details or tack welded at the Contractor's option; however, enough panels must be bolted to allow removal of equipment from the plenums. Cover interior surfaces with 2-inch thick, acoustical lining.
    a. Plenum Access Doors: Minimum two fastening devices that can be operated on either side of the door; these devices to be readily operated and moving parts to have bronze pins. All parts of the door shall be constructed of galvanized iron and shall be airtight. Latches: "Ventlock" No. 310 OAE.
2. Double Wall Plenums: Factory fabricated, Semco or equivalent. Submit shop drawings for review including overall configuration, construction details, access doors, erection drawings and structural calculations stamped by a registered structural engineer,.
    a. Factory fabricated, minimum 18 gauge galvanized steel outside, perforated galvanized steel inside, with 2-inch sound insulation between. Plenums downstream of final filters shall have solid inner panel.
    b. Heat transfer coefficient shall not exceed 0.0575 BTUH/SF-F at 75 deg F mean temperature. Pressure Ratings: 12 in. wg positive and 10 in. wg negative.
    c. Noise attenuation shall be as follows in decibels, re 10^{-12} watts.

	OCTAVE BAND							
	1	2	3	4	5	5	7	8
Attenuation, db:	26	30	36	41	34	36	44	37
Noise Absorption Coeff:	0.22	0.39	1.20	1.36	1.03	0.84	0.74	0.68

3.02 DUCTWORK ACCESSORIES

A. Dampers: Install dampers with shafts horizontal. Locate dampers so that actuators are readily accessible. Verify that dampers operate smoothly.

1. Manual Dampers (Balancing Dampers): Damper Types D1 through D23 are all suitable for use as manual balancing dampers. Provide locking quadrants.
2. Automatic Applications: The following damper types may be used for automatic applications: D4, D5, D6, D7, D21, D22 and D23. Provide damper actuators per Section 23 0900.

B. Flexible Connectors: Provide flexible connectors at locations indicated on the drawings and at the inlet and outlet of each fan directly connected to duct system. Select flexible connectors appropriate for the application. Provide steel spring vibration isolators spanning across flexible connections of isolated fan housings to prevent blow-apart due to horizontal displacement of fan housings.

C. Access Doors: Provide as required for access to all components located within ductwork. Locate to facilitate access to such components. Size as appropriate. In addition to locations specifically called out on the drawings or elsewhere in these specs, provide access doors at the following: FDs, SMDs, FSDs, instrumentation mounted within ductwork, fan bearings.

D. Turning Vanes: Provide turning vanes in square elbows of all supply ducts. Single wall turning vanes may be used in ducts up to 1500 FPM and 24-inch vane length. Provide double wall turning vanes in ducts exceeding either of these criteria.

E. Roof Curbs and Equipment Support Rails: Coordinate the location of roof curbs and rails with the roof structure, ductwork distribution, and other work. Install after roof deck is installed but before roof is insulated. Mount curbs and rails securely to deck per manufacturer's recommendations. Provide counterflashing as required.

F. Louvers: Coordinate louver size and construction with structural and architectural openings to assure proper fit. Securely fasten louver to internal structural members to withstand a force of 25 lb/sf plus a safety factor of 3.0.

G. Instrumentation: Install duct thermometers and filter gauges so they are easily readable from the operator level.

3.03 FLUES AND VENTS FOR FUEL-FIRED EQUIPMENT

A. General: Install per the drawings and these specifications, manufacturer's instructions, the terms of the vent's UL Listing, the UMC and NFPA-211.

1. Use the same type vent for the entire system from the equipment connection to the termination outside. Provide all fittings, transitions, adapters, supports, storm collars, etc.
2. Install per the venting requirements of the appliance manufacturer. Comply with clearances per UL Listing. Minimize offsets and resistance to flow. System shall develop a positive flow adequate to remove products of combustion to outside. Do not run any portion of the vent system through any supply or return air duct or plenum. Do not connect the vent from any Category I or II (non-positive pressure) appliance with any Category III or IV (positive pressure) appliance. Do not install any manually operated damper at any point in vent system.
3. Properly support the system and make provisions for thermal expansion. Install so as to prevent leakage of flue gases into the building. Provide drain connections where condensate is likely to accumulate, and pipe to spill over floor drain.

4. Provide ventilated thimbles where vents pass through walls, floors and roof. Paint all galvanized or aluminized steel parts exposed to the weather with one coat of corrosion and heat-resistant primer, and one coat of heat resistant paint.
5. Terminate low heat appliances as indicated on the drawings, but not less than:
   a. 3 ft above the highest point where the vent passes the roof.
   b. 2 ft above any portion of a building within a horizontal distance of 10 ft.
   c. 3 ft above any forced air inlet located within 10 ft.

B. Type B: If a draft damper is supplied with the appliance for installation in the flue, install it per manufacturer's instructions. If appliance is listed for use with a draft hood but is not supplied with one, provide a properly sized barometric draft regulator immediately in the vent outlet, and install per manufacturer's recommendations. Pitch vent up minimum 1/4-inch per foot. Join sections per manufacturer's recommendations using sheet metal screws or proprietary closure system of a UL Listed venting system. Provide vent cap,

C. Type III and IV: Install per the drawings and these specifications, per manufacturer's instructions, per the terms of the vent's UL listing, and per NFPA-211.

3.04 DAMPERS FOR FIRE AND SMOKE CONTROL

A. Select FDs, SMDs and FSDs as appropriate to the application. Dampers may be rectangular or round, and single-section or multi-section as required, but shall not be less than the duct sizes indicated on the drawings nor larger than the maximum sizes per the UL listing for a given style of damper. Provide transitions and sleeves as required.
1. FSDs may be used where SMDs are indicated provided they meet the required ratings of the indicated SMDs and provided the FSDs are installed in accordance with their listing.

B. Install dampers in accordance with their listing. Terminate acoustic lining at dampers as necessary to ensure proper damper operation. Install actuators and access doors on the side of the duct unless space conditions preclude this. Provide adequate clearance for proper operation, and minimum 36-inch clearance for servicing actuator.
1. When space conditions preclude installing actuators on the side, such components may be installed on the top or bottom of the duct provided good access to these components is maintained.
2. When size requires the use of multiple dampers, provide framing to ensure the dampers remain in place.
3. Provide a duct access door at each FD, SMD and FSD for inspection and maintenance. Provide minimum 1/2-inch high label, "SMOKE DAMPER," "FIRE DAMPER," or "FIRE/SMOKE DAMPER."

C. Test all SMDs and FSDs after the system is installed to ensure proper operation based on both smoke and fire signals. Advise Owner minimum 2 weeks in advance and invite him to observe these tests. Submit a written report with a table which identifies each such damper (along with plans which indicate each such damper); gives its size, type and model number; the date on which it was tested; the test results; and places for the initials of the person performing test for the contractor and the person witnessing test for owner. Should any dampers fail to operate properly, service them and demonstrate proper operation. Reset all dampers when the testing is complete.

3.05 FILTERS AND FILTER GAUGES

A. Provide one set of MERV-7 temporary filters until testing and balancing is complete. Then immediately before the system is turned over to the Owner at the completion of the project, remove these filters and provide the specified filters.

3.06 TERMINAL UNITS

A. Install terminal units so that controls and piping components are readily accessible for normal service and maintenance. Provide minimum 3 ft clear in front of control panels.

3.07 GRILLES REGISTERS AND DIFFUSERS

A. Install grilles, registers & diffusers (GRDs) square with building construction. Mount sidewall GRDs minimum, 3-inches above floor level. If GRDs have provisions to adjust the direction of air flow, submit a written recommendation regarding the best direction for air flows, obtain written approval from the Owner's Representative, and adjust GRDs accordingly.

B. Verify frame types with architectural RCPs prior to ordering GRDs.

3.08 CLOSEOUT ISSUES

A. Leakage Testing

1. Pressure test not less than 25% of the installed ductwork of each system rated at 3 in wg or more, either positive or negative pressure. Advise Owner's Representative when systems will be ready for testing. For large systems separate tests may be made on different sections. The Owner's representative will designate the sections to be tested, but not more than 24 hours in advance of test. Cap ends of ducts as required and provide equipment as required for testing.
2. Measure duct leakage per the SMACNA HVAC Duct Leakage Test manual. Leakage shall not exceed the following:

   $L_{max} = C_L P^{0.65}$, where

   L_{max} = maximum permitted leakage, cfm/100 sf of duct surface area

   C_L = Duct leakage class (cfm/100 sf at 1-inch wg)

   = 6 for rectangular sheet metal, rectangular fiberglass, and round flexible ducts

   = 3 for round and flat oval sheet metal or fiberglass ducts

   P = Test pressure. Test pressure shall match system pressure class.
3. If sample is defective, the contractor shall repair or modify the defective section and re-test it to demonstrate compliance. In addition, for each section which fails its original pressure test, the Owner's Representative will designate an additional ductwork section of similar size, for the Contractor to test. This section will be in addition to 25% area originally planned to be tested. .
4. Complete all leakage testing and repairs prior to concealing ducts.
5. Submit a test report that documents the test procedure and results. Include:
   a. Test equipment – model numbers, technical data, calibration data, etc.
   b. Drawings showing the extent of the systems tested.
   c. Test results.
   d. Dates, witnesses, and signatures of witnesses.

B. Testing and Balancing: Test and balance the complete air tempering system as specified in Section 23 0593. It is anticipated that the TAB effort will identify some system deficiencies. Work in a cooperative manner to identify the cause of these deficiencies. Where deficiencies aer due to defects in installation, or workmanship, repair as required and re-test to demonstrate proper performance.

C. Cleaning

1. All ducts, coils, housing, registers, grilles, fans, etc., shall be clean when installed and shall be kept clean until the system is completed. As the various parts of the system are installed, they shall be wiped or blown clean and openings taped dust-tight with heavy paper or cardboard until the system is completed and ready for testing. At that time all covers and protective wrappings shall be removed. Where one has been torn or previously removed, the duct, coil, register, etc., shall be carefully cleaned of any dirt or dust that has entered the opening.

END OF SECTION 23 3000

SECTION 26 0500

COMMON WORK RESULTS FOR ELECTRICAL

PART 1 GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of Contract, including General Conditions, Supplementary Conditions, and Division 1 Specification Sections apply to all Sections of Division 26.

B. The requirements listed under General Conditions and Supplementary Conditions and the General Requirements are applicable to this section and all subsequent sections of Division 26 and form a part of the contract.

C. See Division 2, Site Work for Trenching, Backfilling and Compaction requirements.

D. See Division 1, Coordination for additional requirements.

E. See Division 1, Submittals for additional requirements.

F. See Division 7, Joint Sealants for additional requirements.

1.02 SUMMARY

A. This Section includes general administrative and procedural requirements of electrical installations. The following administrative and procedural requirements are included in this Section to expand the requirements specified in Division 1:

1. Submittals
2. Coordination Drawings
3. Record Documents
4. Maintenance Manuals
5. Rough-Ins
6. Electrical Installations

1.03 CODES AND PERMITS

A. Perform electrical work in strict accordance with the applicable provisions of the National Electrical Code, Latest Edition; National Electric Safety Code, Latest Edition; the International Building Code, Latest Edition as adopted and interpreted by the State of New Mexico, City of Santa Fe, and the National Fire Protection Association (NFPA Regulations), current adopted edition. Provide all materials and labor necessary to comply with rules, regulations and ordinances. Where the drawings and/or specifications indicate materials or construction in excess of code requirements, the drawings and/or specifications shall govern. The Contractor shall hold and save the Engineer free and harmless from liability of any nature or kind arising from his failure to comply with codes and ordinances.

B. Secure and pay for all permits necessary for performance of the work. Pay for all utility connections unless otherwise specified herein.

C. The following lists applicable codes and standards that, as a minimum, shall be followed.

Applicable county and state electrical codes, laws and ordinances.

National Electrical Manufacturer's Association Standards

National Electrical Code

National Electrical Safety Code

Underwriters Laboratories, Inc. Standards

American National Standards Institute

American Society for Testing Materials Standards

Standards and requirements of local utility companies

National Fire Protection Association Standards

Institute of Electrical and Electronics Engineers Standards

Insulated Cable Engineers Association

Occupational Safety and Health Act

International Fire Code

Americans with Disabilities Act

Commercial and Industrial Insulation Standards (MICA)

1.04 RECORD DRAWINGS

A. Maintain a complete and accurate set of marked up blue-line prints showing information on the installed location and arrangement of all electrical work, and in particular, where changes were made during construction. Use red color to indicate additions or corrections to prints, green color to indicate deletions, and yellow color to indicate items were installed as shown. Keep record drawings accurate and up-to-date throughout the construction period. Record drawings may be reviewed and checked by the Construction Manager during the construction and in conjunction with review and approval of monthly pay requests. Include copies of all addenda, RFI's, bulletins, and change orders neatly taped or attached to record drawing set. Transmit drawings to the Architect at the conclusion of the project for delivery to the Owner's Representative.

B. Prepare record documents in accordance with the requirements in Division 1, Section "PROJECT CLOSEOUT." In addition to the requirements specified in Division 1, indicate installed conditions for:

1. All raceway systems including manholes, size and location (vertical & horizontal). Survey all conduit runs prior to backfill.
2. Equipment pad locations, dimensioned from prominent building lines and centers of conduit stub-ups.
3. Approved substitutions, Contract Modifications, and actual equipment and materials installed.

1.05 QUALIFICATIONS

A. All electricians shall be skilled in their respective trade.

1.06 SUBSTITUTIONS

A. Equipment submitted for substitution must fit the space conditions leaving adequate room for maintenance around all equipment. A minimum of 36 inches, or more if required by Code, must be maintained clear in front of all electrical panels, starters, gutters, or other electrical apparatus. Submit drawings showing the layout, size and exact method of interconnection of conduit, wiring and controls, which shall conform to the manufacturer's recommendations and these specifications. The scale of these drawings shall be scale of Contract Drawings. The Contractor shall bear the excess costs, by any and all crafts, of fitting the equipment into the space and the system designated. Where additional labor or material is required to permit equipment submitted for substitution to function in an approved manner, this shall be furnished and installed by the Contractor without additional cost to the Owner.

B. Equipment submitted for substitution shall be approved in writing by the Owner or his representative and shall be accompanied by the following:

1. A sample of each item submitted for substitution shall accompany the submittal.
2. Provide a unit price quotation with each item intended for substitution. Include a unit price for the specified item and a unit price for the intended substitute item. Provide a total (per item) of the differential payback to the Owner should the intended substitute item be approved as equivalent to that which is specified.
3. Reimburse the Owner for the Architect/Engineer's additional services required to review and process substitutions.

1.07 PRIOR APPROVAL

A. The Engineer will not review submittals for electrical equipment prior to bid ("Prior Approvals"). Refer to specification sections and drawings for requirements and approved vendors.

1.08 HAZARDOUS CONDITIONS

A. Protruding metal (bolts, steel angles, etc.) potentially hazardous to maintenance and operation personnel, shall be cut back and/or protected to reduce the risk of injury.

1.09 DEFINITIONS

A. Definitions of terms will be found in the National Electrical Code.

B. Whenever a term is used in this Specification which is defined in the Code, the definition given will govern its meaning in this Specification.

C. Whenever a technical term is used which does not appear in the Code, the definition to govern its meaning in these Specifications will be found in the Standard Dictionary of Electrical and Electronic Terms, published by the Institute of Electrical and Electronics Engineers, 445 Hoes Lane, Piscataway, New Jersey 08855-1331.

D. "Provide" means furnish, install, connect and test unless otherwise noted.

1.10 SUBMITTALS

A. The Contractor shall submit submittal brochures of equipment, fixtures and materials to be furnished under Division 26.

B. Unauthorized Substitutions: If substitute materials, equipment or systems are installed without prior review or are installed in a manner which is not in conformance with the requirement of this Specification and for which the Contractor has not received a written review, removal of the unauthorized materials and installation of those indicated or specified shall be provided at no change in contract amount.

C. Install equipment in accordance with the manufacturer's recommendations. Provide accessories and components for optimum operation as recommended by the manufacturer.

D. Costs for the preparation, correction, delivery, and return of the submittals shall be borne by the Contractor.

E. Complete data must be furnished showing performance, quality and dimensions. No equipment or materials shall be purchased prior to receiving written notification from the Architect/Engineer that submittals have been reviewed and marked either "NO EXCEPTIONS TAKEN" or "EXCEPTIONS AS NOTED." Submittals returned marked "EXCEPTIONS AS NOTED" do not require resubmittal provided that the Contractor agrees to comply with all exceptions noted in the submittal, and so states in a letter to the Architect/Engineer.

F. Review of Submittals: Submittals will be reviewed with reasonable promptness, but only for conformance with the design concept of the Project and for conformance with the information indicated on the Drawings and stated in the Specifications. Review of a separate item as such will not indicate review of the assembly in which the item functions. Review of submittals shall not relieve the Contractor of responsibility for any deviation from the requirements of the Contract Documents, nor for errors or omissions in the submittals; or for the accuracy of dimensions and quantities, the adequacy of connections, and the proper and acceptable fitting, execution, functioning and completion of the work. Review shall not relieve the Contractor of responsibility for the equipment fitting within the allotted space shown on the drawings with all clearances required for equipment operation, service and maintenance including a minimum of 3 feet clear in front of all electrical equipment and panels as defined by the National Electrical Code. Any relocation of mechanical and/or electrical equipment, materials and systems required to comply with minimum clearances shall be provided by the Contractor without additional cost under the Contract.

G. Shop Drawings: Unless the following information is included, shop drawings will be returned unchecked:

1. Cover sheet for each submittal, listing equipment, products, and materials, and referencing data and sections in Specifications and drawings. Clearly reference project name and provide space for a review stamp.

2. Cover sheet shall clearly identify deviations from specifications, and justification.

3. Include all related equipment in a single submittal to allow complete review. Similar equipment may be submitted under a common cover sheet.
4. Size, dimensions, and weight of equipment.
5. Equipment performance under specified conditions, not a copy of scheduled data on drawings.
6. Indicate actual equipment proposed, where data sheets indicate more than one (1) device or equipment.

H. Use of substitutions reviewed and checked by the Engineer does not relieve the Contractor from compliance with the Contract Documents. Contractor shall bear all extra expense resulting from the use of any substitutions where substitutions affect adjoining or related work required in this Division or other Divisions of this Specification.

I. If Contractor substitutes equipment for that drawn to scale on the drawings, he shall prepare a 1/4" = 1'-0" installation drawing for each equipment room where a substitution is made, using dimensions of substituted equipment, and including piping, and electrical equipment requirements, to verify that equipment will fit space with adequate clearances for maintenance. This 1/4" = 1'-0" fabrication drawing shall be submitted, for review by the Engineer with the shop drawing submittals of the substituted. Failure to comply with this requirement will result in the shop drawings being returned unchecked.

J. Submittals and one (1) resubmittal will be reviewed by the Architect/Engineer. If the Contractor fails to provide the required data with his second submittal, he will be charged for the third and subsequent reviews.

K. See Division 1 for additional submission requirements.

L. The Contractor shall submit a maximum amount of seven (7) copies of submittal brochures for review. Brochures shall be submitted within thirty (30) days after contract award. One (1) copy of all submittals will be retained by the Engineer, with the remaining six (6) sets returned to the Owner's Representative. Additional sets of submittals, if required by the Contractor, shall be reproduced by the Contractor from the reviewed and marked sets returned to the Contractor.

1.11 MAINTENANCE MANUALS

A. Prepare maintenance manuals in accordance with Division 1, Section "PROJECT CLOSEOUT." In addition to the requirements specified in Division 1, include the following information for equipment items:

1. Description of function, normal operating characteristics and limitations, performance curves, engineering data and tests, and complete nomenclature and commercial numbers of replacement parts.
2. Manufacturer’s printed operating procedures to include start-up, break-in, and routine and normal operating instructions; regulation, control, stopping, shutdown, and emergency instructions; and summer and winter operating instructions.
3. Maintenance procedures for routine preventative maintenance and troubleshooting; disassembly, repair, and reassembly; aligning and adjusting instructions.
4. Servicing instructions and lubrication charts and schedules.

1.12 COORDINATION DRAWINGS

A. Prepare coordination drawings in accordance with Division 1, Section "PROJECT COORDINATION", to a scale of 1/4" = 1'-0" or larger; detailing major elements, components, and systems of electrical equipment and materials in relationship with other systems, installations, and building components. Indicate locations where space is limited for installation and access and where sequencing and coordination of installations are of importance to the efficient flow of the Work, including (but not necessarily limited to) the following:

1. Indicate the proposed locations of major raceway systems, equipment, and materials. Include the following:
    a. Clearances for servicing equipment, including space for equipment disassembly

required for periodic maintenance.

b. Exterior wall and foundation penetrations.

c. Fire-rated wall and floor penetrations.

d. Equipment connections and support details.

e. Sizes and location of required concrete pads and bases.

2. Indicate scheduling, sequencing, movement, and positioning of large equipment into the building during construction.

3. Prepare floor plans, elevations, and details to indicate penetrations in floors, walls, and ceilings and their relationship to other penetrations and installations.

4. Prepare reflected ceiling plans to coordinate and integrate installations, air outlets and inlets, light fixtures, communications systems components, sprinklers, and other ceiling-mounted devices.

1.13 USE OF CADD FILES

A. Under certain conditions, the Contractor will be permitted the use of the Engineer's CADD files for documentation of as-builts, submittals, or coordination drawings.

B. The Engineer shall be compensated for the time required to format the CADD files for delivery to the Contractor. Such work may include removal of title blocks, professional seals, calculations, proprietary information, etc.

C. The Contractor shall complete the enclosed License, Indemnity and Warranty Agreement, complete with contractor's name, address, and Contractor's Representative signature prior to request for CADD file usage.

1.14 DRAWINGS AND SPECIFICATIONS

A. Electrical drawings are diagrammatic, but shall be followed as closely as actual construction and work of the other sections shall permit. Size and location of equipment is drawn to scale wherever possible. Do not scale from electrical drawings.

B. Drawings and specifications are for the assistance and guidance of the Contractor. Exact locations, distances, and levels will be governed by the building. The Contractor shall make use of data in all the Contract Documents to verify information at the building site.

C. In any case where there appears to be a conflict between that which is shown on the electrical drawings, and that shown in any other part of the Contract Documents, the Contractor shall notify and secure directions from the Owner’s Representative.

D. Drawings and specifications are intended to complement each other. Where a conflict exists between the requirements of the drawings and/or the specifications, request clarification. Do not proceed with work without direction.

E. The Owner’s Representative shall interpret the drawings and the specifications. The Owner’s Representative's interpretation as to the true intent and meaning thereof and the quality, quantity, and sufficiency of the materials and workmanship furnished there under shall be accepted as final and conclusive.

F. In the case of conflicts not clarified prior to the bidding deadline, use the most costly alternative (better quality, greater quantity, and larger size) in preparing the bid. A clarification will be issued to the successful bidder as soon as feasible after the award and, if appropriate, a deductive change order will be issued.

G. Where items are specified in the singular, this division shall provide the quantity as shown on drawings plus any spares or extras indicated on the drawings or in the specifications.

H. Investigate structural and finish conditions and arrange work accordingly. Provide all fittings, equipment, and accessories required for actual conditions.

1.15 SIMILAR MATERIALS

A. All items of a similar type shall be products of the same manufacturer.

B. Contractor shall coordinate among suppliers of various equipment to assure that similar equipment type is product of the same manufacturer.

1.16 DELIVERY, STORAGE AND HANDLING

A. Deliver products to the project properly identified with names, model numbers, types, grades, compliance labels, and other information needed for identification.

1.17 GUARANTEE-WARRANTY

A. See Division 1 for warranties.

B. The following guarantee is a part of the specifications and shall be binding on the Contractor:

"The Contractor guarantees that this installation is free from ALL defects. He agrees to replace or repair any part of the installation which may fail within a period of one (1) year after date established below, provided that such failure is due to defects in the materials or workmanship or to failure to follow the specifications and drawings. Warranty of the Contractor-furnished equipment or systems shall begin on the date the system or equipment is placed in operation for beneficial use of the Owner or occupancy by the Owner, whichever occurs first; such date to be determined in writing by means of issuing a 'Certificate of Substantial Completion', AIA Form G704."

C. The extent of guarantees or warranties by Equipment and/or Materials Manufacturers shall not diminish the requirements of the Contractor's guarantee-warranty to the Owner.

D. All items of electrical equipment furnished and installed under Division 26 shall be provided with a full two (2) year parts and labor warranty.

PART 2 PRODUCTS

2.01 QUALITY OF MATERIALS

A. All equipment and materials shall be new, and shall be the standard product of manufacturers regularly engaged in the production of electrical equipment, and shall be the manufacturer's latest design. Specific equipment, shown in schedules on drawings and specified herein, is to set forth a standard of quality and operation.

2.02 ALTITUDE RATINGS

A. Unless otherwise noted, all specified equipment capacities are for an altitude of 7,500 feet above sea level and adjustments to manufacturer's ratings must be made accordingly.

2.03 EQUIPMENT REQUIREMENTS

A. The electrical requirements for equipment specified or indicated on the drawings are based on information available at the time of design. If equipment furnished for installation has electrical requirements other than those indicated on the electrical drawings, make all adjustments to wire and conduit size, controls, over current protection and installation as required to accommodate the equipment supplied. Delineate all adjustments to the drawings reflecting the electrical system in a submittal to the Contract Administrator immediately upon knowledge of the required adjustment.

PART 3 EXECUTION

3.01 COOPERATION WITH OTHER TRADES

A. Coordinate all work so that the construction operations can proceed without harm to the Owner from interference, delay, or absence of coordination. The Contractor shall be responsible for the size and accuracy of all openings.

3.02 DRAWINGS

A. The electrical drawings show the general arrangement of equipment, conduit runs, etc., and shall be followed as closely as actual building construction and work of other trades will permit. Whenever discrepancies occur between plans and specifications, the most stringent shall govern. All Contract Documents shall be considered as part of the work. Coordinate with architectural, mechanical, and structural drawings. Because of the small scale of the electrical drawings, it is not possible to indicate all offsets, fittings and accessories which may be required. Provide all fittings, boxes, and accessories as may be required to meet actual conditions. Should conditions

necessitate a rearrangement of equipment, such departures and the reasons therefore, shall be submitted by the Contractor for review in the form of detailed drawings showing the proposed changes. No changes shall be made without the prior written approval. All changes shall be marked on record drawings.

B. Should any doubt or question arise in respect to the true meaning of the drawings or specifications, the question shall be submitted in writing.

C. Installation of all equipment shall be arranged to provide all clearances required for equipment operation, service, and maintenance, including minimum clearance, as defined by the National Electrical Code (NEC).

D. The installation of all concealed electrical systems shall be carefully arranged to fit within the available space without interference with adjacent structural and mechanical systems.

3.03 ELECTRICAL INSTALLATIONS

A. General: Sequence, coordinate, and integrate the various elements of electrical system, materials, and equipment. Comply with the following requirements:

1. Coordinate electrical systems, equipment, and materials installation with all other building components.
2. Verify all dimensions by field measurements.
3. Arrange for chases, slots, and openings in all other building components during progress of construction, to allow for electrical installations.
4. 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.
5. 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.
6. Where mounting heights are not detailed or dimensioned, install systems, materials, and equipment to provide the maximum clearance possible.
7. Coordinate connection of electrical systems with exterior underground utilities and services. Comply with requirements of governing regulations, franchised service companies, and controlling agencies. Provide required connection for each service.
8. Install systems, materials, and equipment to conform with approved submittal data, including coordination drawings, to greatest extent possible. Conform to arrangements indicated by the Contract Documents, recognizing that portions of the Work are shown only in diagrammatic form. Where coordination requirements conflict with individual system requirements, refer conflict to the Owner's Representative.
9. Install systems, materials, and equipment level and plumb, parallel and perpendicular to other building systems and components.
10. Install electrical equipment to facilitate servicing, maintenance, and repair or replacement of equipment components. As much as practical, connect equipment for ease of disconnecting, with minimum of interference with other installations.
11. Install systems, materials, and equipment giving right-of-way priority to systems requiring installation at a specified slope.

3.04 FIELD MEASUREMENTS

A. No extra compensation shall be claimed or allowed due to differences between actual dimensions, including dimensions of equipment, fixtures and materials furnished, and those indicated on the drawings. Contractor shall examine adjoining work, and shall report any work which must be corrected. Review of submittal data in accordance with paragraph "Submittals" shall in no manner relieve the Contractor of responsibility for the proper installation of the electrical work within the available space. Installation of equipment and systems within the building space shall be carefully coordinated by the Contractor.

3.05 EQUIPMENT SUPPORT

A. Provide support for equipment to the building structure. Provide all necessary structures, inserts, sleeves, firestops and hanging devices for installation of equipment. Coordinate installation of devices. Verify with the Owner's Representative that the devices and supports are adequate as intended and do not overload the building's structural components in any way.

3.06 PROTECTION OF MATERIALS AND EQUIPMENT

A. The Contractor shall be responsible for the protection of all work, materials and equipment furnished and installed under this section of the specifications, whether incorporated in the building or not.

B. All items of electrical equipment shall be stored in a protected weatherproof enclosure prior to installation within the building, or shall be otherwise protected from the weather in a suitable manner approved by the Engineer.

C. The Contractor shall provide protection for all work and shall be responsible for all damage done to property, equipment and materials. Storage of materials within the building shall be approved by the Construction Manager prior to such storage.

D. Conduit openings shall be closed with caps or plugs, or covered to prevent lodgment of dirt or trash during the course of installation. At the completion of the work, fixtures, equipment and materials shall be cleaned and polished thoroughly and delivered in a condition satisfactory to the Engineer.

3.07 EXCAVATION

A. Provide all excavation, trenching and backfilling required.

B. Slope sides of excavations to comply with codes and ordinances. Shore and brace as required for stability of excavation.

3.08 ERECTION OF METAL SUPPORTS AND ANCHORAGE

A. Cut, fit, and place miscellaneous metal fabrications accurately in location, alignment, and elevation to support and anchor electrical materials and equipment.

B. Field Welding: Comply with AWS "Structural Welding Code."

3.09 ERECTION OF WOOD SUPPORTS AND ANCHORAGE

A. Cut, fit, and place wood grounds, nailers, blocking, and anchorage accurately in location, alignment, and elevation to support and anchor electrical materials and equipment.

B. Select fastener sizes that will not penetrate members where opposite side will be exposed to view or will receive finish materials. Make tight connections between members. Install fasteners without splitting wood members.

C. Attach to substrates as required to support applied loads.

3.10 APPLICATION OF JOINT SEALERS

A. General: Comply with joint sealer manufacturer's printed application instructions applicable to products and applications indicated, except where more stringent requirements apply.

1. Comply with recommendations of ASTM C 962 for use of elastomeric joint sealants.
2. Comply with recommendations of ASTM C 790 for use of acrylic-emulsion joint sealants.

B. Immediately after sealant application and prior to time shinning or curing begins, tool sealants to form smooth, uniform beads; to eliminate air pockets; and to ensure contact and adhesion of sealant with sides of joint. Remove excess sealants from surfaces adjacent to joint. Do not use tooling agents that discolor sealants or adjacent surfaces or are not approved by sealant manufacturer.

3.11 CUTTING AND PATCHING

A. Perform cutting and patching in accordance with Division 1, Section "CUTTING AND PATCHING." In addition to the requirements specified in Division 1, the following requirements apply:

1. Perform cutting, fitting, and patching of electrical equipment and materials required to:
   a. Remove and replace defective Work.
   b. Remove and replace Work not conforming to requirements of the Contract Documents.
   c. Remove samples of installed Work as specified for testing.
   d. Install equipment and materials in existing structures.
   e. Upon written instructions from the Contracting Officer, uncover and restore Work to provide for Contracting Officer observation of concealed Work.
2. Provide and maintain temporary partitions or dust barriers adequate to prevent the spread of dust and dirt to adjacent areas.
3. During cutting and patching operations, protect adjacent installations.
4. Patch existing finished surfaces and building components using new materials matching existing materials and experienced installers.

3.12 MANUFACTURER'S INSTRUCTIONS

A. All equipment shall be installed in strict accordance with recommendations of the manufacturer. If such recommendations conflict with plans and specifications, the Contractor shall submit such conflicts to the Engineer who shall make such compromises as he deems necessary and desirable.

3.13 CONCRETE BASES AND HOUSEKEEPING PADS

A. Install concrete bases and housekeeping pads under all freestanding electrical equipment unless otherwise noted.

B. Contractor shall be responsible for the accurate dimensions of all pads and bases and shall furnish and install all anchor bolts, etc. Coordinate weight of concrete bases and housekeeping pads with the structural engineer.

C. All concrete bases and housekeeping pads shall conform to the requirements specified under Division 3, Concrete, portions of these specifications. Pad foundations shall be 4" high minimum, unless otherwise indicated on the drawings. Chamfer edges shall be 1". Faces shall be free of voids and rubbed smooth with Carborundum block after stripping forms. Tops shall be level. Provide dowel rods or other required material in floor for lateral stability and anchorage.

D. Equipment anchor bolts shall be set in a galvanized pipe or sheet metal sleeves 1" larger than bolt diameter. Anchor bolts shall be high strength steel J shape. Anchor bolt design shall be arranged and paid for by the Contractor.

3.14 TESTS

A. All tests shall be conducted in the presence of the designated and authorized Owner's Representative. The Contractor shall notify the Construction Manager one week in advance of all tests. The Contractor shall furnish all necessary equipment, materials, and labor to perform the required tests.

3.15 OPERATION AND MAINTENANCE INSTRUCTIONS

A. The Contractor shall furnish the complete operating and maintenance instructions covering all units of electrical equipment herein specified together with parts lists. Furnish four (4) copies of all the literature; each shall be suitably bound in loose leaf book form.

B. Operating and maintenance manuals as required herein shall be submitted for review not less than two (2) weeks prior to the date scheduled for the Contractor to provide Operating and Maintenance Instructions to the Owner as specified herein.

C. Upon completion of all work and all tests, Contractor shall furnish the necessary skilled labor and

helpers for operating the electrical systems and equipment for a period of five (5) days of eight (8) hours each. During this period, the Contractor shall instruct the Owner or his representative in the operations, adjustment and maintenance of all equipment furnished. Contractor shall provide at least two weeks notice in advance of this period, with a written schedule of each training session, the subject of the session, the Contractors' representatives who plan to attend the session, and the time for each session.

D. The Contractor shall record the instruction and training sessions using a DVD camcorder, and at the completion and acceptance (by Owner and Architect) of the training sessions, the Contractor shall submit (2) copies of the DVD.

3.16 CERTIFICATIONS

A. Before receiving final payment, certify in writing that all equipment furnished and all work done is in compliance with all applicable codes mentioned in these specifications. Submit certifications and acceptance certificates to the Owner's Representative including proof of delivery of O&M manuals, spare parts required, and equipment warranties which shall be bound with O&M manuals.

3.17 OPERATION PRIOR TO ACCEPTANCE

A. Operation of equipment and systems installed by the Contractor for the benefit of the Owner prior to substantial completion will be allowed providing a written agreement between the Owner and the Contractor has established warranty and other responsibilities to the satisfaction of both parties.

B. Operation of equipment and systems installed by the Contractor, for the benefit of the Contractor, except for the purposes of testing and balancing will not be permitted without a written agreement between the Owner and the Contractor establishing warranty and other responsibilities.

3.18 SITE VISITS AND OBSERVATION OF CONSTRUCTION

A. The Owner's Representative/Engineer will make periodic visits to the project site at various stages of construction in order to observe the progress and quality of various aspects of the Contractor's work, in order to determine in general if such work is proceeding in accordance with the Contract Documents. This observation by the Architect/Engineer however, shall in no way release the Contractor from his complete responsibility to supervise, direct, and control all construction work and activities, nor shall the Architect/Engineer have authority over, or a responsibility to means, methods, techniques, sequences, or procedures of construction provided by the Contractor or for safety precautions and programs, or for failure by the Contractor to comply with all law, regulations, and codes.

END OF SECTION 26 0500

SECTION 26 0519
LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES

PART 1 GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SUMMARY

A. Section Includes:
   1. Copper building wire rated 600 V or less.
   2. Connectors, splices, and terminations rated 600 V and less.

B. Related Requirements:
   1. Section 260513 "Medium-Voltage Cables" for single-conductor, cable splices, and terminations for electrical distribution systems with 601 to 35,000 V.

1.03 DEFINITIONS

A. RoHS: Restriction of Hazardous Substances.

B. VFC: Variable-frequency controller.

1.04 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Product Schedule: Indicate type, use, location, and termination locations.

1.05 INFORMATIONAL SUBMITTALS

A. Qualification Data: For testing agency.

B. Field quality-control reports.

1.06 QUALITY ASSURANCE

A. Testing Agency Qualifications: Member company of NETA.
   1. Testing Agency's Field Supervisor: Certified by NETA to supervise on-site testing.

PART 2 PRODUCTS

2.01 COPPER BUILDING WIRE

A. Description: Flexible, insulated and uninsulated, drawn copper current-carrying conductor with an overall insulation layer or jacket, or both, rated 600 V or less.

B. 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. Okonite Company (The).
   2. Southwire Company.

C. Standards:
   1. Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and use.
   2. RoHS compliant.
   3. Conductor and Cable Marking: Comply with wire and cable marking according to UL's "Wire and Cable Marking and Application Guide."

D. Conductors: Copper, complying with ASTM B 3 for bare annealed copper and with ASTM B 8 for stranded conductors.

E. Conductor Insulation:

1. Type THHN and Type THWN-2: Comply with UL 83.
2. Type XHHW-2: Comply with UL 44.

2.02 CONNECTORS AND SPLICES

A. Description: Factory-fabricated connectors, splices, and lugs of size, ampacity rating, material, type, and class for application and service indicated; listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and use.

B. 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. 3M Electrical Products.
2. ILSCO.
3. Thomas & Betts Corporation; A Member of the ABB Group.

C. Lugs: One piece, seamless, designed to terminate conductors specified in this Section.

1. Material: Copper.
2. Type: Two hole with standard barrels.
3. Termination: Compression.

PART 3 EXECUTION

3.01 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.

C. VFC Output Circuits Cable: Extra-flexible stranded for all sizes.

D. Power-Limited Fire Alarm and Control: Solid for No. 12 AWG and smaller.

3.02 CONDUCTOR INSULATION AND MULTICONDUCTOR CABLE APPLICATIONS AND WIRING METHODS

A. Service Entrance: Type THHN/THWN-2, single conductors in raceway.

B. Exposed Feeders: Type THHN/THWN-2, single conductors in raceway.

C. Feeders Concealed in Ceilings, Walls, Partitions, and Crawlspaces: Type THHN/THWN-2, single conductors in raceway.

D. Feeders below Slabs-on-Grade, and Underground: Type THHN/THWN-2, single conductors in raceway.

E. Feeders Installed below Raised Flooring: Type THHN/THWN-2, single conductors in raceway.

F. Exposed Branch Circuits, Including in Crawlspaces: Type THHN/THWN-2, single conductors in raceway.

G. Branch Circuits Concealed in Ceilings, Walls, and Partitions: Type THHN/THWN-2, single conductors in raceway.

H. Branch Circuits below Slabs-on-Grade, and Underground: Type THHN/THWN-2, single conductors in raceway.

I. Branch Circuits Installed below Raised Flooring: Type THHN/THWN-2, single conductors in raceway.

J. Cord Drops and Portable Appliance Connections: Type SO, hard service cord with stainless-steel, wire-mesh, strain relief device at terminations to suit application.

K. VFC Output Circuits: Type XHHW-2 in metal conduit.

3.03 INSTALLATION OF CONDUCTORS AND CABLES

A. Conceal cables in finished walls, ceilings, and below floors unless otherwise indicated.

B. Complete raceway installation between conductor and cable termination points according to Section 260533 "Raceways and Boxes for Electrical Systems" prior to pulling conductors and cables.

C. 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.

D. Use pulling means, including fish tape, cable, rope, and basket-weave wire/cable grips, that will not damage cables or raceway.

E. Install exposed cables parallel and perpendicular to surfaces of exposed structural members, and follow surface contours where possible.

F. Support cables according to Section 260529 "Hangers and Supports for Electrical Systems."

3.04 CONNECTIONS

A. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A-486B.

B. Make splices, terminations, and taps that are compatible with conductor material and that possess equivalent or better mechanical strength and insulation ratings than unspliced conductors.

C. Wiring at Outlets: Install conductor at each outlet, with at least 6 inches (150 mm) of slack.

3.05 IDENTIFICATION

A. Identify and color-code conductors and cables according to Section 260553 "Identification for Electrical Systems."

B. Identify each spare conductor at each end with identity number and location of other end of conductor, and identify as spare conductor.

3.06 SLEEVE AND SLEEVE-SEAL INSTALLATION FOR ELECTRICAL PENETRATIONS

A. Install sleeves and sleeve seals at penetrations of exterior floor and wall assemblies. Comply with requirements in Section 260544 "Sleeves and Sleeve Seals for Electrical Raceways and Cabling."

3.07 FIRESTOPPING

A. Apply firestopping to electrical penetrations of fire-rated floor and wall assemblies to restore original fire-resistance rating of assembly according to Section 078413 "Penetration Firestopping."

3.08 FIELD QUALITY CONTROL

A. Testing Agency: Owner will engage a qualified testing agency to perform tests and inspections.

B. Perform tests and inspections.

1. After installing conductors and cables and before electrical circuitry has been energized, test service entrance and feeder conductors feeding the following critical equipment and services for compliance with requirements:

2. Perform each of the following visual and electrical tests:

a. Inspect exposed sections of conductor and cable for physical damage and correct connection according to the single-line diagram.

b. Test bolted connections for high resistance using one of the following:

1) A low-resistance ohmmeter.

2) Calibrated torque wrench.

3) Thermographic survey.

c. Inspect compression-applied connectors for correct cable match and indentation.

d. Inspect for correct identification.

e. Inspect cable jacket and condition.

f. Insulation-resistance test on each conductor for ground and adjacent conductors. Apply a potential of 500-V dc for 300-V rated cable and 1000-V dc for 600-V rated cable for a one-minute duration.

g. Continuity test on each conductor and cable.

h. Uniform resistance of parallel conductors.

C. Cables will be considered defective if they do not pass tests and inspections.

D. Prepare test and inspection reports to record the following:

1. Procedures used.
2. Results that comply with requirements.
3. Results that do not comply with requirements, and corrective action taken to achieve compliance with requirements.

END OF SECTION 26 0519

SECTION 26 0526
GROUNDING AND BONDING

PART 1 GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SUMMARY

A. This Section includes grounding of electrical systems and equipment. Grounding requirements specified in this section may be supplemented by special requirements of systems described in other sections.

B. Related Sections include the following:

1. Division 26 Section "Lightning Protection" for additional grounding and bonding materials.

1.03 SUBMITTALS

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

B. Qualification Data: For firms and persons specified in "Quality Assurance" Article.

C. Field Test Reports: Submit written test reports to include the following:

1. Test procedures used.
2. Test results that comply with requirements.
3. Results of failed tests and corrective action taken to achieve test results that comply with requirements.

1.04 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.

1. Comply with UL 467, "Standard for Grounding and Bonding Equipment."
2. Comply with IEEE 837 "IEEE Standard for Qualifying Permanent Connections used in Substation Grounding."

B. Comply with NFPA 70; for overhead-line construction and medium-voltage underground construction, comply with IEEE C2.

C. Comply with NFPA 780 and UL 96 when interconnecting with lightning protection system.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. Grounding Conductors, Cables, Connectors, and Rods:
    a. Apache Grounding/Erico Inc.
    b. Chance/Hubbell
    c. Copperweld Corp.
    d. Erico Inc.; Electrical Products Group
    e. Framatome Connectors/Burndy Electrical
    f. Harger Lightning Protection, Inc.
    g. Heary Brothers Lightning Protection Co.
    h. Ideal Industries, Inc.
    i. ILSCO

j. Kearney/Cooper Power Systems
k. Lightning Master Corp.
l. Lyncole XIT Grounding
m. O-Z/Gedney Co.; a business of the EGS Electrical Group
n. Raco, Inc.; Division of Hubbell
o. Thomas & Betts, ElectricaL

2.02 GROUNDING CONDUCTORS

A. For insulated conductors, comply with Division 26 Section "Conductors and Cables."

B. Equipment Grounding Conductors: Insulated with green-colored insulation.

C. Isolated Ground Conductors: Insulated with green-colored insulation with yellow stripe. On feeders with isolated ground, use colored tape, alternating bands of green and yellow tape to provide a minimum of three bands of green and two bands of yellow.

D. Grounding Electrode Conductors: Stranded cable.

E. Underground Conductors: Bare, tinned, stranded, unless otherwise indicated.

F. Bare Copper Conductors: Comply with the following:
1. Solid Conductors: ASTM B 3
2. Assembly of Stranded Conductors: ASTM B 8
3. Tinned Conductors: ASTM B 33

G. Copper Bonding Conductors: As follows:
1. Bonding Cable: 28 kcmil, 14 strands of No. 17 AWG copper conductor, 1/4 inch in diameter.
2. Bonding Conductor: No. 4 or No. 6 AWG, stranded copper conductor.
3. Bonding Jumper: Bare copper tape, braided bare copper conductors, terminated with copper ferrules; 1-5/8 inches wide and 1/16 inch thick.
4. Tinned Bonding Jumper: Tinned-copper tape, braided copper conductors, terminated with copper ferrules; 1-5/8 inches wide and 1/16 inch thick.

H. Grounding Bus: Bare, annealed copper bars of rectangular cross section, with insulators.

2.03 CONNECTOR PRODUCTS

A. Meet the requirements of IEEE 837 and UL 467; listed for use for specific types, sizes, and combinations of conductors and connected items.

B. Bolted Connectors: Bolted-pressure-type connectors, or compression type.

C. Welded Connectors: Exothermic-welded type, in kit form, and selected per manufacturer's written instructions.

D. Irreversible Compression Connectors In Kit Form, selected per manufacturer's written instructions.

E. Connectors listed by UL for direct burial in earth or embedment in concrete applications according to UL 467.

F. Connectors for Lightning Protection listed according to UL 96.

2.04 GROUNDING ELECTRODES

A. Ground Rods: Sectional type; copper-clad steel.
1. Size: 3/4 by 120 inches in diameter.

B. Chemical Electrodes: UL listed copper tube, straight or L-shaped, filled with nonhazardous chemical salts, terminated with a 4/0 bare conductor. Provide backfill material recommended by manufacturer.

C. Ground Bar: 12 inches long or greater length as indicated on the drawings, fabricated from 1/4 inch thick, 4 inch wide copper stock with 1.75 inch x 1.75 inch NEMA bolt hole pattern. Mount ground bar on 2700V standoff insulators.

D. Ground Electrode Backfill Material

1. Bentonite clay or equivalent commercial ground enhancement backfill material for ground rods and cable type electrodes.
2. Backfill material, when at 300% moisture content ((weight of water/weight of material) x 100) shall have a resistivity of approximately 250 ohm-cm and a pH of 8 to 10

PART 3 EXECUTION

3.01 APPLICATION

A. Use only copper conductors for both insulated and bare grounding conductors.

B. In raceways, use insulated equipment grounding conductors.

C. Exothermic-Welded Connections or Irreversible Compression Connection: Use for connections to structural steel and for underground connections, except those at test wells.

D. Equipment Grounding Conductor Terminations: Use bolted pressure clamps.

E. Ground Rod Clamps at Test Wells: Use bolted pressure clamps with at least two bolts.

F. Grounding Bus: Install in electrical and telephone equipment rooms, in rooms housing service equipment, and elsewhere as indicated.

1. Use insulated spacer rated 2700V; space 1 inch from wall and support from wall 6 inches above finished floor, unless otherwise indicated.
2. At doors, route the bus up to the top of the door frame, across the top of the doorway, and down to the specified height above the floor.

G. Underground Grounding Conductors: Use tinned-copper conductor, No. 2/0 AWG minimum. Bury at least 24 inches below grade or bury 12 inches above duct bank when installed as part of the duct bank.

3.02 EQUIPMENT GROUNDING CONDUCTORS

A. Comply with NFPA 70, Article 250, for types, sizes, and quantities of equipment grounding conductors, unless specific types, larger sizes, or more conductors than required by NFPA 70 are indicated.

B. Install insulated equipment grounding conductors in all feeders and circuits.

C. Busway Supply Circuits: Install insulated equipment grounding conductor from the grounding bus in the switchgear, switchboard, or distribution panel to equipment grounding bar terminal on busway.

D. Computer Outlet Circuits: Install insulated equipment grounding conductor in branch-circuit runs from computer-area power panels or power-distribution units.

E. X-Ray Equipment Circuits: Install insulated equipment grounding conductor in circuits supplying x-ray equipment.

F. Isolated Grounding Receptacle Circuits: Install an insulated equipment grounding conductor connected to the receptacle grounding terminal. Isolate grounding conductor from raceway and from panelboard grounding terminals. Terminate at equipment grounding conductor terminal of the applicable derived system or service, unless otherwise indicated.

G. Isolated Equipment Enclosure Circuits: For designated equipment supplied by a branch circuit or feeder, isolate equipment enclosure from supply raceway with a nonmetallic raceway fitting listed for the purpose. Install fitting where raceway enters enclosure, and install a separate equipment grounding conductor. Isolate equipment grounding conductor from raceway and from panelboard grounding terminals. Terminate at equipment grounding conductor terminal of the applicable derived system or service, unless otherwise indicated.

H. Nonmetallic Raceways: Install an equipment grounding conductor in nonmetallic raceways unless they are designated for telephone or data cables.

I. Air-Duct Equipment Circuits: Install an equipment grounding conductor to duct-mounted electrical devices operating at 120 V and more, including air cleaners and heaters. Bond conductor to each unit and to air duct.

J. Water Heater, Heat-Tracing, and Antifrost Heating Cables: Install a separate equipment grounding conductor to each electric water heater, heat-tracing, and antifrost heating cable. Bond conductor to heater units, piping, connected equipment, and components.

K. Signal and Communication Systems: For telephone, alarm, voice and data, and other communication systems, provide No. 4 AWG minimum insulated grounding conductor in raceway from grounding electrode system to each service location, terminal cabinet, wiring closet, and central equipment location.

1. Service and Central Equipment Locations and Wiring Closets: Terminate grounding conductor on a 1/4-by-2-by-12-inch grounding bus.

2. Terminal Cabinets: Terminate grounding conductor on cabinet grounding terminal.

L. Metal Poles Supporting Outdoor Lighting Fixtures: Provide a grounding electrode in addition to installing a separate equipment grounding conductor with supply branch-circuit conductors.

M. Common Ground Bonding with Lightning Protection System: Bond electrical power system ground directly to lightning protection system grounding conductor at closest point to electrical service grounding electrode. Use bonding conductor sized same as system grounding electrode conductor, and install in conduit.

3.03 MAIN GROUND ELECTRODE SYSTEM

A. Use the building concrete grade beam to make a concrete encased main grounding electrode; conductor shall be reinforcing steel:

1. Make one reinforcing bar, located in the bottom one-third of the footing, electrically continuous around the entire perimeter of the building. The reinforcing bar shall be at least #6 size and uncoated. Bond the reinforcing bars together by exothermically welding #4/0 AWG ground cable across splices.

3.04 INSTALLATION

A. Ground Rods: 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.

1. Drive ground rods until tops are 2 inches (50 mm) below finished floor or final grade, unless otherwise indicated.

2. Interconnect ground rods with grounding electrode conductors. Use exothermic welds, except at test wells and as otherwise indicated. Make connections without exposing steel or damaging copper coating.

B. Grounding Conductors: Route along shortest and straightest paths possible, unless otherwise indicated. Avoid obstructing access or placing conductors where they may be subjected to strain, impact, or damage.

1. Where grounding conductors are required in PVC conduits or bare, do not completely encircle conduit or conductor with steel clamp or other steel devices.

2. Where grounding conductor is routed in steel conduit, bond both ends of conduit to grounding conductor with full size conductor.

C. Bonding Straps and Jumpers: Install so vibration by equipment mounted on vibration isolation hangers and supports is not transmitted to rigidly mounted equipment. Use exothermic-welded connectors for outdoor locations, unless a disconnect-type connection is required; then, use a bolted clamp. Bond straps directly to the basic structure taking care not to penetrate any adjacent parts. Install straps only in locations accessible for maintenance.

D. Metal Water Service Pipe: Provide 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 by grounding clamp connectors. Where a dielectric main water fitting is installed, connect grounding conductor to street side of fitting. Bond metal grounding conductor conduit or sleeve to conductor at each end.

E. Water Meter Piping: Use braided-type bonding jumpers to electrically bypass water meters. Connect to pipe with grounding clamp connectors.

F. Bond interior metal piping systems and metal air ducts to equipment grounding conductors of associated pumps, fans, blowers, electric heaters, and air cleaners. Use braided-type bonding straps.

G. Bond each aboveground portion of gas piping system upstream from equipment shutoff valve.

H. Install one test well for each service at the ground rod electrically closest to the service entrance. Set top of well flush with finished grade or floor.

I. Electrical Room Grounding Bus: Space 1 inch from wall and support from wall 6 inches above finished floor, except as otherwise indicated.

3.05 CONNECTIONS

A. General: Make connections so galvanic action or electrolysis possibility is minimized. Select connectors, connection hardware, conductors, and connection methods so metals in direct contact will be galvanically compatible.

1. Use electroplated or hot-tin-coated materials to ensure high conductivity and to make contact points closer to order of galvanic series.
2. Make connections with clean, bare metal at points of contact.
3. Make aluminum-to-steel connections with stainless-steel separators and mechanical clamps.
4. Make aluminum-to-galvanized steel connections with tin-plated copper jumpers and mechanical clamps.
5. Coat and seal connections having dissimilar metals with inert material to prevent future penetration of moisture to contact surfaces.

B. Exothermic-Welded Connections: Comply with manufacturer's written instructions. Welds that are puffed up or that show convex surfaces indicating improper cleaning are not acceptable.

C. Equipment Grounding Conductor Terminations: For No. 8 AWG and larger, use pressure-type grounding lugs. No. 10 AWG and smaller grounding conductors may be terminated with winged pressure-type connectors.

D. Noncontact Metal Raceway Terminations: If metallic raceways terminate at metal housings without mechanical and electrical connection to housing, terminate each conduit with a grounding bushing. Connect grounding bushings with a bare grounding conductor to grounding bus or terminal in housing. Bond electrically noncontinuous conduits at entrances and exits with grounding bushings and bare grounding conductors, unless otherwise indicated.

E. Connections at Test Wells: Use compression-type connectors on conductors and make bolted- and clamped-type connections between conductors and ground rods.

F. Common Ground Bonding with Lightning Protection System: Bond electric power system ground directly to lightning protection system grounding conductor at closest point to electric service grounding electrode. Use bonding conductor sized same as system grounding conductor and install in conduit.

G. Tighten screws and bolts for grounding and bonding 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.

H. Compression-Type Connections: Use hydraulic compression tools to provide correct circumferential pressure for compression connectors. Use tools and dies recommended by connector manufacturer. Provide embossing die code or other standard method to make a visible indication that a connector has been adequately compressed on grounding conductor.

I. Moisture Protection: If insulated grounding conductors are connected to ground rods or grounding buses, insulate entire area of connection and seal against moisture penetration of insulation and cable.

3.06 UNDERGROUND DISTRIBUTION SYSTEM GROUNDING

A. Duct Banks: Install a grounding conductor with at least 50 percent ampacity of the largest phase conductor in the duct bank or if conductor size is not known, use 4/0 AWG.

B. Manholes and Handholes: Install a driven ground rod 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 a 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 tape or heat-shrunk insulating sleeve from 2 inches above to 6 inches below concrete. Seal floor opening with waterproof, nonshrink grout.

C. Connections to Manhole Components: Connect 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 conductor. Train conductors level or plumb around corners and fasten to manhole walls. Connect to cable armor and cable shields as recommended by manufacturer of splicing and termination kits.

D. Pad-Mounted Transformers and Switches: Install two ground rods and counterpoise circling pad. Ground pad-mounted equipment and noncurrent-carrying metal items associated with substations by connecting them to underground cable and grounding electrodes. Use tinned-copper conductor not less than No. 2 AWG for counterpoise and for taps to equipment ground pad. Bury counterpoise not less than 18 inches below grade and 6 inches from the foundation.

3.07 FIELD QUALITY CONTROL

A. Testing Agency: Engage a qualified testing agency to perform tests and inspections per section 26 08 80 “Electrical Acceptance Testing.”

B. Testing: Perform the following field quality-control testing:

1. After installing grounding system but before permanent electrical circuitry has 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, and at ground test wells. Measure ground resistance not less than two full days after the last trace of precipitation, and without the 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. Perform tests, by the fall-of-potential method according to IEEE 81.

3. Provide drawings locating each ground rod and ground rod assembly and other grounding electrodes, identify each by letter in alphabetical order, and key to the record of tests and observations. Include the number of rods driven and their depth at each location and include observations of weather and other phenomena that may affect test results. Describe measures taken to improve test results.

a. Equipment Rated 500 kVA and Less: 10 ohms

b. Equipment Rated 500 to 1000 kVA: 5 ohms

c. Equipment Rated More Than 1000 kVA: 3 ohms

d. Substations and Pad-Mounted Switching Equipment: 5 ohms

e. Manhole Grounds: 10 ohms

4. Excessive Ground Resistance: If resistance to ground exceeds specified values, notify Architect promptly and include recommendations to reduce ground resistance.

END OF SECTION 26 0526

SECTION 26 0529
HANGERS AND SUPPORTS FOR ELECTRICAL SYSTEMS

PART 1 GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SUMMARY

A. Section Includes:
   1. Steel slotted support systems.
   2. Aluminum slotted support systems.
   3. Nonmetallic slotted support systems.
   4. Conduit and cable support devices.
   5. Support for conductors in vertical conduit.
   6. Structural steel for fabricated supports and restraints.
   7. Mounting, anchoring, and attachment components, including powder-actuated fasteners, mechanical expansion anchors, concrete inserts, clamps, through bolts, toggle bolts, and hanger rods.
   8. Fabricated metal equipment support assemblies.

B. Related Requirements:
   1. Section 260548.16 "Seismic Controls for Electrical Systems" for products and installation requirements necessary for compliance with seismic criteria.

1.03 ACTION SUBMITTALS

A. Product Data: For each type of product.
   1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for the following:
      a. Slotted support systems, hardware, and accessories.
      b. Clamps.
      c. Hangers.
      d. Sockets.
      e. Eye nuts.
      f. Fasteners.
      g. Anchors.
      h. Saddles.
      i. Brackets.
   2. Include rated capacities and furnished specialties and accessories.

B. Shop Drawings: For fabrication and installation details for electrical hangers and support systems.
   1. Hangers. Include product data for components.
   2. Slotted support systems.
   3. Equipment supports.

4. Vibration Isolation Base Details: Detail fabrication including anchorages and attachments to structure and to supported equipment. Include adjustable motor bases, rails, and frames for equipment mounting.

C. Delegated-Design Submittal: For hangers and supports for electrical systems.
   1. Include design calculations and details of hangers.
   2. Include design calculations for seismic restraints.

1.04 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Reflected ceiling plan(s) and other details, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of the items involved:
   1. Suspended ceiling components.
   2. Ductwork, piping, fittings, and supports.
   3. Structural members to which hangers and supports will be attached.
   4. Size and location of initial access modules for acoustical tile.
   5. Items penetrating finished ceiling, including the following:
      a. Luminaires.
      b. Air outlets and inlets.
      c. Speakers.
      d. Sprinklers.
      e. Access panels.
      f. Projectors.

B. Seismic Qualification Data: Certificates, for hangers and supports for electrical equipment and 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.

C. Welding certificates.

1.05 QUALITY ASSURANCE

A. Welding Qualifications: Qualify procedures and personnel according to AWS D1.1/D1.1M.

B. Welding Qualifications: Qualify procedures and personnel according to the following:
   1. AWS D1.1/D1.1M.
   2. AWS D1.2/D1.2M.

PART 2 PRODUCTS

2.01 PERFORMANCE REQUIREMENTS

A. Delegated Design: Engage a qualified professional engineer, as defined in Section 014000 "Quality Requirements," to design hanger and support system.

B. Seismic Performance: Hangers and supports shall withstand the effects of earthquake motions determined according to ASCE/SEI 7.
   1. The term "withstand" means "the supported equipment and systems will remain in place without separation of any parts when subjected to the seismic forces specified and the supported equipment and systems will be fully operational after the seismic event."
   2. Component Importance Factor: 1.5.

3. Insert requirements for Component Amplification Factor and Component Response Modification Factor.

C. Surface-Burning Characteristics: Comply with ASTM E 84; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.

1. Flame Rating: Class 1.
2. Self-extinguishing according to ASTM D 635.

2.02 SUPPORT, ANCHORAGE, AND ATTACHMENT COMPONENTS

A. Steel Slotted Support Systems: Preformed steel channels and angles with minimum 13/32-inch-diameter holes at a maximum of 8 inches in at least one surface.

1. Standard: Comply with MFMA-4 factory-fabricated components for field assembly.
2. Material for Channel, Fittings, and Accessories: Galvanized steel.
3. Channel Width: Selected for applicable load criteria.
4. Metallic Coatings: Hot-dip galvanized after fabrication and applied according to MFMA-4.
5. Nonmetallic Coatings: Manufacturer's standard PVC, polyurethane, or polyester coating applied according to MFMA-4.
6. Painted Coatings: Manufacturer's standard painted coating applied according to MFMA-4.
7. Protect finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.

B. Aluminum Slotted Support Systems: Extruded-aluminum channels and angles with minimum 13/32-inch- diameter holes at a maximum of 8 inches o.c. in at least one surface.

1. Standard: Comply with MFMA-4 factory-fabricated components for field assembly.
2. Channel Material: 6063-T5 aluminum alloy.
3. Fittings and Accessories Material: 5052-H32 aluminum alloy.
4. Channel Width: Selected for applicable load criteria 1-5/8 inches.
5. Nonmetallic Coatings: Manufacturer's standard PVC, polyurethane, or polyester coating applied according to MFMA-4.
6. Painted Coatings: Manufacturer's standard painted coating applied according to MFMA-4.
7. Protect finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.

C. Conduit and Cable Support Devices: Steel hangers, clamps, and associated fittings, designed for types and sizes of raceway or cable to be supported.

D. Support for Conductors in Vertical Conduit: Factory-fabricated assembly consisting of threaded body and insulating wedging plug or plugs for nonarmored 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 made of 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. Powder-Actuated Fasteners: Threaded-steel stud, for use in hardened portland cement concrete, steel, or wood, with tension, shear, and pullout capacities appropriate for supported loads and building materials where used.

2. Mechanical-Expansion Anchors: Insert-wedge-type, zinc-coated steel, for use in hardened portland cement concrete, with tension, shear, and pullout capacities appropriate for supported loads and building materials where used.
3. Concrete Inserts: Steel or malleable-iron, slotted support system units are similar to MSS Type 18 units and comply with MFMA-4 or MSS SP-58.
4. Clamps for Attachment to Steel Structural Elements: MSS SP-58 units are suitable for attached structural element.
5. Through Bolts: Structural type, hex head, and high strength. Comply with ASTM A 325.
6. Toggle Bolts: All Stainless-steel springhead type.
7. Hanger Rods: Threaded steel.

2.03 FABRICATED METAL EQUIPMENT SUPPORT ASSEMBLIES

A. Description: Welded or bolted structural-steel shapes, shop or field fabricated to fit dimensions of supported equipment.

B. Materials: Comply with requirements in Section 055000 "Metal Fabrications" for steel shapes and plates.

PART 3 EXECUTION

3.01 APPLICATION

A. Comply with the following standards for application and installation requirements of hangers and supports, except where requirements on Drawings or in this Section are stricter:
1. NECA 1.
2. NECA 101
3. NECA 102.
4. NECA 105.
5. NECA 111.

B. Comply with requirements in Section 078413 "Penetration Firestopping" for firestopping materials and installation for penetrations through fire-rated walls, ceilings, and assemblies.

C. Comply with requirements for raceways and boxes specified in Section 260533 "Raceways and Boxes for Electrical Systems."

D. Maximum Support Spacing and Minimum Hanger Rod Size for Raceways: Space supports for EMT, IMC, and RMC as required by NFPA 70. Minimum rod size shall be 1/4 inch in diameter.

E. Multiple Raceways or Cables: Install trapeze-type supports fabricated with steel slotted or other 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 two-bolt conduit clamps.

F. 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.

3.02 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, according to 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.
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 comply with seismic-restraint strength and anchorage requirements.

E. Drill holes for expansion anchors in concrete at locations and to depths that avoid the need for reinforcing bars.

3.03 INSTALLATION OF FABRICATED METAL SUPPORTS

A. Comply with installation requirements in Section 055000 "Metal Fabrications" for site-fabricated metal supports.

B. Cut, fit, and place miscellaneous metal supports accurately in location, alignment, and elevation to support and anchor electrical materials and equipment.

C. Field Welding: Comply with AWS D1.1/D1.1M.

3.04 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. Concrete materials, reinforcement, and placement requirements are specified in Section 033000 "Cast-in-Place Concrete."

C. Anchor equipment to concrete base as follows:

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.

3.05 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. Touchup: Comply with requirements in Section 099113 "Exterior Painting", Section 099123 "Interior Painting" and Section 099600 "High-Performance Coatings" for cleaning and touchup painting of field welds, bolted connections, and abraded areas of shop paint on miscellaneous metal.

C. Galvanized Surfaces: Clean welds, bolted connections, and abraded areas and apply galvanizing-repair paint to comply with ASTM A 780.

END OF SECTION 26 0529

SECTION 26 0533

RACEWAYS AND BOXES FOR ELECTRICAL SYSTEMS

PART 1 GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SUMMARY

A. Section Includes:

1. Metal conduits and fittings.
2. Nonmetallic conduits and fittings.
3. Metal wireways and auxiliary gutters.
4. Nonmetal wireways and auxiliary gutters.
5. Surface raceways.
6. Boxes, enclosures, and cabinets.
7. Handholes for exterior underground wiring.

B. Related Requirements:

1. Section 078413 "Penetration Firestopping" for firestopping at conduit and box entrances.
2. Section 260543 "Underground Ducts and Raceways for Electrical Systems" for exterior ductbanks, manholes, and underground utility construction.
3. Section 270528 "Pathways for Communications Systems" for conduits, wireways, surface pathways, innerduct, boxes, faceplate adapters, enclosures, cabinets, and handholes serving communications systems.

1.03 DEFINITIONS

A. ARC: Aluminum rigid conduit.

B. GRC: Galvanized rigid steel conduit.

C. IMC: Intermediate metal conduit.

1.04 ACTION SUBMITTALS

A. Product Data: For surface raceways, wireways and fittings, floor boxes, hinged-cover enclosures, and cabinets.

B. Shop Drawings: For custom enclosures and cabinets. Include plans, elevations, sections, and attachment details.

1.05 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Conduit routing plans, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of items involved:

1. Structural members in paths of conduit groups with common supports.
2. HVAC and plumbing items and architectural features in paths of conduit groups with common supports.

B. Seismic Qualification Data: Certificates, for enclosures, cabinets, and conduit racks and their mounting provisions, including those for internal components, from manufacturer.

1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.
2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.

3. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.
4. Detailed description of conduit support devices and interconnections on which the certification is based and their installation requirements.

C. Source quality-control reports.

PART 2 PRODUCTS

2.01 METAL CONDUITS AND FITTINGS

A. Metal Conduit:

1. Listing and Labeling: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
2. GRC: Comply with ANSI C80.1 and UL 6.
3. ARC: Comply with ANSI C80.5 and UL 6A.
4. IMC: Comply with ANSI C80.6 and UL 1242.
5. PVC-Coated Steel Conduit: PVC-coated rigid steel conduit.
   a. Comply with NEMA RN 1.
   b. Coating Thickness: 0.040 inch (1 mm), minimum.
6. EMT: Comply with ANSI C80.3 and UL 797.
7. FMC: Comply with UL 1; zinc-coated steel.
8. LFMC: Flexible steel conduit with PVC jacket and complying with UL 360.

B. Metal Fittings:

1. Comply with NEMA FB 1 and UL 514B.
2. Listing and Labeling: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
3. Fittings, General: Listed and labeled for type of conduit, location, and use.
4. Conduit Fittings for Hazardous (Classified) Locations: Comply with UL 1203 and NFPA 70.
5. Fittings for EMT:
   a. Material: Steel.
   b. Type: compression.
6. 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.
7. Coating for Fittings for PVC-Coated Conduit: Minimum thickness of 0.040 inch (1 mm), with overlapping sleeves protecting threaded joints.

C. Joint Compound for IMC, GRC, or ARC: Approved, as defined in NFPA 70, by authorities having jurisdiction for use in conduit assemblies, and compounded for use to lubricate and protect threaded conduit joints from corrosion and to enhance their conductivity.

2.02 NONMETALLIC CONDUITS AND FITTINGS

A. Nonmetallic Conduit:

1. Listing and Labeling: Nonmetallic conduit shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
2. ENT: Comply with NEMA TC 13 and UL 1653.
3. RNC: Type EPC-40-PVC, complying with NEMA TC 2 and UL 651 unless otherwise indicated.
4. LFNC: Comply with UL 1660.

B. Nonmetallic Fittings:
   1. Fittings, General: Listed and labeled for type of conduit, location, and use.
   2. Fittings for ENT and RNC: Comply with NEMA TC 3; match to conduit or tubing type and material.
      a. Fittings for LFNC: Comply with UL 514B.
   3. Solvents and Adhesives: As recommended by conduit manufacturer.

2.03 METAL WIREWAYS AND AUXILIARY GUTTERS

A. Description: Sheet metal, complying with UL 870 and NEMA 250, sized according to NFPA 70.
   1. Metal wireways installed outdoors shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

B. Fittings and Accessories: Include covers, couplings, offsets, elbows, expansion joints, adapters, hold-down straps, end caps, and other fittings to match and mate with wireways as required for complete system.

C. Wireway Covers: Hinged type unless otherwise indicated.

D. Finish: Manufacturer's standard enamel finish.

2.04 NONMETALLIC WIREWAYS AND AUXILIARY GUTTERS

A. Listing and Labeling: Nonmetallic wireways and auxiliary gutters shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

B. Description: Fiberglass polyester, extruded and fabricated to required size and shape, without holes or knockouts. Cover shall be gasketed with oil-resistant gasket material and fastened with captive screws treated for corrosion resistance. Connections shall be flanged and have stainless-steel screws and oil-resistant gaskets.

C. Description: PVC, extruded and fabricated to required size and shape, and having snap-on cover, mechanically coupled connections, and plastic fasteners.

D. Fittings and Accessories: Couplings, offsets, elbows, expansion joints, adapters, hold-down straps, end caps, and other fittings shall match and mate with wireways as required for complete system.

2.05 SURFACE RACEWAYS

A. Listing and Labeling: Surface raceways and tele-power poles shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

B. Surface Metal Raceways: Galvanized steel with snap-on covers complying with UL 5. Manufacturer's standard enamel finish in color selected by Architect.

C. Surface Nonmetallic Raceways: Two- or three-piece construction, complying with UL 5A, and manufactured of rigid PVC with texture and color selected by Architect from manufacturer's standard colors. Product shall comply with UL 94 V-0 requirements for self-extinguishing characteristics.

2.06 BOXES, ENCLOSURES, AND CABINETS

A. General Requirements for Boxes, Enclosures, and Cabinets: Boxes, enclosures, and cabinets installed in wet locations shall be listed for use in wet locations.

B. Sheet Metal Outlet and Device Boxes: Comply with NEMA OS 1 and UL 514A.

C. Cast-Metal Outlet and Device Boxes: Comply with NEMA FB 1, aluminum, Type FD, with gasketed cover.

D. Nonmetallic Outlet and Device Boxes: Comply with NEMA OS 2 and UL 514C.

E. Metal Floor Boxes:

1. Material: Cast 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.

F. Luminaire Outlet Boxes: Nonadjustable, designed for attachment of luminaire weighing 50 lb (23 kg). Outlet boxes designed for attachment of luminaires weighing more than 50 lb (23 kg) shall be listed and marked for the maximum allowable weight.

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. Box extensions used to accommodate new building finishes shall be of same material as recessed box.

J. Device Box Dimensions: 4 inches square by 2-1/8 inches deep (100 mm square by 60 mm deep) Gangable boxes are allowed.

K. Hinged-Cover Enclosures: Comply with UL 50 and NEMA 250, with continuous-hinge cover with flush latch unless otherwise indicated.
1. Metal Enclosures: Steel, finished inside and out with manufacturer's standard enamel.
2. Nonmetallic Enclosures: Plastic.
3. Interior Panels: Steel; all sides finished with manufacturer's standard enamel.

L. Cabinets:
1. NEMA 250, galvanized-steel box with removable interior panel and removable front, finished inside and out with manufacturer's standard enamel.
2. Hinged door in front cover with flush latch and concealed hinge.
3. Key latch to match panelboards.
4. Metal barriers to separate wiring of different systems and voltage.
5. Accessory feet where required for freestanding equipment.
6. Nonmetallic cabinets shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

2.07 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. Standard: Comply with SCTE 77.
2. Traffic loading rated.
3. Configuration: Designed for flush burial with integral closed bottom unless otherwise indicated.
4. Cover: Weatherproof, secured by tamper-resistant locking devices and having structural load rating consistent with enclosure and handhole location.
5. Cover Finish: Nonskid finish shall have a minimum coefficient of friction of 0.50.

6. Cover Legend: Molded lettering, "ELECTRIC".
7. Conduit Entrance Provisions: Conduit-terminating fittings shall mate with entering ducts for secure, fixed installation in enclosure wall.
8. Handholes 12 Inches Wide by 24 Inches Long and Larger: Have inserts for cable racks and pulling-in irons installed before concrete is poured.

2.08 SOURCE QUALITY CONTROL FOR UNDERGROUND ENCLOSURES

A. Handhole and Pull-Box Prototype Test: Test prototypes of handholes and boxes for compliance with SCTE 77. Strength tests shall be for specified tier ratings of products supplied.
   1. Tests of materials shall be performed by an independent testing agency.
   2. Strength tests of complete boxes and covers shall be by either an independent testing agency or manufacturer. A qualified registered professional engineer shall certify tests by manufacturer.
   3. Testing machine pressure gages shall have current calibration certification complying with ISO 9000 and ISO 10012 and traceable to NIST standards.

PART 3 EXECUTION

3.01 RACEWAY APPLICATION

A. Outdoors: Apply raceway products as specified below unless otherwise indicated:
   1. Exposed Conduit: GRC.
   2. Concealed Conduit, Aboveground: GRC.
   3. Underground Conduit: RNC, Type EPC-40-PVC concrete encased where indicated.
   4. Connection to Vibrating Equipment (Including Transformers and Hydraulic, Pneumatic, Electric Solenoid, or Motor-Driven Equipment): LFNC.
   5. Boxes and Enclosures, Aboveground: NEMA 250, Type 3R.

B. Indoors: Apply raceway products as specified below unless otherwise indicated:
   1. Exposed, Not Subject to Physical Damage: EMT.
   2. Exposed, Not Subject to Severe Physical Damage: EMT.
   3. Exposed and Subject to Severe Physical Damage: GRC. Raceway locations include the following:
      a. Loading dock.
      b. Corridors used for traffic of mechanized carts, forklifts, and pallet-handling units.
      c. Mechanical, electrical rooms and central plant.
   4. Concealed in Ceilings and Interior Walls and Partitions: EMT.
   5. Connection to Vibrating Equipment (Including Transformers and Hydraulic, Pneumatic, Electric Solenoid, or Motor-Driven Equipment): FMC, except use LFMC in damp or wet locations.
   6. Damp or Wet Locations: GRC.
   7. Boxes and Enclosures: NEMA 250, Type 1, except use NEMA 250, Type 4 stainless steel in institutional and commercial kitchens and damp or wet locations.

C. Minimum Raceway Size: 3/4-inch (21-mm) 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 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.

E. Install nonferrous conduit or tubing for circuits operating above 60 Hz. Where aluminum raceways are installed for such circuits and pass through concrete, install in nonmetallic sleeve.

F. Do not install aluminum conduits, boxes, or fittings in contact with concrete or earth.

G. Install surface raceways only where indicated on Drawings.

H. Do not install nonmetallic conduit where ambient temperature exceeds 120 deg F (49 deg C).

3.02 INSTALLATION

A. **Slabs on grade or Elevated Slabs: Conduits are NOT ALLOWED to be installed in concrete slabs on grade, OR in elevated slabs.**

B. Comply with requirements in Section 260529 "Hangers and Supports for Electrical Systems" for hangers and supports.

C. Comply with NECA 1 and NECA 101 for installation requirements except where requirements on Drawings or in this article are stricter. Comply with NECA 102 for aluminum conduits. Comply with NFPA 70 limitations for types of raceways allowed in specific occupancies and number of floors.

D. Do not install raceways or electrical items on any "explosion-relief" walls or rotating equipment.

E. Do not fasten conduits onto the bottom side of a metal deck roof.

F. Keep raceways at least 6 inches (150 mm) away from parallel runs of flues and steam or hot-water pipes. Install horizontal raceway runs above water and steam piping.

G. Complete raceway installation before starting conductor installation.

H. Arrange stub-ups so curved portions of bends are not visible above finished slab.

I. 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 (300 mm) of changes in direction.

J. Make bends in raceway using large-radius preformed ells. Field bending shall be according to NFPA 70 minimum radii requirements. Use only equipment specifically designed for material and size involved.

K. Conceal conduit within finished walls, and ceilings unless otherwise indicated. Install conduits parallel or perpendicular to building lines.

L. Support conduit within 12 inches (300 mm) of enclosures to which attached.

M. 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.

N. 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.

O. Coat field-cut threads on PVC-coated raceway with a corrosion-preventing conductive compound prior to assembly.

P. Raceway Terminations at Locations Subject to Moisture or Vibration: Use insulating bushings to protect conductors including conductors smaller than No. 4 AWG.

Q. 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 (35mm) trade size and insulated throat metal bushings on 1-1/2-inch (41-mm) trade size and larger conduits terminated with locknuts. Install insulated throat metal grounding bushings on service conduits.

R. Install raceways square to the enclosure and terminate at enclosures with locknuts. Install locknuts hand tight plus 1/4 turn more.

S. Do not rely on locknuts to penetrate nonconductive coatings on enclosures. Remove coatings in the locknut area prior to assembling conduit to enclosure to assure a continuous ground path.

T. Cut conduit perpendicular to the length. For conduits 2-inch (53-mm) trade size and larger, use roll cutter or a guide to make cut straight and perpendicular to the length.

U. Install pull wires in empty raceways. Use polypropylene or monofilament plastic line with not less than 200-lb (90-kg) tensile strength. Leave at least 12 inches (300 mm) of slack at each end of pull wire. Cap underground raceways designated as spare above grade alongside raceways in use.

V. Surface Raceways:

1. Install surface raceway with a minimum 2-inch (50-mm) radius control at bend points.
2. Secure surface raceway with screws or other anchor-type devices at intervals not exceeding 48 inches (1200 mm) and with no less than two supports per straight raceway section. Support surface raceway according to manufacturer's written instructions. Tape and glue are not acceptable support methods.

W. 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.

X. 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. Conduit extending from interior to exterior of building.
4. Conduit extending into pressurized duct and equipment.
5. Conduit extending into pressurized zones that are automatically controlled to maintain different pressure set points.
6. Where otherwise required by NFPA 70.

Y. Comply with manufacturer's written instructions for solvent welding RNC and fittings.

Z. Expansion-Joint Fittings:

1. Install in each run of aboveground RNC that is located where environmental temperature change may exceed 30 deg F (17 deg C) and that has straight-run length that exceeds 25 feet (7.6 m). Install in each run of aboveground RMC and EMT conduit that is located where environmental temperature change may exceed 100 deg F (55 deg C) and that has straight-run length that exceeds 100 feet (30 m).
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 (70 deg C) temperature change.

b. Outdoor Locations Exposed to Direct Sunlight: 155 deg F (86 deg C) temperature change.

c. Indoor Spaces Connected with Outdoors without Physical Separation: 125 deg F (70 deg C) 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 (0.06 mm per meter of length of straight run per deg C) of temperature change for PVC conduits. Install fitting(s) that provide expansion and contraction for at least 0.000078 inch per foot of length of straight run per deg F (0.0115 mm per meter of length of straight run per deg C) of temperature change for metal conduits.

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. Install conduit supports to allow for expansion movement.

AA. 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 subject to severe physical damage.

2. Use LFMC or LFNC in damp or wet locations not subject to severe physical damage.

BB. Mount boxes at heights indicated on Drawings. If mounting heights of boxes are not individually indicated, give priority to ADA requirements. Install boxes with height measured to bottom of box unless otherwise indicated.

CC. Recessed Boxes in Masonry Walls: Saw-cut opening for box in center of cell of masonry block, and install box flush with surface of wall. Prepare block surfaces to provide a flat surface for a raintight connection between box and cover plate or supported equipment and box.

DD. Horizontally separate boxes mounted on opposite sides of walls so they are not in the same vertical channel.

EE. Locate boxes so that cover or plate will not span different building finishes.

FF. Support boxes of three gangs or more from more than one side by spanning two framing members or mounting on brackets specifically designed for the purpose.

GG. Fasten junction and pull boxes to or support from building structure. Do not support boxes by conduits.

HH. Set metal floor boxes level and flush with finished floor surface.

II. Set nonmetallic floor boxes level. Trim after installation to fit flush with finished floor surface.

3.03 INSTALLATION OF UNDERGROUND CONDUIT

A. Direct-Buried Conduit:

1. Excavate trench bottom to provide firm and uniform support for conduit. Prepare trench bottom as specified in Section 312000 "Earth Moving" for pipe less than 6 inches (150 mm) in nominal diameter.

2. Install backfill as specified in Section 312000 "Earth Moving."

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 (300 mm) of finished grade, make final conduit connection at end of run and complete backfilling with normal compaction as specified in Section 312000 "Earth Moving."

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 (75 mm) of concrete for a minimum of 12 inches (300 mm) 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 (1500 mm) from edge of foundation or equipment base. Install insulated grounding bushings on terminations at equipment.
6. Warning Planks: Bury warning planks approximately 12 inches (300 mm) above direct-buried conduits but a minimum of 6 inches (150 mm) below grade. Align planks along centerline of conduit.
7. Underground Warning Tape: Comply with requirements in Section 260553 "Identification for Electrical Systems."

3.04 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 (12.5-mm) sieve to No. 4 (4.75-mm) 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 (25 mm) above finished grade.

D. Install handholes with bottom below frost line, below grade.

E. 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.

F. 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.

3.05 SLEEVE AND SLEEVE-SEAL INSTALLATION FOR ELECTRICAL PENETRATIONS

A. Install 0sleeves and sleeve seals at penetrations of exterior floor and wall assemblies. Comply with requirements in Section 260544 "Sleeves and Sleeve Seals for Electrical Raceways and Cabling."

3.06 FIRESTOPPING

A. Install firestopping at penetrations of fire-rated floor and wall assemblies. Comply with requirements in Section 078413 "Penetration Firestopping."

3.07 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.

3.08 IDENTIFICATION

A. Identify Raceways of Certain Systems with colored conduit and banding: Conduits shall have color factory applied full length with colored bands for exposed or accessible raceways of the following systems for identification. Bands shall be pre-tensioned, snap- around colored plastic sleeves, colored adhesive marking tape, or a combination of the two. Make each color band 1 inch wide, completely encircling conduit, and place adjacent bands of two-color markings in contact, side by side. Install bands at changes in direction, at penetrations of walls (both sides) and floors and at 10-foot maximum intervals in straight runs.

1. Fire Alarm System: Red
2. Security Systems: White
3. BAS: Purple
4. 120/208V Normal Power: Black
5. 277/480V Normal Power: Black with White Band
6. 120/208V Life Safety Emergency Power: Yellow
7. 277/480V Life Safety Emergency Power: Yellow with Black Band
8. 120/208V Critical Emergency Power: Blue
9. 277/480V Critical Emergency Power: Blue with Black Band
10. 120/208V Equipment (including X-Ray)

B. Emergency Power: Orange

1. 277/480V Equipment (including X-Ray)

C. Emergency Power: Orange with Black Band

1. Grounding Green
2. ATS Controls Silver with Blue Band
3. Med Gas Alarms: Silver with Yellow Band
4. 120 Volt Control: Silver
5. Computer System: Silver
6. TV Systems: Silver
7. Paging: Silver
8. Telephone: Silver

D. Identify junction, pull, and connection boxes: Code-required caution sign for boxes shall be pressure- sensitive, self-adhesive label indicating system voltage in black, preprinted on orange background. Install on outside of box cover. Also label box covers with identity of contained circuits. Use black permanent marker in concealed and pressure-sensitive plastic labels at exposed locations and similar labels. Work must be performed in a craftsman-like manner.

E. Use conductors with color factory-applied the entire length of the conductors except as follows under which conditions field applied color-coding methods may be used in lieu of factory-coded sire for sizes larger than No. 10 AWG:

1. Apply colored, pressure-sensitive plastic tape in half–lapped turns for a distance of 6 inches from terminal points and in pull access points are made. Apply the last two laps of tape with no tension to prevent possible unwinding. Use ¾ inch wide tape in colors as specified. Do not obliterate cable identification markings by taping. Tape locations may be adjusted slightly to prevent such obliteration.

F. Tag or label conductors as follows:

1. Future Connections: Conductors indicated to be for future connection or connection under another contract with identification indicating source and circuit numbers.

2. Multiple Circuits: Where multiple branch circuits are present in the same box the neutral conductor shall be labeled to match corresponding circuit numbers.

END OF SECTION 26 0533

SECTION 26 0543

UNDERGROUND DUCTS AND RACEWAYS FOR ELECTRICAL SYSTEMS

PART 1 GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specifications Sections, apply to this section.

1.02 SUMMARY

A. This Section includes the following:

1. Ducts in direct buried duct banks.
2. Ducts in concrete encased duct banks.
3. Handholes and handhole accessories.

B. Related Sections include the following:

1. Division 26, Section 26 05 26, “Grounding and Bonding” for clamps and connectors for grounding metallic handhole accessories, and testing of ground.

1.03 SUBMITTALS

A. Product Data: For the following:

1. Handhole hardware.
2. Conduit and ducts, including elbows, bell ends, bends, fittings, and solvent cement.
3. Duct bank materials, including spacers and miscellaneous components.
4. Warning tape.

B. Coordination Drawings: Show duct profiles and coordination with other utilities and underground structures. Include plans and sections drawn to scale, and show all bends and location of expansion fittings.

C. Product Test Reports: Indicate compliance of manholes with ASTM C 857 and ASTM C 858, based on factory inspection.

1.04 QUALITY ASSURANCE

A. Electrical Components, Devices, and Accessories Including Ducts for Communications and Telephone Service: Listed and labeled as defined in NFP A 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

B. Comply with ANSI C2.

C. Comply with NFPA 70.

1.05 DELIVERY, STORAGE AND HANDLING

A. Deliver ducts to project site with ends capped. Store nonmetallic ducts with supports to prevent **bending, warping, and deforming.**

1.06 COORDINATION

A. Coordinate layout and installation of ducts and handholes with final arrangement of other utilities and site grading, as determined in the field.

B. Coordinate elevations of ducts and duct bank entrances into handholes with final profiles of conduits as determined by coordination with other utilities and underground obstructions. Revise locations and elevations from those indicated as required to suit field conditions and to ensure duct runs drain to handholes, and as approved by Architect.

PART 2 PRODUCTS

2.01 PRODUCTS AND MANUFACTURERS

A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the work include, but are not limited to, the following:

1. Nonmetallic Ducts and Accessories:
   a. Cantex, Inc.
   b. Certainteed Corporation, Pipe & Plastics Group
   c. Lamson & Sessions; Carlon Electrical Products
   d. Manhattan/CDT/Cole-Flex
   e. Spiraduct/AFC Cable Systems, Inc.

2.02 DUCTS

A. Rigid Nonmetallic Conduit: NEMA TC 2, Type EPC-40-PVC, UL 651, with matching fittings by the same manufacturer as the conduit, complying with NEMA TC 3 and 514B.

B. Rigid Nonmetallic Conduit: NEMA TC 2, Type EPC-80-PVC, UL 651, with matching fittings by the same manufacturer as the conduit, complying with NEMA TC 3 and UL 514B.

C. Plastic Utilities Duct: NEMA TC 6, Type EB-20-PVC, ASTM F 512, UL 651A, with matching fittings by the same manufacturer as the conduit, complying with NEMA TC 9.

D. Plastic Utilities Duct: NEMA TC 6, Type DB-60-PVC, ASTM F 512, with matching fittings by the same manufacturer as the conduit, complying with NEMA TC 9.

2.03 HANDHOLES

A. Fiberglass Handholes: Molded fiberglass, with 6-inch square cable entrance at each side and weatherproof cover with nonskid finish and legend. Unit, when buried, shall be designed to support AASHTO H10 loading.

B. Cover Legend: “ELECTRIC” or “TELECOMMUNICATIONS” or “CABLE TV” or “BLUE PHONES”, or “PARKING ACCESS”, or “HELIPAD” or “SITE SIGNAGE” as applicable.

2.04 ACCESSORIES

A. Duct Spacers: Rigid PVC interlocking spacers, selected to provide minimum duct spacings and cover depths indicated while supporting ducts during concreting and backfilling; produced by the same manufacturer as the ducts.

B. Grounding Materials: Comply with Division 16, Section 26 05 26, Grounding and Bonding for Electrical Systems.

C. Pulling Eye and Iron Pockets: Recess pulling eyes and irons in pockets approximately 8" x 7" x 4" deep with reusable lids.

D. Duct Sealing Compound: Nonhardening, safe for contact with human skin, not deleterious to cable insulation, and workable at temperatures as low as 35^{o} F. Capable of withstanding temperature of 300^{o} F without slump and of adhering to clean surfaces of plastic ducts, metallic conduits, conduit coatings, concrete, masonry, lead, cablesheaths, cable jackets, insulation materials, and common metals.

E. Warning Tape: Underground line warning tape specified in Division 26, Section 26 05 53, “Electrical Identification”.

F. Signage: Metal backed Butyrate sign, weather resistant, non-fading, preprinted cellulose acetate with 0.0396-inch galvanized steel backing, yellow background with 0.5-inch letters to read, 'Confined Space. Authorized Personnel Only.'

2.05 CONSTRUCTION MATERIALS

A. Waterproofing: Comply with Division 7 Section 'Composite Sheet Waterproofing.'

B. Dampproofing: Comply with Division 7 Section ‘Bituminous Dampproofing.'

C. Mortar: Comply with ASTM C 270, Type M, except for quantities less than 2.0 Cu. Ft. where packaged mix complying with ASTM C 387, Type M, may be used.

D. Concrete: Use 3000 PSI minimum, 28-day compressive strength and 3/8-inch maximum aggregate size. Concrete and reinforcement are specified in Division 3 Section 'Cast-in-Place Concrete.'

PART 3 EXECUTION

3.01 APPLICATION

A. Underground Ducts for Electrical Cables Higher than 600V: Type EPC-40-PVC, concrete-encased Underground Ducts for Electrical Branch Circuits: Type DB-60-PVC, direct buried duct bank.

B. Underground Ducts for Telephone Utility Service: Type EPC-80-PVC, direct buried duct bank.

C. Underground Ducts for Communication Circuits: Type EPC-40 PVC, direct buried duct bank.

3.02 EARTHWORK

A. Excavation and Backfill: Comply with Division 2 Section, Earthwork, but do not use heavy duty hydraulic operated, compaction equipment. The entire depth of trench shall be backfilled in 12 inch layers, and each layer shall be moistened and compacted to 95% below any walks, paving or structures and to 90% in open areas. Compaction shall be based on Standard Proctor Tests conducted on the materials used.

B. Restore surface features at areas disturbed by excavation and re-establish original grades, unless otherwise indicated. Replace removed sod immediately after backfilling is completed.

C. Restore all areas disturbed by trenching, storing of dirt, cable laying, and other work. Restore vegetation and include necessary topsoiling, fertilizing, liming, seeding, sodding, sprigging, and mulching. Comply with Division 2 Section 'Landscaping.'

D. Restore disturbed pavement. Refer to Division 1 Section, Cutting and Patching.

3.03 CONDUIT AND DUCT INSTALLATION

A. Slope: Pitch ducts a minimum slop of 1:300 down toward handholes and away from buildings and equipment. Slope ducts from a high point in runs between two handholes to drain in both directions.

B. Curves and Bends: Use manufactured elbows for stub-ups at equipment and at building entrances. Use manufactured long sweep bends with a minimum radius of 25 feet, both horizontally and vertically, at other locations.

C. Use solvent cement joints in ducts and fittings and make watertight according to manufacturer’s written instructions. Stagger couplings so those of adjacent ducts do not lie in the same plane.

D. Duct Entrances to Handholes: Space end bells approximately 10 inches o.c. for 5 inch ducts and vary proportionately for other duct sizes. Change from regular spacing to end bell spacing 10 feet from the end bell without reducing duct line slope and without forming a trap in the line.

E. Building Entrances: Make a transition from underground duct to conduit at least ten feet outside the building wall. Use fittings manufactured for this purpose. Follow the appropriate installation instructions below.

1. Concrete Encased Ducts: Install reinforcement in duct banks passing through disturbed earth near buildings and other excavations. Coordinate duct bank with structural design to support duct bank at wall without reducing structural or watertight integrity of building wall.

2. Direct Buried, Nonencased Ducts at Nonwaterproofed Wall Penetrations: Install a Schedule 40, galvanized steel pipe sleeve for each duct. Calk space between conduit and sleeve with duct sealing compound on both sides for moisture tight seal.

3. Waterproofed Wall and Floor Penetrations: Install a watertight entrance sealing device with sealing gland assembly on the inside. Anchor device into masonry construction with one or more integral flanges. Secure membrane waterproofing to the device to make permanently watertight.

F. Concrete Encased, Nonmetallic Ducts: Support ducts on duct spacers, spaced as recommended by manufacturer and coordinated with duct size, duct spacing and outdoor temperature. Install as follows:

1. Separator Installation: Space separators close enough to prevent sagging and deforming of ducts and secure separators to earth and to ducts to prevent floating during concreting.

Stagger spacers approximately 6-inches between tiers. Tie entire assembly together using fabric straps; do not use tie wires or reinforcing steel that may form conductive or magnetic loops around ducts or duct groups.

2. Concreting: Spade concrete carefully during pours to prevent voids under and between conduits and at exterior surface of envelope. Do not allow a heavy mass of concrete to fall directly onto ducts. Use a plank to direct concrete down sides of bank assembly to trench bottom. Allow concrete to flow to center of bank and rise up in middle, uniformly filling all open spaces. Do not use power driven agitating equipment unless specifically designed for duct bank application. Pour each run of envelope in one continuous operation. If more than one pour is necessary, terminate each pour in a vertical plane and install 3/4 inch reinforcing rod dowels extending 18 inches into concrete on both sides of joint near corners of envelope.
3. Reinforcement: Reinforce duct banks where they cross disturbed earth and where indicated.
4. Forms: Use walls of trench to form side walls of duct bank where soil is self supporting and concrete envelope can be poured without soil inclusions; otherwise, use forms.
5. Minimum Clearances Between Ducts: Three (3) inches between ducts and exterior envelope wall, two (2) inches between ducts for like services, and four (4) inches between power and signal ducts.
6. Depth: Install top of duct bank at least 24 inches below finished grade in nontraffic areas and at least 30 inches below finished grade in vehicular traffic areas, unless otherwise indicated.

G. Direct Buried Ducts: Support ducts on duct spacers, spaced as recommended by manufacturer and coordinated with duct size, duct spacing, and outdoor temperature. Install as follows:

1. Separator Installation: Space separators close enough to prevent sagging and deforming of ducts.
2. Install expansion fittings as shown on shop drawings.
3. Trench Bottom: Continuous, firm, and uniform support for duct bank. Prepare trench bottoms as specified in Division 2, Section, Earthwork for pipes less than 6 inches in nominal diameter.
4. Backfill: Install backfill as specified in Division 2, Section, Earthwork. After installing first tier of ducts, backfill and compact. Repeat backfilling after placing each tier. After placing last tier, hand place backfill to 4 inches over ducts and hand tamp. Firmly tamp backfill around ducts to provide maximum supporting strength. Use hand temper only. After placing controlled backfill over final tier, complete backfilling normally.
5. Minimum Clearances Between Ducts: Three (3) inches between ducts for like services and six (6) inches between power and signal ducts.
6. Depth: Install top of duct bank at least 36 inches below finished grade, unless otherwise indicated.

H. Warning Tape: Bury warning tape approximately 12 inches above all concrete encased duct banks. Align tape parallel to and within 3 inches of the centerline of duct bank.

I. Stub Ups: Use rigid steel conduit for stub ups to equipment. For equipment mounted on outdoor concrete bases, extend steel conduit a minimum of 5 feet from edge of base. Install insulated grounding bushings on terminations. Couple steel conduits to ducts with adapters designed for this purpose and encase coupling with 3 inches of concrete.

J. Sealing: Provide temporary closure at terminations of ducts that have cables pulled. Seal spare ducts at terminations. Use sealing compound and plugs to withstand at least 15 PSIG hydrostatic pressure.

K. Pulling Cord: Install 100 lbf test nylon cord in ducts, including spares.

3.04 HANDHOLE INSTALLATION

A. Elevation: Install handholes with depth as indicated.

B. Drainage: Install drains in bottom of units where indicated. Coordinate with drainage provisions indicated.

3.05 FIELD QUALITY CONTROL

A. Testing: Demonstrate capability and compliance with requirements on completion of installation of underground ducts and utility structures.

B. Grounding: Test manhole grounding to ensure electrical continuity of grounding and bonding connections. Measure and report ground resistance as specified in Division 26, Section 26 05 26, Grounding and Bonding.

C. Duct Integrity: Pull aluminum or wood test mandrel through duct to prove joint integrity and test for out-of-round duct. Provide mandrel equal to 80% fill of the duct. If obstructions are indicated, remove obstructions and retest.

D. Correct installations if possible and retest to demonstrate compliance. Remove and replace defective products and retest.

3.06 CLEANING

A. Pull leather washer type duct cleaner, with graduated washer sizes, through full length of ducts. Follow with rubber duct swab for final cleaning and to assist in spreading lubricant throughout ducts.

END OF SECTION 2 60543

SECTION 26 0544

SLEEVES AND SLEEVE SEALS FOR ELECTRICAL RACEWAYS AND CABLING

PART 1 GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SUMMARY

A. Section Includes:

1. Sleeves for raceway and cable penetration of non-fire-rated construction walls and floors.
2. Sleeve-seal systems.
3. Sleeve-seal fittings.
4. Grout.
5. Silicone sealants.

B. Related Requirements:

1. Section 078413 "Penetration Firestopping" for penetration firestopping installed in fire-resistance-rated walls, horizontal assemblies, and smoke barriers, with and without penetrating items.

1.03 ACTION SUBMITTALS

A. Product Data: For each type of product.

PART 2 PRODUCTS

2.01 SLEEVES

A. Wall Sleeves:

1. Steel Pipe Sleeves: ASTM A 53/A 53M, Type E, Grade B, Schedule 40, zinc coated, plain ends.
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:

1. Material: Galvanized sheet steel.
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.

2.02 SLEEVE-SEAL SYSTEMS

A. Description: Modular sealing device, designed for field assembly, to fill annular space between sleeve and raceway or cable.

1. Sealing Elements: EPDM rubber interlocking links shaped to fit surface of pipe. Include type and number required for pipe material and size of pipe.
2. Pressure Plates: Carbon steel.
3. Connecting Bolts and Nuts: Carbon steel, with corrosion-resistant coating, of length required to secure pressure plates to sealing elements.

2.03 SLEEVE-SEAL FITTINGS

A. Description: Manufactured plastic, sleeve-type, waterstop assembly made for embedding in concrete slab or wall. Unit shall have plastic or rubber waterstop collar with center opening to match piping OD.

2.04 GROUT

A. Description: Nonshrink; recommended for interior and exterior sealing openings in non-fire-rated walls or floors.

B. Standard: ASTM C 1107/C 1107M, Grade B, post-hardening and volume-adjusting, dry, hydraulic-cement grout.

C. Design Mix: 5000-psi, 28-day compressive strength.

D. Packaging: Premixed and factory packaged.

2.05 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.

PART 3 EXECUTION

3.01 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 079200 "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 or unless seismic criteria require different clearance.
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.
5. Install sleeves for floor penetrations. Extend sleeves installed in floors 2 inches above finished floor level. Install sleeves during erection of floors.

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.

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.

3.02 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.

3.03 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 0544

SECTION 26 0553

IDENTIFICATION FOR ELECTRICAL SYSTEMS

PART 1 GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SUMMARY

A. Section Includes:

1. Color and legend requirements for raceways, conductors, and warning labels and signs.
2. Labels.
3. Bands and tubes.
4. Tapes and stencils.
5. Tags.
6. Signs.
7. Cable ties.
8. Paint for identification.
9. Fasteners for labels and signs.

1.03 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for electrical identification products.

B. Samples: For each type of label and sign to illustrate composition, size, colors, lettering style, mounting provisions, and graphic features of identification products.

C. Identification Schedule: For each piece of electrical equipment and electrical system components to be an index of nomenclature for electrical equipment and system components used in identification signs and labels. Use same designations indicated on Drawings.

D. Delegated-Design Submittal: For arc-flash hazard study.

PART 2 PRODUCTS

2.01 PERFORMANCE REQUIREMENTS

A. Comply with ASME A13.1.

B. Comply with NFPA 70.

C. Comply with 29 CFR 1910.144 and 29 CFR 1910.145.

D. Comply with ANSI Z535.4 for safety signs and labels.

E. Comply with NFPA 70E and Section 260574 "Overcurrent Protective Device Arc-Flash Study" requirements for arc-flash warning labels.

F. Adhesive-attached labeling materials, including label stocks, laminating adhesives, and inks used by label printers, shall comply with UL 969.

G. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes.

1. Temperature Change: 120 deg F (67 deg C), ambient;

2.02 COLOR AND LEGEND REQUIREMENTS

A. Raceways and Cables Carrying Circuits at 600 V or Less:

1. Colored raceways are required. Refer to section 260533 for requirements.

2. Black letters on an orange field.
3. Legend: Indicate voltage and system or service type.

B. Color-Coding for Phase-and Voltage-Level Identification, 600 V or Less: Use colors listed below for ungrounded service feeder and branch-circuit conductors.
1. Color shall be factory applied or field applied for sizes larger than No. 8 AWG if authorities having jurisdiction permit.
2. Colors for 208/120-V Circuits:
a. Phase A: Black.
b. Phase B: Red.
c. Phase C: Blue.
3. Colors for 240-V Circuits:
a. Phase A: Black.
b. Phase B: Red.
4. Colors for 480/277-V Circuits:
a. Phase A: Brown.
b. Phase B: Orange.
c. Phase C: Yellow.
5. Color for Neutral: White or gray.
6. Color for Equipment Grounds: Bare copper or Green.
7. Colors for Isolated Grounds: Green with white stripe.

C. Raceways and Cables Carrying Circuits at More Than 600 V:
1. Black letters on an orange field.
2. Legend: "DANGER - CONCEALED HIGH VOLTAGE WIRING."

D. Warning Label Colors:
1. Identify system voltage with black letters on an orange background.

E. Warning labels and signs shall include, but are not limited to, the following legends:
1. Multiple Power Source Warning: "DANGER - ELECTRICAL SHOCK HAZARD - EQUIPMENT HAS MULTIPLE POWER SOURCES."
2. Workspace Clearance Warning: "WARNING - OSHA REGULATION - AREA IN FRONT OF ELECTRICAL EQUIPMENT MUST BE KEPT CLEAR FOR 36 INCHES (915 MM)."

F. Equipment Identification Labels:
1. Black letters on a white field.

2.03 LABELS

A. Vinyl Wraparound Labels: Preprinted, flexible labels laminated with a clear, weather- and chemical-resistant coating and matching wraparound clear adhesive tape for securing label ends.

B. Snap-around Labels: Slit, pretensioned, flexible, preprinted, color-coded acrylic sleeves, with diameters sized to suit diameters and that stay in place by gripping action.

C. Self-Adhesive Wraparound Labels: Preprinted, 3-mil- (0.08-mm-) thick, polyester or vinyl flexible label with acrylic pressure-sensitive adhesive.
1. Self-Lamination: Clear; UV-, weather- and chemical-resistant; self-laminating, protective shield over the legend. Labels sized such that the clear shield overlaps the entire printed legend.

2. Marker for Labels: Permanent, waterproof, black ink marker recommended by tag manufacturer.
3. Marker for Labels: Machine-printed, permanent, waterproof, black ink recommended by printer manufacturer.

D. Self-Adhesive Labels: Polyester, thermal, transfer-printed, 3-mil- (0.08-mm-) thick, multicolor, weather- and UV-resistant, pressure-sensitive adhesive labels, configured for intended use and location.
1. Minimum Nominal Size:
a. 1-1/2 by 6 inches (37 by 150 mm)for raceway and conductors.
b. 3-1/2 by 5 inches (76 by 127 mm)for equipment.
c. As required by authorities having jurisdiction.

2.04 BANDS AND TUBES

A. Snap-around, Color-Coding Bands: Slit, pretensioned, flexible, solid-colored acrylic sleeves, 2 inches (50 mm) long, with diameters sized to suit diameters and that stay in place by gripping action.

B. Heat-Shrink Preprinted Tubes: Flame-retardant polyolefin tubes with machine-printed identification labels, sized to suit diameter and shrunk to fit firmly. Full shrink recovery occurs at a maximum of 200 deg F (93 deg C). Comply with UL 224.

2.05 TAPES AND STENCILS

A. Marker Tapes: Vinyl or vinyl-cloth, self-adhesive wraparound type, with circuit identification legend machine printed by thermal transfer or equivalent process.

B. Self-Adhesive Vinyl Tape: Colored, heavy duty, waterproof, fade resistant; not less than 3 mils (0.08 mm) thick by 1 to 2 inches (25 to 50 mm) wide; compounded for outdoor use.

C. Tape and Stencil: 4-inch- (100-mm-) wide black stripes on 10-inch (250-mm) centers placed diagonally over orange background and is 12 inches (300 mm) wide. Stop stripes at legends.

D. Floor Marking Tape: 2-inch- (50-mm-) wide, 5-mil (0.125-mm) pressure-sensitive vinyl tape, with black and white stripes and clear vinyl overlay.

E. Underground-Line Warning Tape:
1. Tape:
a. Recommended by manufacturer for the method of installation and suitable to identify and locate underground electrical and communications utility lines.
b. Printing on tape shall be permanent and shall not be damaged by burial operations.
c. Tape material and ink shall be chemically inert and not subject to degradation when exposed to acids, alkalis, and other destructive substances commonly found in soils.
2. Color and Printing:
a. Comply with ANSI Z535.1, ANSI Z535.2, ANSI Z535.3, ANSI Z535.4, and ANSI Z535.5.
b. Inscriptions for Red-Colored Tapes: "ELECTRIC LINE, HIGH VOLTAGE".
c. Inscriptions for Orange-Colored Tapes: "TELEPHONE CABLE, CATV CABLE, COMMUNICATIONS CABLE, OPTICAL FIBER CABLE".

F. Stenciled Legend: In nonfading, waterproof, black ink or paint. Minimum letter height shall be 1 inch (25 mm).

2.06 TAGS

A. Metal Tags: Brass or aluminum, 2 by 2 by 0.05 inch (50 by 50 by 1.3 mm), with stamped legend, punched for use with self-locking cable tie fastener.

B. Nonmetallic Preprinted Tags: Polyethylene tags, 0.015 inch (0.38 mm) thick, color-coded for phase and voltage level, with factory screened permanent designations; punched for use with self-locking cable tie fastener.

C. Write-on Tags:

1. Polyester Tags: 0.010 inch (0.25 mm) thick, with corrosion-resistant grommet and cable tie for attachment.
2. Marker for Tags: Permanent, waterproof, black ink marker recommended by tag manufacturer.
3. Marker for Tags: Machine-printed, permanent, waterproof, black ink marker recommended by printer manufacturer.

2.07 SIGNS

A. Baked-Enamel Signs:

1. Preprinted aluminum signs, high-intensity reflective, punched or drilled for fasteners, with colors, legend, and size required for application.
2. 1/4-inch (6.4-mm) grommets in corners for mounting.
3. Nominal Size: 7 by 10 inches (180 by 250 mm).

B. Metal-Backed Butyrate Signs:

1. Weather-resistant, nonfading, preprinted, cellulose-acetate butyrate signs, with 0.0396-inch (1-mm) galvanized-steel backing, punched and drilled for fasteners, and with colors, legend, and size required for application.
2. 1/4-inch (6.4-mm) grommets in corners for mounting.
3. Nominal Size: 10 by 14 inches (250 by 360 mm).

C. Laminated Acrylic or Melamine Plastic Signs:

1. Engraved legend.
2. Thickness:
   a. For signs up to 20 sq. in. (129 sq. cm), minimum 1/16 inch (1.6 mm) thick.
   b. For signs larger than 20 sq. in. (129 sq. cm), 1/8 inch (3.2 mm) thick.
   c. Engraved legend with black letters on white face.
   d. Punched or drilled for mechanical fasteners with 1/4-inch (6.4-mm) grommets in corners for mounting.
   e. Framed with mitered acrylic molding and arranged for attachment at applicable equipment.

2.08 CABLE TIES

A. General-Purpose Cable Ties: Fungus inert, self-extinguishing, one piece, self-locking, and Type 6/6 nylon.

1. Minimum Width: 3/16 inch (5 mm).
2. Tensile Strength at 73 Deg F (23 Deg C) according to ASTM D 638: 12,000 psi (82.7 MPa).
3. Temperature Range: Minus 40 to plus 185 deg F (Minus 40 to plus 85 deg C).
4. Color: Black, except where used for color-coding.

B. UV-Stabilized Cable Ties: Fungus inert, designed for continuous exposure to exterior sunlight, self-extinguishing, one piece, self-locking, and Type 6/6 nylon.

1. Minimum Width: 3/16 inch (5 mm).
2. Tensile Strength at 73 Deg F (23 Deg C) according to ASTM D 638: 12,000 psi (82.7 MPa).

3. Temperature Range: Minus 40 to plus 185 deg F (Minus 40 to plus 85 deg C).
4. Color: Black.

C. Plenum-Rated Cable Ties: Self-extinguishing, UV stabilized, one piece, and self-locking.
1. Minimum Width: 3/16 inch (5 mm).
2. Tensile Strength at 73 Deg F (23 Deg C) according to ASTM D 638: 7000 psi (48.2 MPa).
3. UL 94 Flame Rating: 94V-0.
4. Temperature Range: Minus 50 to plus 284 deg F (Minus 46 to plus 140 deg C).
5. Color: Black.

2.09 MISCELLANEOUS IDENTIFICATION PRODUCTS

A. Paint: Comply with requirements in painting Sections for paint materials and application requirements. Retain 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

3.01 PREPARATION

A. Self-Adhesive Identification Products: Before applying electrical identification products, clean substrates of substances that could impair bond, using materials and methods recommended by manufacturer of identification product.

3.02 INSTALLATION

A. Verify and coordinate identification names, abbreviations, colors, and other features with requirements in other Sections requiring identification applications, Drawings, Shop Drawings, manufacturer's wiring diagrams, and operation and maintenance manual. Use consistent designations throughout Project.

B. Install identifying devices before installing acoustical ceilings and similar concealment.

C. Verify identity of each item before installing identification products.

D. Coordinate identification with Project Drawings, manufacturer's wiring diagrams, and operation and maintenance manual.

E. Apply identification devices to surfaces that require finish after completing finish work.

F. Install signs with approved legend to facilitate proper identification, operation, and maintenance of electrical systems and connected items.

G. System Identification for Raceways and Cables under 600 V: Identification shall completely encircle cable or conduit. Place identification of two-color markings in contact, side by side.
1. Secure tight to surface of conductor, cable, or raceway.

H. System Identification for Raceways and Cables over 600 V: Identification shall completely encircle cable or conduit. Place adjacent identification of two-color markings in contact, side by side.
1. Secure tight to surface of conductor, cable, or raceway.

I. Auxiliary Electrical Systems Conductor Identification: Identify field-installed alarm, control, and signal connections.

J. Emergency Operating Instruction Signs: Install instruction signs with white legend on a red background with minimum 3/8-inch- (10-mm-) high letters for emergency instructions at equipment used for power transfer and load shedding.

K. Elevated Components: Increase sizes of labels, signs, and letters to those appropriate for viewing from the floor.

L. Accessible Fittings for Raceways: Identify the covers of each junction and pull box of the following systems with the wiring system legend and system voltage. System legends shall be as follows:
   1. "EMERGENCY POWER."
   2. "POWER."
   3. "UPS."

M. Vinyl Wraparound Labels:
   1. Secure tight to surface of raceway or cable at a location with high visibility and accessibility.
   2. Attach labels that are not self-adhesive type with clear vinyl tape, with adhesive appropriate to the location and substrate.

N. Snap-around Labels: Secure tight to surface at a location with high visibility and accessibility.

O. Self-Adhesive Wraparound Labels: Secure tight to surface at a location with high visibility and accessibility.

P. Self-Adhesive Labels:
   1. On each item, install unique designation label that is consistent with wiring diagrams, schedules, and operation and maintenance manual.
   2. Unless otherwise indicated, provide a single line of text with 1/2-inch- (13-mm-) high letters on 1-1/2-inch- (38-mm-) high label; where two lines of text are required, use labels 2 inches (50 mm) high.

Q. Snap-around Color-Coding Bands: Secure tight to surface at a location with high visibility and accessibility.

R. Heat-Shrink, Preprinted Tubes: Secure tight to surface at a location with high visibility and accessibility.

S. Marker Tapes: Secure tight to surface at a location with high visibility and accessibility.

T. Self-Adhesive Vinyl Tape: Secure tight to surface at a location with high visibility and accessibility.
   1. Field-Applied, Color-Coding Conductor Tape: Apply in half-lapped turns for a minimum distance of 6 inches (150 mm) where splices or taps are made. Apply last two turns of tape with no tension to prevent possible unwinding.

U. Tape and Stencil: Comply with requirements in painting Sections for surface preparation and paint application.

V. Floor Marking Tape: Apply stripes to finished surfaces following manufacturer's written instructions.

W. Underground Line Warning Tape:
   1. During backfilling of trenches, install continuous underground-line warning tape directly above cable or raceway at 6 to 8 inches (150 to 200 mm) below finished grade. Use multiple tapes where width of multiple lines installed in a common trench or concrete envelope exceeds 16 inches (400 mm) overall.
   2. Limit use of underground-line warning tape to direct-buried cables.
   3. Install underground-line warning tape for direct-buried cables and cables in raceways.

X. Metal Tags:
   1. Place in a location with high visibility and accessibility.
   2. Secure using general-purpose cable ties.

Y. Nonmetallic Preprinted Tags:
   1. Place in a location with high visibility and accessibility.

2. Secure using general-purpose cable ties.

Z. Write-on Tags:

1. Place in a location with high visibility and accessibility.
2. Secure using general-purpose cable ties.

AA. Baked-Enamel Signs:

1. Attach signs that are not self-adhesive type with mechanical fasteners appropriate to the location and substrate.
2. Unless otherwise indicated, provide a single line of text with 1/2-inch- (13-mm-) high letters on minimum 1-1/2-inch- (38-mm-) high sign; where two lines of text are required, use signs minimum 2 inches (50 mm) high.

BB. Metal-Backed Butyrate Signs:

1. Attach signs that are not self-adhesive type with mechanical fasteners appropriate to the location and substrate.
2. Unless otherwise indicated, provide a single line of text with 1/2-inch- (13-mm-) high letters on 1-1/2-inch- (38-mm-) high sign; where two lines of text are required, use labels 2 inches (50 mm) high.

CC. Laminated Acrylic or Melamine Plastic Signs:

1. Attach signs that are not self-adhesive type with mechanical fasteners appropriate to the location and substrate.
2. Unless otherwise indicated, provide a single line of text with 1/2-inch- (13-mm-) high letters on 1-1/2-inch- (38-mm-) high sign; where two lines of text are required, use labels 2 inches (50 mm) high.

DD. Cable Ties: General purpose, for attaching tags, except as listed below:

1. Outdoors: UV-stabilized nylon.
2. In Spaces Handling Environmental Air: Plenum rated.

3.03 IDENTIFICATION SCHEDULE

A. **REFER TO SECTION 260533 FOR IDENTIFICATION OF EXPOSED OR ACCESSIBLE RACEWAYS**.

B. Install identification materials and devices at locations for most convenient viewing without interference with operation and maintenance of equipment. Install access doors or panels to provide view of identifying devices.

C. Identify conductors, cables, and terminals in enclosures and at junctions, terminals, pull points, and locations of high visibility. Identify by system and circuit designation.

D. Concealed Raceways, Duct Banks, more than 600 V, within Buildings: Tape and stencil. Stencil legend "DANGER - CONCEALED HIGH-VOLTAGE WIRING" with 3-inch- (75-mm-) high, black letters on 20-inch (500-mm) centers.

1. Locate identification at changes in direction, at penetrations of walls and floors, and at 10-foot (3-m) maximum intervals.

E. Accessible Raceways More Than 600 V: Vinyl wraparound labels.

1. Locate identification at changes in direction, at penetrations of walls and floors, at 50-foot (15-m) maximum intervals in straight runs, and at 25-foot (7.6-m) maximum intervals in congested areas.

F. Accessible Raceways 600 V or Less: See section 260533.

1. Locate identification at changes in direction, at penetrations of walls and floors, at 50-foot (15-m) maximum intervals in straight runs, and at 25-foot (7.6-m) maximum intervals in congested areas.

G. Accessible Fittings for Raceways and Cables within Buildings: Identify the covers of each junction and pull box of the following systems with self-adhesive labels containing the wiring system legend and system voltage. System legends shall be as follows:
   1. "EMERGENCY POWER."
   2. "POWER."
   3. "UPS."

H. Power-Circuit Conductor Identification, 600 V or Less: For conductors in vaults, pull and junction boxes, manholes, and handholes, use vinyl wraparound labels to identify the phase.
   1. Locate identification at changes in direction, at penetrations of walls and floors, at 50-foot (15-m) maximum intervals in straight runs, and at 25-foot (7.6-m) maximum intervals in congested areas.

I. Power-Circuit Conductor Identification, More Than 600 V: For conductors in vaults, pull and junction boxes, manholes, and handholes, use nonmetallic preprinted tags colored and marked to indicate phase, and a separate tag with the circuit designation. Indicate upstream/downstream next equipment connection or manhole number.

J. Control-Circuit Conductor Identification: For conductors and cables in pull and junction boxes, manholes, and handholes, use self-adhesive labels with the conductor or cable designation, origin, and destination.

K. Control-Circuit Conductor Termination Identification: For identification at terminations, provide self-adhesive labels with the conductor designation.

L. Conductors to Be Extended in the Future: Attach write-on tags to conductors and list source.

M. Auxiliary Electrical Systems Conductor Identification: Self-adhesive vinyl tape that is uniform and consistent with system used by manufacturer for factory-installed connections.
   1. Identify conductors, cables, and terminals in enclosures and at junctions, terminals, and pull points. Identify by system and circuit designation.

N. Locations of Underground Lines: Underground-line warning tape for power, lighting, communication, and control wiring and optical-fiber cable.

O. Concealed Raceways and Duct Banks, More Than 600 V, within Buildings: Apply floor marking tape to the following finished surfaces:
   1. Floor surface directly above conduits running beneath and within 12 inches (300 mm) of a floor that is in contact with earth or is framed above unexcavated space.
   2. Wall surfaces directly external to raceways concealed within wall.
   3. Accessible surfaces of concrete envelope around raceways in vertical shafts, exposed in the building, or concealed above suspended ceilings.

P. Workspace Indication: Apply floor marking tape to finished surfaces. Show working clearances in the direction of access to live parts. Workspace shall comply with NFPA 70 and 29 CFR 1926.403 unless otherwise indicated. Do not install at flush-mounted panelboards and similar equipment in finished spaces.

Q. Instructional Signs: Self-adhesive labels, including the color code for grounded and ungrounded conductors.

R. Warning Labels for Indoor Cabinets, Boxes, and Enclosures for Power and Lighting: Self-adhesive labels.
   1. Apply to exterior of door, cover, or other access.
   2. 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.

S. Arc Flash Warning Labeling: Self-adhesive labels.

T. Operating Instruction Signs: Self-adhesive labels.

U. Emergency Operating Instruction Signs: Self-adhesive labels with white legend on a red background with minimum 3/8-inch- (10-mm-) high letters for emergency instructions at equipment used for power transfer and load shedding.

V. Equipment Identification Labels:

1. Indoor Equipment: Laminated acrylic or melamine plastic sign.
2. Outdoor Equipment: Laminated acrylic or melamine sign and Stenciled legend 4 inches (100 mm) high.
3. Equipment to Be Labeled:
    a. Panelboards: Typewritten directory of circuits in the location provided by panelboard manufacturer. Panelboard identification shall be in the form of an engraved, laminated acrylic or melamine label.
    b. Enclosures and electrical cabinets.
    c. Access doors and panels for concealed electrical items.
    d. Switchgear.
    e. Switchboards.
    f. Transformers: Label that includes tag designation indicated on Drawings for the transformer, feeder, and panelboards or equipment supplied by the secondary.
    g. Substations.
    h. Emergency system boxes and enclosures.
    i. Motor-control centers.
    j. Enclosed switches.
    k. Enclosed circuit breakers.
    l. Enclosed controllers.
    m. Variable-speed controllers.
    n. Push-button stations.
    o. Power-transfer equipment.
    p. Contactors.
    q. Remote-controlled switches, dimmer modules, and control devices.
    r. Battery-inverter units.
    s. Battery racks.
    t. Power-generating units.
    u. Monitoring and control equipment.
    v. UPS equipment.
    w. All receptacles and power outlets.

END OF SECTION 26 0553

SECTION 26 0923
LIGHTING CONTROL DEVICES

PART 1 GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SUMMARY

A. Section Includes:
   1. Time switches.
   2. Photoelectric switches.
   3. Standalone daylight-harvesting switching and dimming controls.
   4. Indoor occupancy and vacancy sensors.
   5. Switchbox-mounted occupancy sensors.
   6. Digital timer light switches.
   7. High-bay occupancy sensors.
   8. Extreme temperature occupancy sensors.
   9. Outdoor motion sensors.
   10. Lighting contactors.
   11. Emergency shunt relays.

B. Related Requirements:
   1. Section 262726 "Wiring Devices" for wall-box dimmers, non-networkable wall-switch occupancy sensors, and manual light switches.

1.03 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Shop Drawings:
   1. Show installation details for the following:
      a. Occupancy sensors.
      b. Vacancy sensors.
   2. Interconnection diagrams showing field-installed wiring.
   3. Include diagrams for power, signal, and control wiring.

1.04 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Reflected ceiling plan(s) and elevations, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of the items involved:
   1. Suspended ceiling components.
   2. Structural members to which equipment will be attached.
   3. Items penetrating finished ceiling, including the following:
      a. Luminaires.
      b. Air outlets and inlets.
      c. Speakers.
      d. Sprinklers.
      e. Access panels.

f. Control modules.

B. Field quality-control reports.

C. Sample Warranty: For manufacturer's warranties.

1.05 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For each type of lighting control device to include in operation and maintenance manuals.

B. Software and Firmware Operational Documentation:

1. Software operating and upgrade manuals.
2. Program Software Backup: On USB media. Provide names, versions, and website addresses for locations of installed software.
3. Device address list.
4. Printout of software application and graphic screens.

1.06 WARRANTY

A. Manufacturer's Warranty: Manufacturer and Installer agree to repair or replace lighting control devices that fail(s) in materials or workmanship within specified warranty period.

1. Failures include, but are not limited to, the following:
   a. Faulty operation of lighting control software.
   b. Faulty operation of lighting control devices.
2. Warranty Period: Two year(s) from date of Substantial Completion.

PART 2 PRODUCTS

2.01 INDOOR OCCUPANCYAND VACANCY SENSORS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Hubbell Building Automation, Inc.
2. Lithonia Lighting; Acuity Brands Lighting, Inc.
3. Sensor Switch, Inc.
4. WattStopper; a Legrand® Group brand.

B. General Requirements for Sensors:

1. Wall and Ceiling-mounted, solid-state indoor occupancy and vacancy sensors.
2. Dual technology.
3. Integrated power pack.
4. Hardwired connection to switch; and BAS and lighting control system.
5. Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
6. Operation:
   a. Occupancy Sensor: Unless otherwise indicated, turn lights on when coverage area is occupied, and turn them off when unoccupied; with a time delay for turning lights off, adjustable over a minimum range of 1 to 15 minutes.
   b. Vacancy Sensor: Unless otherwise indicated, lights are manually turned on and sensor turns lights off when the room is unoccupied; with a time delay for turning lights off, adjustable over a minimum range of 1 to 15 minutes.
   c. Combination Sensor: Unless otherwise indicated, sensor shall be programmed to turn lights on when coverage area is occupied and turn them off when unoccupied, or to turn off lights that have been manually turned on; with a time delay for turning lights off, adjustable over a minimum range of 1 to 15 minutes.

7. Sensor Output: Contacts rated to operate the connected relay, complying with UL 773A.
8. Power: Line voltage.
9. Power Pack: Dry contacts rated for 20-A ballast or LED load at 120- and 277-V ac, for 13-A tungsten at 120-V ac, and for 1 hp at 120-V ac. Sensor has 24-V dc, 150-mA, Class 2 power source, as defined by NFPA 70.
10. Mounting:
    a. Sensor: Suitable for mounting in any position on a standard outlet box.
    b. Relay: Externally mounted through a 1/2-inch (13-mm) knockout in a standard electrical enclosure.
    c. Time-Delay and Sensitivity Adjustments: Recessed and concealed behind hinged door.
11. Indicator: Digital display, to show when motion is detected during testing and normal operation of sensor.
12. Bypass Switch: Override the "on" function in case of sensor failure.
13. Automatic Light-Level Sensor: Adjustable from 2 to 200 fc (21.5 to 2152 lux); turn lights off when selected lighting level is present.

C. Dual-Technology Type: Wall or 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- (150-mm-) minimum movement of any portion of a human body that presents a target of not less than 36 sq. in. (232 sq. cm), and detect a person of average size and weight moving not less than 12 inches (305 mm) in either a horizontal or a vertical manner at an approximate speed of 12 inches/s (305 mm/s).
3. Detection Coverage (Standard Room): Detect occupancy anywhere within a circular area of 1000 sq. ft. (93 sq. m) when mounted on a 96-inch- (2440-mm-) high ceiling.
4. Detection Coverage (Room, Wall Mounted): Detect occupancy anywhere within a 180-degree pattern centered on the sensor over an area of 2000 square feet (220 square meters) when mounted 48 inches (1200 mm) above finished floor.

2.02 DIGITAL TIMER LIGHT SWITCH

A. Description: Combination digital timer and conventional switch lighting control unit. Switchbox-mounted, backlit LCD display, with selectable time interval in 10 minute increments.
1. Rated 960 W at 120-V ac for tungsten lighting, 10 A at 120-V ac or 10 amps at 277-V ac for ballast or LED, and 1/4 horsepower at 120-V ac.
2. Integral relay for connection to BAS.
3. Voltage: Match the circuit voltage.
4. Color: White
5. Faceplate: Color matched to switch.

2.03 CONDUCTORS AND CABLES

A. Power Wiring to Supply Side of Remote-Control Power Sources: Not smaller than No. 12 AWG. Comply with requirements in Section 260519 "Low-Voltage Electrical Power Conductors and Cables."

B. Classes 2 and 3 Control Cable: Multiconductor cable with stranded-copper conductors not smaller than No. 22 AWG. Comply with requirements in Section 260519 "Low-Voltage Electrical Power Conductors and Cables."

C. Class 1 Control Cable: Multiconductor cable with stranded-copper conductors not smaller than No. 16 AWG. Comply with requirements in Section 260519 "Low-Voltage Electrical Power Conductors and Cables."

PART 3 EXECUTION

3.01 EXAMINATION

A. Examine lighting control devices before installation. Reject lighting control devices that are wet, moisture damaged, or mold damaged.

B. Examine walls and ceilings for suitable conditions where lighting control devices will be installed.

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

3.02 SENSOR INSTALLATION

A. Comply with NECA 1.

B. Coordinate layout and installation of ceiling-mounted devices with other construction that penetrates ceilings or is supported by them, including light fixtures, HVAC equipment, smoke detectors, fire-suppression systems, and partition assemblies.

C. Install and aim sensors in locations to achieve not less than 90-percent coverage of areas indicated. Do not exceed coverage limits specified in manufacturer's written instructions.

3.03 CONTACTOR INSTALLATION

A. Comply with NECA 1.

B. 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.

3.04 WIRING INSTALLATION

A. Comply with NECA 1.

B. Wiring Method: Comply with Section 260519 "Low-Voltage Electrical Power Conductors and Cables." Minimum conduit size is 1/2 inch (13 mm).

C. Wiring within Enclosures: Comply with NECA 1. Separate power-limited and nonpower-limited conductors according to conductor manufacturer's written instructions.

D. Size conductors according to lighting control device manufacturer's written instructions unless otherwise indicated.

E. Splices, Taps, and Terminations: Make connections only on numbered terminal strips in junction, pull, and outlet boxes; terminal cabinets; and equipment enclosures.

3.05 IDENTIFICATION

A. Identify components and power and control wiring according to Section 260553 "Identification for Electrical Systems."

1. Identify controlled circuits in lighting contactors.
2. Identify circuits or luminaires controlled by photoelectric and occupancy sensors at each sensor.

B. Label time switches and contactors with a unique designation.

3.06 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 with the assistance of a factory-authorized service representative:

1. Operational Test: After installing time switches and sensors, and after electrical circuitry has been energized, start units to confirm proper unit operation.

2. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

C. Lighting control devices will be considered defective if they do not pass tests and inspections.

D. Prepare test and inspection reports.

3.07 ADJUSTING

A. Occupancy Adjustments: When requested within 12 months from date of Substantial Completion, provide on-site assistance in adjusting lighting control devices to suit actual occupied conditions. Provide up to two visits to Project during other-than-normal occupancy hours for this purpose.

1. For occupancy and motion sensors, verify operation at outer limits of detector range. Set time delay to suit Owner's operations.
2. For daylighting controls, adjust set points and deadband controls to suit Owner's operations.
3. Align high-bay occupancy sensors using manufacturer's laser aiming tool.

3.08 SOFTWARE SERVICE AGREEMENT

A. Technical Support: Beginning at Substantial Completion, service agreement shall include software support for two years.

B. Upgrade Service: At Substantial Completion, update software to latest version. Install and program software upgrades that become available within two years from date of Substantial Completion. Upgrading software shall include operating system and new or revised licenses for using software.

1. Upgrade Notice: At least 30 days to allow Owner to schedule and access the system and to upgrade computer equipment if necessary.

3.09 DEMONSTRATION

A. Coordinate demonstration of products specified in this Section with demonstration requirements for low-voltage, programmable lighting control systems specified in Section 260943.16 "Addressable-Luminaire Lighting Controls" and Section 260943.23 "Relay-Based Lighting Controls."

B. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain lighting control devices.

END OF SECTION 26 0923

SECTION 26 2416
PANELBOARDS

PART 1 GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SUMMARY

A. This Section includes lighting and power panelboards and associated auxiliary equipment rated 600 V and less.

B. Related Sections include the following:

1. Division 26, Section 26 0500, Basic Electrical Materials and Methods for general materials and installation methods.
2. Division 26, Section 26 0553, Identification for Electrical Systems for labeling materials.
3. Division 26, Section 26 2813, Fuses.
4. Division 26, Section 26 4313 Surge Protection Devices for Low-Voltage Electrical Power Circuits.

1.03 SUBMITTALS

A. Product Data: For each type of panelboard, accessory item, and component specified.

B. Shop Drawings: For panelboards. Include dimensioned plans, sections, and elevations. Show tabulations of installed devices, major features, and voltage rating. Include the following:

1. Enclosure type with details for types other than NEMA 250, Type 1.
2. Bus configuration and current ratings.
3. Short-circuit current rating of panelboard.
4. Features, characteristics, ratings, and factory settings of individual protective devices and auxiliary components.
5. Wiring Diagrams: Details of schematic diagram including control wiring and differentiating between manufacturer-installed and field-installed wiring.

C. Electronic Grade Panelboards: Submit the following additional information:

1. Documentation: Provide data showing the following:
   a. UL Listing: UL 67 and UL 1283.
   b. Clamping Voltage: UL 1449 Rating.
   c. Factory Tests: Procedure and reports. Tested to meet ANSI/IEEE C62.41, tested per ANSI/IEEE C62.45.

D. Field Test Reports: Indicate and interpret test results for compliance with performance requirements.

E. Panelboard Schedules: For installation in panelboards. Submit final versions after load balancing.

F. Maintenance Data: For panelboard components to include in the maintenance manuals specified in Division 1. Include manufacturer's written instructions for testing circuit breakers.

1.04 QUALITY ASSURANCE

A. Testing Agency Qualifications: In addition to the requirements specified in Division 1 Section "Quality Control," an testing agency shall meet OSHA criteria for accreditation of testing laboratories, Title 29, Part 1907, or shall be a full member company of the InterNational Electrical Testing Association.

1. Testing Agency's Field Supervisor: Person currently certified by the InterNational Electrical Testing Association or National Institute for Certification in Engineering Technologies, to

supervise on-site testing specified in Part 3.

B. Listing and Labeling: Provide products specified in this Section that are listed and labeled.
   1. The Terms "Listed" and "Labeled": As defined in the National Electrical Code, Article 100.

C. Comply with NFPA 70 and NEMA PB 1.

1.05 EXTRA MATERIALS

A. Keys: 6 spares of each type for panelboard cabinet lock. All locks shall be keyed alike.

B. Touch-Up Paint: One half pint container for enclosures and fronts.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by the following:
   1. Panelboards:
      a. Eaton Corporation & Cutler-Hammer Products
      b. General Electric Company; Electrical Distribution & Control Div.
      c. Siemens Energy & Automation, Inc.
      d. Square D Co.
   2. Electronic Grade Panelboards:
      a. Current Technology
      b. Liebert, Control Concepts
      c. United Power
      d. EFI

2.02 PANELBOARD FABRICATION

A. Enclosures: Flush- or surface-mounted cabinets as indicated. NEMA PB 1, Type 1, unless otherwise indicated to meet environmental conditions at installed location.
   1. Outdoor Locations: NEMA 250, Type 3R Type 4.
   2. Kitchen Areas: NEMA 250, Type 4X, stainless steel.
   3. Other Wet or Damp Indoor Locations: NEMA 250, Type 4.
   4. Hazardous Areas Indicated on Drawings: NEMA 250, Type 7C.

B. Directory Frame: Metal, mounted inside each panelboard door.

C. Bus: Hard drawn copper of 98 percent conductivity.

D. Main and Neutral Lugs: Mechanical type suitable for use with conductor material.

E. Equipment Ground Bus: Adequate for feeder and branch-circuit equipment ground conductors. Bonded to box.

F. Service Equipment Approval: Listed for use as service equipment for panelboards with main service disconnect.

G. Future Devices: Equip with mounting brackets, bus connections, and necessary appurtenances, for the overcurrent protective device ampere ratings indicated for future installation of devices.

H. Special Features: Include the following features for panelboards as indicated:
   1. Hinged Front Cover: Entire front trim hinged to box with standard door within hinged trim cover. The door over the interior of the panel shall be provided with hinge and combination lock and latch. The outside door over the panel gutters shall have a hinge on one side and combination lock and latches. All locks shall be keyed alike. Front for surface mounted panelboards shall be same dimensions as box. Fronts for flush panelboards shall overlap box, unless otherwise indicated. Required for NEMA 1 panelboards unless otherwise indicated.

2. Isolated Equipment Ground Bus: Adequate for branch-circuit equipment ground conductors; insulated from box.
3. Split Bus: Vertical bus of indicated panelboards divided into 2 vertical sections with connections as indicated.
4. 200% Neutral: Copper, rated 200% of phase bus, and UL listed as suitable for non-linear loads.
5. Skirt for Surface-Mounted Panelboards: Same gage and finish as panelboard front with flanges for attachment to panelboard, wall, and floor.

I. Feed-through Lugs: Mechanical type sized to accommodate feeders indicated.

2.03 PANELBOARD SHORT-CIRCUIT RATING

A. UL label indicating series connected rating with integral or remote upstream devices. Include size and type of upstream device allowable, branch devices allowable, and UL series connect short-circuit rating.

B. Fully rated to interrupt symmetrical short-circuit current available at terminals.

C. Panelboards shall have a minimum AIC rating as indicated on the drawings based on the short circuit study.

2.04 LOAD CENTERS

A. Overcurrent Protective Devices: Plug-in, full-module circuit breaker.
1. Circuit Breakers for Switching Lights at Panelboards: Indicated as Type SWD.
2. Circuit Breakers for Equipment Marked Type HACR: Indicated as Type HACR.

B. Conductor Connectors: Mechanical type for main, neutral, and ground lugs and buses.

2.05 LIGHTING AND APPLIANCE BRANCH-CIRCUIT PANELBOARDS

A. Branch Overcurrent Protective Devices: Bolt-on circuit breakers, replaceable without disturbing adjacent units.

B. Doors: Door-in-door in panelboard front, with concealed hinges. Secure with flush catch and tumbler lock, all keyed alike.

2.06 DISTRIBUTION PANELBOARDS

A. Doors: In panelboard front, except omit in fusible-switch panelboard, unless otherwise indicated. Secure door with vault-type latch with tumbler lock, all keyed alike.

B. Branch-Circuit Breakers: Where overcurrent protective devices are indicated to be circuit breakers, use bolt-on circuit breakers, except circuit breakers 225-A frame size and greater may be plug-in type where individual positive-locking device requires mechanical release for removal.

2.07 OVERCURRENT PROTECTIVE DEVICES

A. Molded-Case Circuit Breaker: NEMA AB 1 / UL 489.
1. Characteristics: Frame size, trip rating, number of poles, and auxiliary devices as indicated and interrupting capacity rating to meet available fault current.
2. Application Listing: Appropriate for application, including Type SWD for switching fluorescent lighting loads and Type HACR for heating, air-conditioning, and refrigerating equipment.
3. Circuit Breakers, 200 A and Larger: Trip units interchangeable within frame size.
4. Circuit Breakers, 400 A and Larger: Field-adjustable short-time and continuous current settings.
5. Current-Limiting Trips: Where indicated, let-through ratings less than NEMA FU 1, Class RK-5.
6. Current Limiters: Where indicated, integral fuse listed for circuit breaker.
7. Lugs: Mechanical lugs and power-distribution connectors for number, size, and material of conductors indicated.

8. Shunt Trip: Where indicated.
9. Handle Lockable: Where indicated.

B. Fusible Switch: NEMA KS 1, Type HD, clips to accommodate specified fuses, handle lockable.

2.08 SURGE PROTECTION DEVICES / TRANSIENT VOLTAGE SURGE SUPPRESSORS

A. See Division 26, Section 26 4313 Surge Protection Devices for Low-Voltage Electrical Power Circuits.

2.09 CONTROLLERS

A. Motor Controllers: NEMA ICS 2, Class A combination controller equipped for panelboard mounting, with the following accessories and pilot devices as indicated:
1. Individual control power transformers.
2. Fuses for control power transformers.
3. Solid state overload relay.
4. Indicating lights.
5. Seal-in contact.
6. Convertible auxiliary contacts as indicated, minimum of 2.
7. Selector switches.

B. Contactors: NEMA ICS 2, Class A combination controller equipped for panelboard mounting, with the following accessories and pilot devices as indicated:
1. Individual control power transformers.
2. Fuses for control power transformers.
3. Indicating lights.
4. Seal-in contact.
5. At least one convertible auxiliary contact. Provide more as indicated.
6. Selector switches.

C. Controller Disconnect Switches: Motor-circuit protector integral with or adjacent to and interlocked with controller.
1. Auxiliary contacts on disconnect de-energize external control source.

D. Contactors in Main Bus: NEMA ICS 2, Class A, mechanically held general-purpose controller, with current rating, poles, and connections as indicated; factory mounted in indicated panelboard.
1. Control Power Source: 120-V branch circuit as indicated.

2.10 ACCESSORY COMPONENTS AND FEATURES

A. Accessory Set: Include tools and miscellaneous items as required for overcurrent protective device test, inspection, maintenance, and operation.

B. Portable Test Set: Arranged to permit testing of functions of solid-state trip devices without removal from panelboard.

C. Fungus Proofing: Permanent fungicidal treatment for panelboard interior, including overcurrent protective devices and other components.

PART 3 EXECUTION

3.01 INSTALLATION

A. Install panelboards and accessory items according to NEMA PB 1.1.

B. Mounting Heights: Top of trim 74 inches above finished floor, unless otherwise indicated.

C. Mounting: Plumb and rigid without distortion of box. Mount flush panelboards uniformly flush with wall finish.

D. Circuit Directory: Type directory to indicate installed circuit loads after balancing panelboard loads.

Directory to reference permanent room numbering in lieu of room numbering shown on the drawings. Obtain approval before installing.

E. Install filler plates in unused spaces.

F. Provision for Future Circuits at Flush Panelboards: Stub four 1-inch (27-GRC) empty conduits from panelboard into accessible ceiling space or space designated to be ceiling space in the future. Stub four 1-inch (27-GRC) empty conduits into raised floor space or below slab not on grade.

G. Wiring in Panelboard Gutters: Arrange conductors into groups, and bundle and wrap with wire ties after completing load balancing.

H. Labels for identifying the breakers shall be engraved laminated plastic strips attached by screws or Phenolic buttons or small window frame type. Adhesive stick-on labels will not be acceptable.

3.02 IDENTIFICATION

A. Identify field-installed wiring and components and provide warning signs as specified in Division 26, Section 26 0553, Identification for Electrical Systems.

B. Panelboard Nameplates: Label each panelboard with engraved laminated-plastic or metal nameplates mounted with corrosion-resistant screws.

3.03 GROUNDING

A. Make equipment grounding connections for panelboards or main electrical ground bus as indicated.

3.04 CONNECTIONS

A. Tighten electrical connectors and terminals, including grounding connections, according to manufacturer's published torque-tightening values. Where manufacturer's torque values are not indicated, use those specified in UL 486A and UL 486B.

3.05 FIELD QUALITY CONTROL

A. Prepare for acceptance tests as follows:

1. Make insulation-resistance tests of each panelboard bus, component, and connecting supply, feeder, and control circuits.

2. Make continuity tests of each circuit.

B. Testing: After installing panelboards and after electrical circuitry has been energized, demonstrate product capability and compliance with requirements.

1. Procedures: Perform each visual and mechanical inspection and electrical test stated in NETA ATS, Section 7.5 for switches and Section 7.6 for molded-case circuit breakers. Certify compliance with test parameters.

2. Correct malfunctioning units on-site, where possible, and retest to demonstrate compliance; otherwise, remove and replace with new units, and retest.

C. Balancing Loads: After Substantial Completion, but not more than 2 months after Final Acceptance, conduct load-balancing measurements and make circuit changes as follows:

1. Perform measurements during period of normal working load as advised by Owner.

2. Perform load-balancing circuit changes outside normal occupancy/working schedule of the facility. Make special arrangements with Owner to avoid disrupting critical 24-hour services such as fax machines and on-line data processing, computing, transmitting, and receiving equipment.

3. Recheck loads after circuit changes during normal load period. Record all load readings before and after changes and submit test records.

4. Tolerance: Difference exceeding 20 percent between phase loads, within a panelboard, is not acceptable. Rebalance and recheck as required to meet this minimum requirement.

D. Infrared Scanning: After Substantial Completion, but not more than 2 months after Final Acceptance, perform an infrared scan of each panelboard. Remove fronts to make joints and

connections accessible to a portable scanner.

1. Follow-up Infrared Scanning: Perform an additional follow-up infrared scanning of each panelboard 11 months after date of Substantial Completion.
2. Instrument: Use an approved infrared scanning device designed to measure temperature or detect significant deviations from normal values. Provide calibration record for device used.
3. Record of Infrared Scanning: Prepare a certified report identifying panelboards checked and describing results of scanning. Include notation of deficiencies detected, remedial action taken, and observations after remedial action.

3.06 ADJUSTING

A. Set field-adjustable switches and circuit-breaker trip ranges as indicated.

3.07 CLEANING

A. On completion of installation, inspect interior and exterior of panelboards. Remove paint splatters and other spots, dirt, and debris. Touch up scratches and mars of finish to match original finish.

END OF SECTION 26 2416

SECTION 26 2726
WIRING DEVICES

PART 1 GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SUMMARY

A. Section Includes:

1. Straight-blade convenience, hospital-grade, isolated-ground, and tamper-resistant receptacles.
2. USB charger devices.
3. GFCI receptacles.
4. Twist-locking receptacles.
5. Pendant cord-connector devices.
6. Toggle switches.
7. Wall switch sensor light switches with dual technology sensors.
8. Digital timer light switches.
9. Wall-box dimmers.
10. Wall plates.
11. Floor service outlets.
12. Poke-through assemblies.
13. Prefabricated multioutlet assemblies.

1.03 DEFINITIONS

A. Abbreviations of Manufacturers' Names:

1. Cooper: Cooper Wiring Devices; Division of Cooper Industries, Inc.
2. Hubbell: Hubbell Incorporated: Wiring Devices-Kellems.
3. Leviton: Leviton Mfg. Company, Inc.
4. Pass & Seymour: Pass& Seymour/Legrand.

B. BAS: Building automation system.

C. EMI: Electromagnetic interference.

D. GFCI: Ground-fault circuit interrupter.

E. Pigtail: Short lead used to connect a device to a branch-circuit conductor.

F. RFI: Radio-frequency interference.

G. SPD: Surge protective device.

H. UTP: Unshielded twisted pair.

1.04 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Shop Drawings: List of legends and description of materials and process used for pre-marking wall plates.

C. Samples: One for each type of device and wall plate specified, in each color specified.

1.05 INFORMATIONAL SUBMITTALS

A. Field quality-control reports.

1.06 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.

1.07 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Service/Power Poles: One for every 10, but no fewer than one.
2. Floor Service-Outlet Assemblies: One for every 10, but no fewer than one.
3. Poke-Through, Fire-Rated Closure Plugs: One for every five floor service outlets installed, but no fewer than two.
4. SPD Receptacles: One for every 10 of each type installed, but no fewer than two of each type.

PART 2 PRODUCTS

2.01 GENERAL WIRING-DEVICE REQUIREMENTS

A. Wiring Devices, Components, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

B. Comply with NFPA 70.

C. Devices 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 the requirements in this Section.

D. Devices for Owner-Furnished Equipment:

1. Receptacles: Match plug configurations.
2. Cord and Plug Sets: Match equipment requirements.

E. Source Limitations: Obtain each type of wiring device and associated wall plate from single source from single manufacturer.

2.02 STRAIGHT-BLADE RECEPTACLES

A. Hospital-Grade, Duplex Convenience Receptacles: 125 V, 20 A; comply with NEMA WD 1, NEMA WD 6 Configuration 5-20R, UL 498 Supplement sd, and FS W-C-596.

1. Description: Single-piece, rivetless, nickel-plated, all-brass grounding system. Nickel-plated, brass mounting strap.

B. Tamper-Resistant Convenience Receptacles: 125 V, 20 A; comply with NEMA WD 1, NEMA WD 6 Configuration 5-20R, UL 498, and FS W-C-596.

1. Description: Labeled and complying with NFPA 70, "Health Care Facilities" Article,"Pediatric Locations" Section.

2.03 USB CHARGER DEVICES

A. Tamper-Resistant, USB Charger Receptacles: 12 V dc, 2.0 A, USB Type A; comply with NEMA WD 1, NEMA WD 6 Configuration 5-20R, UL 498, UL 1310, and FS W-C-596.

1. Description: Single-piece, rivetless, nickel-plated, all-brass grounding system. Nickel-plated, brass mounting strap.
2. USB Receptacles: Dual, Type A.
3. Line Voltage Receptacles: Dual, two pole, three wire, and self-grounding.

B. Hospital-Grade, USB Charger Receptacles: 12 V dc, 2.0 A, USB Type A; comply with NEMA WD 1, NEMA WD 6 Configuration 5-20R, UL 498 Supplement sd, UL 1310, and FS W-C-596.

1. Description: Labeled and complying with NFPA 70, "Health Care Facilities" Article, "Pediatric Locations" Section.
2. USB Receptacles: Dual, Type A.
3. Line Voltage Receptacles: Dual, two pole, three wire, and self-grounding.

2.04 GFCI RECEPTACLES

A. General Description:
1. 125 V, 20 A, straight blade, non-feed-through type.
2. Comply with NEMA WD 1, NEMA WD 6 Configuration 5-20R, UL 498, UL 943 Class A, and FS W-C-596.
3. Include indicator light that shows when the GFCI has malfunctioned and no longer provides proper GFCI protection.

B. Duplex GFCI Convenience Receptacles:

C. Tamper-Resistant, Duplex GFCI Convenience Receptacles:

D. Hospital-Grade, Duplex GFCI Convenience Receptacles: Comply with UL 498 Supplement sd.

2.05 TWIST-LOCKING RECEPTACLES

A. Twist-Lock, Single Convenience Receptacles: 125 V, 20 A; comply with NEMA WD 1, NEMA WD 6 Configuration L5-20R, and UL 498.

B. Twist-Lock, Isolated-Ground, Single Convenience Receptacles: 125 V, 20 A; comply with NEMA WD 1, NEMA WD 6 Configuration L5-20R, and UL 498.
1. Grounding: Equipment grounding contacts shall be connected only to the green grounding screw terminal of the device and with inherent electrical isolation from mounting strap. Isolation shall be integral to receptacle construction and not dependent on removable parts.

2.06 PENDANT CORD-CONNECTOR DEVICES

A. Description:
1. Matching, locking-type plug and receptacle body connector.
2. NEMA WD 6 Configurations L5-20P and L5-20R, heavy-duty grade, and FS W-C-596.
3. Body: Nylon, with screw-open, cable-gripping jaws and provision for attaching external cable grip.
4. 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.

2.07 CORD AND PLUG SETS

A. Description:
1. Match voltage and current ratings and number of conductors to requirements of equipment being connected.
2. 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.
3. Plug: Nylon body and integral cable-clamping jaws. Match cord and receptacle type for connection.

2.08 TOGGLE SWITCHES

A. Comply with NEMA WD 1, UL 20, and FS W-S-896.

B. Switches, 120/277 V, 20 A:
1. Single Pole:

2. Two Pole:
3. Three Way:
4. Four Way:

C. Pilot-Light Switches: 120/277 V, 20 A.
1. Description: Single pole, with LED-lighted handle, illuminated when switch is off.

D. Key-Operated Switches: 120/277 V, 20 A.
1. Description: Single pole, with factory-supplied key in lieu of switch handle.

E. Single-Pole, Double-Throw, Momentary-Contact, Center-off Switches: 120/277 V, 20 A; for use with mechanically held lighting contactors.

F. Key-Operated, Single-Pole, Double-Throw, Momentary-Contact, Center-off Switches: 120/277 V, 20 A; for use with mechanically held lighting contactors, with factory-supplied key in lieu of switch handle.

2.09 WALL SWITCH SENSOR LIGHT SWITCH, DUAL TECHNOLOGY

A. Description: Switchbox-mounted, combination lighting-control sensor and conventional switch lighting-control unit using dual technology.
1. Connections: Provisions for connection to BAS.
2. Connections: Hard wired.
3. Connections: Wireless.
4. Rated 960 W at 120-V ac for tungsten lighting, 10 A at 120-V ac or 10 A at 277-V ac for fluorescent or LED lighting, and 1/4 hp at 120-V ac.
5. Integral relay for connection to BAS.
6. Adjustable time delay of 20 minutes.
7. Able to be locked to Manual-On mode.
8. Automatic Light-Level Sensor: Adjustable from 2 to 200 fc.
9. Comply with NEMA WD 1, UL 20, and FS W-S-896.

2.10 DIGITAL TIMER LIGHT SWITCH

A. Description: Switchbox-mounted, combination digital timer and conventional switch lighting-control unit, with backlit digital display, with selectable time interval in 20-minute increments.
1. Rated 960 W at 120-V ac for tungsten lighting, 10 A at 120-V ac or 10 A at 277-V ac for fluorescent or LED lighting, and 1/4 hp at 120-V ac.
2. Integral relay for connection to BAS.

2.11 WALL-BOX DIMMERS

A. Dimmer Switches: Modular, full-wave, solid-state units with integral, quiet on-off switches, with audible frequency and EMI/RFI suppression filters.

B. Control: Continuously adjustable slider; with single-pole or three-way switching. Comply with UL 1472.

C. 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.

D. Dimmers shall be Lutron NOVA series or equal.

2.12 WALL PLATES

A. Single and combination types shall match corresponding wiring devices.
1. Plate-Securing Screws: Metal with head color to match plate finish.
2. Material for Finished Spaces: 0.035-inch-thick, satin-finished, Type 302 stainless steel 0.04-inch- thick, brushed brass with factory polymer finish 0.05-inch.

3. Material for Unfinished Spaces: Galvanized steel.
4. Material for Damp Locations: Thermoplastic with spring-loaded lift cover, and listed and labeled for use in wet and damp locations.

B. Wet-Location, Weatherproof Cover Plates: NEMA 250, complying with Type 3R, weather-resistant, die-cast aluminum with lockable cover.

2.13 FLOOR SERVICE FITTINGS

A. Type: Modular, flush-type, dual-service units suitable for wiring method used.

B. Compartments: Barrier separates power from voice and data communication cabling.

C. Service Plate: Rectangular, die-cast aluminum with satin finish.

D. Power Receptacle: NEMA WD 6 Configuration 5-20R, gray finish, unless otherwise indicated.

E. Description:

1. Factory-fabricated and -wired assembly of below-floor junction box with multichanneled, through-floor raceway/firestop unit and detachable matching floor service-outlet assembly.
2. Comply with UL 514 scrub water exclusion requirements.
3. Service-Outlet Assembly: Flush type with four simplex receptacles and space for four RJ-45 jacks complying with requirements in Section 271513 "Communications Copper Horizontal Cabling."
4. Fire Rating: Unit is listed and labeled for fire rating of floor-ceiling assembly.
5. Closure Plug: Arranged to close unused cored openings and reestablish fire rating of floor.
6. Wiring Raceways and Compartments: For a minimum of four No. 12 AWG conductors and a minimum of four, four-pair cables that comply with requirements in Section 271513 "Communications Copper Horizontal Cabling."

2.14 PREFABRICATED MULTIOUTLET ASSEMBLIES

A. Description:

1. Two-piece surface metal raceway, with factory-wired multioutlet harness.
2. Components shall be products from single manufacturer designed for use as a complete, matching assembly of raceways and receptacles.

B. Raceway Material: Metal, with manufacturer's standard finish.

C. 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: 12 inches.
3. Wiring: No. 12 AWG solid, Type THHN copper, two circuit, connecting alternating receptacles.

2.15 FINISHES

A. 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 Emergency Power System: Red.
3. SPD Devices: Blue.

B. Wall Plate Color: For plastic covers, match device color.

PART 3 EXECUTION

3.01 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 meet provisions of 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 up, and on horizontally mounted receptacles to the right.
2. Install hospital-grade receptacles in patient-care areas with the ground pin or neutral blade at the top.

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.

3.02 GFCI RECEPTACLES

A. Install non-feed-through-type GFCI receptacles where protection of downstream receptacles is not required.

3.03 IDENTIFICATION

A. Comply with Section 260553 "Identification for Electrical Systems."

B. Identify each receptacle with panelboard identification and circuit number. Use hot, stamped, or engraved machine printing with black-filled lettering on face of plate, and durable wire markers or tags inside outlet boxes.

3.04 FIELD QUALITY CONTROL

A. Test Instruments: Use instruments that comply with UL 1436.

B. Test Instrument for Convenience Receptacles: Digital wiring analyzer with digital readout or illuminated digital-display indicators of measurement.

C. Perform the following tests and inspections with the assistance of a factory-authorized service representative:

1. In healthcare facilities, prepare reports that comply with recommendations in NFPA 99.
2. Test Instruments: Use instruments that comply with UL 1436.
3. Test Instrument for Convenience Receptacles: Digital wiring analyzer with digital readout or illuminated digital-display indicators of measurement.

D. Tests for Convenience 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. Test straight-blade convenience outlets in patient-care areas and all hospital-grade convenience outlets for the retention force of the grounding blade according to NFPA 99. Retention force shall be not less than 4 oz.

F. Wiring device will be considered defective if it does not pass tests and inspections.

G. Prepare test and inspection reports.

END OF SECTION 26 2726

SECTION 26 2813
FUSES

PART 1 GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SUMMARY

A. This Section includes the following:

1. Fuses
2. Spare fuse cabinet

1.03 SUBMITTALS

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

B. Product Data for each fuse type specified. Include the following:

1. Descriptive data and time-current curves.
2. Let-through current curves for fuses with current-limiting characteristics.
3. Coordination charts and tables and related data.
4. Fuse size for elevator feeder and disconnect applications.

C. Field test reports indicating and interpreting test results.

D. Maintenance data for tripping devices to include in the operation and maintenance manual specified in Division 1.

1.04 QUALITY ASSURANCE

A. Source Limitations: Obtain fuses from one source and by a single manufacturer.

B. Comply with NFPA 70 for components and installation.

C. Listing and Labeling: Provide fuses specified in this Section that are listed and labeled.

1. The Terms "Listed" and "Labeled": As defined in the National Electrical Code, Article 100.

1.05 EXTRA MATERIALS

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

1. Spare Fuses 0-600 amperes: Furnish quantity equal to 10 percent of each fuse type and size installed, but not less than 1 set of 3 of each type and size.
2. Spare Fuses 601-6000 amperes: One (1) set of three (3) of each type and size.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide fuses by one of the following:

1. Cooper Industries, Inc.; Bussmann Div.
2. General Electric Co.; Wiring Devices Div.
3. Gould Shawmut
4. Tracor, Inc.; Littelfuse, Inc. Subsidiary

2.02 CARTRIDGE FUSES

A. Characteristics: NEMA FU 1, nonrenewable cartridge fuse; class as specified or indicated;

current rating as indicated; voltage rating consistent with circuit voltage.

1. Manufacturer: All fuses to be of same manufacturer.
2. Color: Distinctive and easily identifiable.
3. Listing: UL Listed for application.

2.03 SPARE FUSE CABINET

A. Cabinet: Wall-mounted, 0.05-inch- (1.27-mm-) thick steel unit with full-length, recessed piano-hinged door with key-coded cam lock and pull.

1. Size: Adequate for orderly storage of spare fuses specified with 15 percent spare capacity minimum.
2. Finish: Gray, baked enamel.
3. Identification: Stencil legend "SPARE FUSES" in 1-1/2-inch (40-mm) letters on door.
4. Fuse Pullers: For each size fuse.

PART 3 EXECUTION

3.01 EXAMINATION

A. Examine utilization equipment nameplates and installation instructions to verify proper fuse locations, sizes, and characteristics.

B. Do not proceed with installation until unsatisfactory conditions have been corrected.

3.02 FUSE APPLICATIONS

A. Main Service 601-6000 ampere: Class L, dual element time delay.

B. Main Feeders 0-600 ampere: Class J, dual element time delay.

C. Motor Branch Circuits: Class J, dual element time delay.

D. Other Branch Circuits: Class J, dual element time delay.

E. Control Transformers and Control Circuits: Class CC or Class J, time delay.

F. Fluorescent and H.I.D. Ballasts: Over 300 volts, Class CC or Class J, time delay.

G. DC Circuits: Less than 500 volts, 0-600A Class J, time delay; 601-6000A Class L, time delay.

H. Existing Installations: As above.

3.03 INSTALLATION

A. Install fuses in fusible devices as indicated. Arrange fuses so fuse ratings are readable without removing fuse.

B. Install a spare fuse cabinet in each room where fused switches are present.

C. Torque mounting bolts to ASTM recommendations.

D. Bolted in place fuses to have "Belleville" washers between each bolt head or nut and fuse blade.

3.04 IDENTIFICATION

A. Install typewritten labels on inside door of each fused switch to indicate fuse replacement information.

B. Nameplates: Label each fuse cabinet with engraved laminated-plastic or metal nameplates mounted with corrosion-resistant screws as specified in Division 26, Section 26 05 53 "Electrical Identification".

END OF SECTION 26 2813

SECTION 26 2816

ENCLOSED SWITCHES AND CIRCUIT BREAKERS

PART 1 GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SUMMARY

A. Section Includes:

1. Fusible switches.
2. Nonfusible switches.
3. Receptacle switches.
4. Shunt trip switches.
5. Molded-case circuit breakers (MCCBs).
6. Molded-case switches.
7. Enclosures.

1.03 DEFINITIONS

A. NC: Normally closed.

B. NO: Normally open.

C. SPDT: Single pole, double throw.

1.04 ACTION SUBMITTALS

A. Product Data: For each type of enclosed switch, circuit breaker, accessory, and component indicated. Include nameplate ratings, dimensioned elevations, sections, weights, and manufacturers' technical data on features, performance, electrical characteristics, ratings, accessories, and finishes.

1. Enclosure types and details for types other than NEMA 250, Type 1.
2. Current and voltage ratings.
3. Short-circuit current ratings (interrupting and withstand, as appropriate).
4. Include evidence of a nationally recognized testing laboratory (NRTL) listing for series rating of installed devices.
5. Detail features, characteristics, ratings, and factory settings of individual overcurrent protective devices, accessories, and auxiliary components.
6. Include time-current coordination curves (average melt) for each type and rating of overcurrent protective device; include selectable ranges for each type of overcurrent protective device. Provide in PDF format.

B. Shop Drawings: For enclosed switches and circuit breakers.

1. Include plans, elevations, sections, details, and attachments to other work.
2. Include wiring diagrams for power, signal, and control wiring.

1.05 INFORMATIONAL SUBMITTALS

A. Qualification Data: For qualified testing agency.

B. Seismic Qualification Certificates: For enclosed switches and circuit breakers, accessories, and components, from manufacturer.

1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.

2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.
3. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.

C. Field quality-control reports.

1.06 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For enclosed switches and circuit breakers to include in emergency, operation, and maintenance manuals.

1. In addition to items specified in Section 017823 "Operation and Maintenance Data," include the following:

a. Manufacturer's written instructions for testing and adjusting enclosed switches and circuit breakers.

b. Time-current coordination curves (average melt) for each type and rating of overcurrent protective device; include selectable ranges for each type of overcurrent protective device. Provide in PDF format.

1.07 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Fuses: Equal to 10 percent of quantity installed for each size and type, but no fewer than three of each size and type.
2. Fuse Pullers: Two for each size and type.

1.08 QUALITY ASSURANCE

A. Testing Agency Qualifications: Accredited by NETA.

1. Testing Agency's Field Supervisor: Currently certified by NETA to supervise on-site testing.

1.09 FIELD CONDITIONS

A. Environmental Limitations: Rate equipment for continuous operation under the following conditions unless otherwise indicated:

1. Ambient Temperature: Not less than minus 22 deg F and not exceeding 104 deg F.
2. Altitude: Not exceeding 6600 feet.

1.10 WARRANTY

A. Manufacturer's Warranty: Manufacturer and Installer agree to repair or replace components that fail in materials or workmanship within specified warranty period.

1. Warranty Period: One year from date of Substantial Completion.

PART 2 PRODUCTS

2.01 PERFORMANCE REQUIREMENTS

A. Seismic Performance: Enclosed switches and circuit breakers shall withstand the effects of earthquake motions determined according to ASCE/SEI 7.

1. The term "withstand" means "the unit will remain in place without separation of any parts from the device when subjected to the seismic forces specified and the unit will be fully operational after the seismic event."

2.02 GENERAL REQUIREMENTS

A. Source Limitations: Obtain enclosed switches and circuit breakers, overcurrent protective devices, components, and accessories, within same product category, from single manufacturer.

B. Product Selection for Restricted Space: Drawings indicate maximum dimensions for enclosed switches and circuit breakers, including clearances between enclosures, and adjacent surfaces and other items. Comply with indicated maximum dimensions.

C. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by an NRTL, and marked for intended location and application.

D. Comply with NFPA 70.

2.03 FUSIBLE SWITCHES

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. ABB Inc.
2. Eaton.
3. General Electric Company.
4. SIEMENS Industry, Inc.; Energy Management Division.

B. Type HD, Heavy Duty:

1. Single throw.
2. Three pole.
3. 600-V ac.
4. 1200 A and smaller.
5. UL 98 and NEMA KS 1, horsepower rated, with clips or bolt pads to accommodate specified fuses.
6. Lockable handle with capability to accept three padlocks, and interlocked with cover in closed position.

C. Accessories:

1. Equipment Ground Kit: Internally mounted and labeled for copper and aluminum ground conductors.
2. Neutral Kit: Internally mounted; insulated, capable of being grounded and bonded; labeled for copper and aluminum neutral conductors.
3. Isolated Ground Kit: Internally mounted; insulated, labeled for copper and aluminum neutral conductors.
4. Class R Fuse Kit: Provides rejection of other fuse types when Class R fuses are specified.
5. Auxiliary Contact Kit: NO/NC (Form "C") auxiliary contact(s), arranged to activate before switch blades open. Contact rating - 24-V ac
6. Hookstick Handle: Allows use of a hookstick to operate the handle.
7. Lugs: Compression type, suitable for number, size, and conductor material.
8. Service-Rated Switches: Labeled for use as service equipment.

2.04 NONFUSIBLE SWITCHES

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Eaton.
2. General Electric Company.
3. SIEMENS Industry, Inc.; Energy Management Division.

B. Type GD, General Duty, Three Pole, Single Throw, 240-V ac, 600 A and Smaller: UL 98 and NEMA KS 1, horsepower rated, lockable handle with capability to accept two padlocks, and interlocked with cover in closed position.

C. Type HD, Heavy Duty, Three Pole, Single Throw, 600-V ac, 1200 A and Smaller: UL 98 and NEMA KS 1, horsepower rated, lockable handle with capability to accept three padlocks, and interlocked with cover in closed position.

D. Type HD, Heavy Duty, Six Pole, Single Throw, 600-V ac, 200 A and Smaller: UL 98 and NEMA KS 1, horsepower rated, lockable handle with capability to accept three padlocks, and interlocked with cover in closed position.

E. Type HD, Heavy Duty, Three Pole, Double Throw, 600-V ac, 1200 A and Smaller: UL 98 and NEMA KS 1, horsepower rated, lockable handle with capability to accept three padlocks, and interlocked with cover in closed position.

F. Accessories:

1. Equipment Ground Kit: Internally mounted and labeled for copper and aluminum ground conductors.
2. Neutral Kit: Internally mounted; insulated, capable of being grounded and bonded; labeled for copper and aluminum neutral conductors.
3. Isolated Ground Kit: Internally mounted; insulated, labeled for copper and aluminum neutral conductors.
4. Class R Fuse Kit: Provides rejection of other fuse types when Class R fuses are specified.
5. Auxiliary Contact Kit: Two NO/NC (Form "C") auxiliary contact(s), arranged to activate before switch blades open. Contact rating - 24-V ac.
6. Hookstick Handle: Allows use of a hookstick to operate the handle.
7. Lugs: Compression type, suitable for number, size, and conductor material.
8. Service-Rated Switches: Labeled for use as service equipment.

2.05 MOLDED-CASE CIRCUIT BREAKERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Eaton.
2. General Electric Company.
3. NOARK Electric North America.
4. SIEMENS Industry, Inc.; Energy Management Division.

B. Circuit breakers shall be constructed using glass-reinforced insulating material. Current carrying components shall be completely isolated from the handle and the accessory mounting area.

C. Circuit breakers shall have a toggle operating mechanism with common tripping of all poles, which provides quick-make, quick-break contact action. The circuit-breaker handle shall be over center, be trip free, and reside in a tripped position between on and off to provide local trip indication. Circuit-breaker escutcheon shall be clearly marked on and off in addition to providing international I/O markings. Equip circuit breaker with a push-to-trip button, located on the face of the circuit breaker to mechanically operate the circuit-breaker tripping mechanism for maintenance and testing purposes.

D. The maximum ampere rating and UL, IEC, or other certification standards with applicable voltage systems and corresponding interrupting ratings shall be clearly marked on face of circuit breaker. Circuit breakers shall be rated as indicated on the Drawings. Circuit breaker/circuit breaker combinations for series connected interrupting ratings shall be listed by UL as recognized component combinations. Any series rated combination used shall be marked on the end-use equipment along with the statement "Caution - Series Rated System. _____ Amps Available. Identical Replacement Component Required."

E. MCCBs shall be equipped with a device for locking in the isolated position.

F. Lugs shall be suitable for 140 deg F rated wire on 125-A circuit breakers and below.

G. Standard: Comply with UL 489 with interrupting capacity to comply with available fault currents.

H. Thermal-Magnetic Circuit Breakers: Inverse time-current thermal element for low-level overloads and instantaneous magnetic trip element for short circuits. Adjustable magnetic trip setting for circuit-breaker frame sizes 250 A and larger.

I. Adjustable, Instantaneous-Trip Circuit Breakers: Magnetic trip element with front-mounted, field-adjustable trip setting.

J. Electronic Trip Circuit Breakers: Field-replaceable rating plug, rms sensing, with the following field-adjustable settings:

1. Instantaneous trip.
2. Long- and short-time pickup levels.
3. Long- and short-time time adjustments.
4. Ground-fault pickup level, time delay, and I-squared t response.

K. Current-Limiting Circuit Breakers: Frame sizes 400 A and smaller, and let-through ratings less than NEMA FU 1, RK-5.

L. Integrally Fused Circuit Breakers: Thermal-magnetic trip element with integral limiter-style fuse listed for use with circuit breaker and trip activation on fuse opening or on opening of fuse compartment door.

M. Ground-Fault Circuit-Interrupter (GFCI) Circuit Breakers: Single- and two-pole configurations with Class A ground-fault protection (6-mA trip).

N. Ground-Fault Equipment-Protection (GFEP) Circuit Breakers: With Class B ground-fault protection (30-mA trip).

O. Features and Accessories:

1. Standard frame sizes, trip ratings, and number of poles.
2. Lugs: Compression type, suitable for number, size, trip ratings, and conductor material.
3. Application Listing: Appropriate for application; Type SWD for switching fluorescent lighting loads; Type HID for feeding fluorescent and high-intensity discharge lighting circuits.
4. Ground-Fault Protection: Comply with UL 1053; integrally mounted, self-powered type with mechanical ground-fault indicator; relay with adjustable pickup and time-delay settings, push-to-test feature, internal memory, and shunt trip unit; and three-phase, zero-sequence current transformer/sensor.
5. Communication Capability: Universal-mounted communication module with functions and features compatible with power monitoring and control system, specified in Section 260913 "Electrical Power Monitoring and Control."
6. Shunt Trip: Trip coil energized from separate circuit, with coil-clearing contact.
7. Undervoltage Trip: Set to operate at 35 to 75 percent of rated voltage without intentional time delay.
8. Auxiliary Contacts: Two SPDT switches with "a" and "b" contacts; "a" contacts mimic circuit-breaker contacts, "b" contacts operate in reverse of circuit-breaker contacts.
9. Alarm Switch: One NO and NC contact that operates only when circuit breaker has tripped.
10. Key Interlock Kit: Externally mounted to prohibit circuit-breaker operation; key shall be removable only when circuit breaker is in off position.
11. Zone-Selective Interlocking: Integral with electronic trip unit; for interlocking ground-fault protection function.

12. Electrical Operator: Provide remote control for on, off, and reset operations.
13. Accessory Control Power Voltage: Integrally mounted, self-powered; 24-V ac

2.06 MOLDED-CASE SWITCHES

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   1. Eaton.
   2. General Electric Company.
   3. NOARK Electric North America.
   4. SIEMENS Industry, Inc.; Energy Management Division.

B. Description: MCCB with fixed, high-set instantaneous trip only, and short-circuit withstand rating equal to equivalent breaker frame size interrupting rating.

C. Standard: Comply with UL 489 with interrupting capacity to comply with available fault currents.

D. Features and Accessories:
   1. Standard frame sizes and number of poles.
   2. Lugs:
      a. Compression type, suitable for number, size, trip ratings, and conductor material.
      b. Lugs shall be suitable for 140 deg F rated wire on 125-A circuit breakers and below rating in NFPA 70.
   3. Ground-Fault Protection: Comply with UL 1053; remote-mounted and powered type with mechanical ground-fault indicator; relay with adjustable pickup and time-delay settings, push-to-test feature, internal memory, and shunt trip unit; and three-phase, zero-sequence current transformer/sensor.
   4. Shunt Trip: Trip coil energized from separate circuit, with coil-clearing contact.
   5. Undervoltage Trip: Set to operate at 35 to 75 percent of rated voltage without intentional time delay.
   6. Auxiliary Contacts: Two SPDT switches with "a" and "b" contacts; "a" contacts mimic switch contacts, "b" contacts operate in reverse of switch contacts.
   7. Alarm Switch: One NO and NC contact that operates only when switch has tripped.
   8. Key Interlock Kit: Externally mounted to prohibit switch operation; key shall be removable only when switch is in off position.
   9. Zone-Selective Interlocking: Integral with ground-fault shunt trip unit; for interlocking ground-fault protection function.
   10. Electrical Operator: Provide remote control for on, off, and reset operations.
   11. Accessory Control Power Voltage: Integrally mounted, self-powered; 24-V ac

2.07 ENCLOSURES

A. Enclosed Switches and Circuit Breakers: UL 489, NEMA KS 1, NEMA 250, and UL 50, to comply with environmental conditions at installed location.

B. Enclosure Finish: The enclosure shall be finished with gray baked enamel paint, electrodeposited on cleaned, phosphatized steel (NEMA 250 Type 1).

C. Conduit Entry: NEMA 250 Types 4, 4X, and 12 enclosures shall contain no knockouts. NEMA 250 Types 7 and 9 enclosures shall be provided with threaded conduit openings in both endwalls.

D. Operating Mechanism: The circuit-breaker operating handle shall be directly operable through the front cover of the enclosure (NEMA 250 Type 1). The cover interlock mechanism shall have an externally operated override. The override shall not permanently disable the interlock

mechanism, which shall return to the locked position once the override is released. The tool used to override the cover interlock mechanism shall not be required to enter the enclosure in order to override the interlock.

E. Enclosures designated as NEMA 250 Type 4, 4X stainless steel, 12, or 12K shall have a dual cover interlock mechanism to prevent unintentional opening of the enclosure cover when the circuit breaker is ON and to prevent turning the circuit breaker ON when the enclosure cover is open.

F. NEMA 250 Type 7/9 enclosures shall be furnished with a breather and drain kit to allow their use in outdoor and wet location applications.

PART 3 EXECUTION

3.01 EXAMINATION

A. Examine elements and surfaces to receive enclosed switches and circuit breakers for compliance with installation tolerances and other conditions affecting performance of the Work.

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

1. Commencement of work shall indicate Installer's acceptance of the areas and conditions as satisfactory.

3.02 PREPARATION

A. Interruption of Existing Electric Service: Do not interrupt electric service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary electric service according to requirements indicated:

1. Notify Architect, Construction Manager, Owner no fewer than 14 days in advance of proposed interruption of electric service.

2. Indicate method of providing temporary electric service.

3. Do not proceed with interruption of electric service without Architect's, Construction Manager's, Owner's written permission.

4. Comply with NFPA 70E.

3.03 INSTALLATION

A. Coordinate layout and installation of switches, circuit breakers, and components with equipment served and adjacent surfaces. Maintain required workspace clearances and required clearances for equipment access doors and panels.

B. Install individual wall-mounted switches and circuit breakers with tops at uniform height unless otherwise indicated.

C. Comply with mounting and anchoring requirements specified in Section 260548.16 "Seismic Controls for Electrical Systems."

D. Temporary Lifting Provisions: Remove temporary lifting of eyes, channels, and brackets and temporary blocking of moving parts from enclosures and components.

E. Install fuses in fusible devices.

F. Comply with NFPA 70 and NECA 1.

3.04 IDENTIFICATION

A. Comply with requirements in Section 260553 "Identification for Electrical Systems."

1. Identify field-installed conductors, interconnecting wiring, and components; provide warning signs.

2. Label each enclosure with engraved metal or laminated-plastic nameplate.

3.05 FIELD QUALITY CONTROL

A. Testing Agency: Owner will engage a qualified testing agency to perform tests and inspections.

B. Testing Agency: Engage a qualified testing agency to perform tests and inspections.

C. Manufacturer's Field Service: Engage a factory-authorized service representative to test and inspect components, assemblies, and equipment installations, including connections.

D. Perform tests and inspections with the assistance of a factory-authorized service representative.

E. Tests and Inspections for Switches:

1. Visual and Mechanical Inspection:
    a. Inspect physical and mechanical condition.
    b. Inspect anchorage, alignment, grounding, and clearances.
    c. Verify that the unit is clean.
    d. Verify blade alignment, blade penetration, travel stops, and mechanical operation.
    e. Verify that fuse sizes and types match the Specifications and Drawings.
    f. Verify that each fuse has adequate mechanical support and contact integrity.
    g. Inspect bolted electrical connections for high resistance using one of the two following methods:
        1) Use a low-resistance ohmmeter.
            a) Compare bolted connection resistance values to values of similar connections. Investigate values that deviate from those of similar bolted connections by more than 50 percent of the lowest value.
        2) Verify tightness of accessible bolted electrical connections by calibrated torque-wrench method in accordance with manufacturer's published data or NETA ATS Table 100.12.
            a) Bolt-torque levels shall be in accordance with manufacturer's published data. In the absence of manufacturer's published data, use NETA ATS Table 100.12.
    h. Verify that operation and sequencing of interlocking systems is as described in the Specifications and shown on the Drawings.
    i. Verify correct phase barrier installation.
    j. Verify lubrication of moving current-carrying parts and moving and sliding surfaces.
2. Electrical Tests:
    a. Perform resistance measurements through bolted connections with a low-resistance ohmmeter. Compare bolted connection resistance values to values of similar connections. Investigate values that deviate from adjacent poles or similar switches by more than 50 percent of the lowest value.
    b. Measure contact resistance across each switchblade fuseholder. Drop values shall not exceed the high level of the manufacturer's published data. If manufacturer's published data are not available, investigate values that deviate from adjacent poles or similar switches by more than 50 percent of the lowest value.
    c. Perform insulation-resistance tests for one minute on each pole, phase-to-phase and phase-to-ground with switch closed, and across each open pole. Apply voltage in accordance with manufacturer's published data. In the absence of manufacturer's published data, use Table 100.1 from the NETA ATS. Investigate values of insulation resistance less than those published in Table 100.1 or as recommended in manufacturer's published data.
    d. Measure fuse resistance. Investigate fuse-resistance values that deviate from each other by more than 15 percent.
    e. Perform ground fault test according to NETA ATS 7.14 "Ground Fault Protection Systems, Low-Voltage."

F. Tests and Inspections for Molded Case Circuit Breakers:

1. Visual and Mechanical Inspection:

a. Verify that equipment nameplate data are as described in the Specifications and shown on the Drawings.

b. Inspect physical and mechanical condition.

c. Inspect anchorage, alignment, grounding, and clearances.

d. Verify that the unit is clean.

e. Operate the circuit breaker to ensure smooth operation.

f. Inspect bolted electrical connections for high resistance using one of the two following methods:

1) Use a low-resistance ohmmeter.

a) Compare bolted connection resistance values to values of similar connections. Investigate values that deviate from those of similar bolted connections by more than 50 percent of the lowest value.

2) Verify tightness of accessible bolted electrical connections by calibrated torque-wrench method in accordance with manufacturer's published data or NETA ATS Table 100.12.

a) Bolt-torque levels shall be in accordance with manufacturer's published data. In the absence of manufacturer's published data, use NETA ATS Table 100.12.

g. Inspect operating mechanism, contacts, and chutes in unsealed units.

h. Perform adjustments for final protective device settings in accordance with the coordination study.

2. Electrical Tests:

a. Perform resistance measurements through bolted connections with a low-resistance ohmmeter. Compare bolted connection resistance values to values of similar connections. Investigate values that deviate from adjacent poles or similar switches by more than 50 percent of the lowest value.

b. Perform insulation-resistance tests for one minute on each pole, phase-to-phase and phase-to-ground with circuit breaker closed, and across each open pole. Apply voltage in accordance with manufacturer's published data. In the absence of manufacturer's published data, use Table 100.1 from the NETA ATS. Investigate values of insulation resistance less than those published in Table 100.1 or as recommended in manufacturer's published data.

c. Perform a contact/pole resistance test. Drop values shall not exceed the high level of the manufacturer's published data. If manufacturer's published data are not available, investigate values that deviate from adjacent poles or similar switches by more than 50 percent of the lowest value.

d. Perform insulation resistance tests on all control wiring with respect to ground. Applied potential shall be 500-V dc for 300-V rated cable and 1000-V dc for 600-V rated cable. Test duration shall be one minute. For units with solid state components, follow manufacturer's recommendation. Insulation resistance values shall be no less than two megohms.

e. Determine the following by primary current injection:

1) Long-time pickup and delay. Pickup values shall be as specified. Trip characteristics shall not exceed manufacturer's published time-current characteristic tolerance band, including adjustment factors.

2) Short-time pickup and delay. Short-time pickup values shall be as specified. Trip characteristics shall not exceed manufacturer's published time-current characteristic tolerance band, including adjustment factors.

3) Ground-fault pickup and time delay. Ground-fault pickup values shall be as specified. Trip characteristics shall not exceed manufacturer's published time-current characteristic tolerance band, including adjustment factors.

4) Instantaneous pickup. Instantaneous pickup values shall be as specified and within manufacturer's published tolerances.

f. Test functionality of the trip unit by means of primary current injection. Pickup values and trip characteristics shall be as specified and within manufacturer's published tolerances.

g. Perform minimum pickup voltage tests on shunt trip and close coils in accordance with manufacturer's published data. Minimum pickup voltage of the shunt trip and close coils shall be as indicated by manufacturer.

h. Verify correct operation of auxiliary features such as trip and pickup indicators; zone interlocking; electrical close and trip operation; trip-free, anti-pump function; and trip unit battery condition. Reset all trip logs and indicators. Investigate units that do not function as designed.

i. Verify operation of charging mechanism. Investigate units that do not function as designed.

3. Correct malfunctioning units on-site, where possible, and retest to demonstrate compliance; otherwise, replace with new units and retest.

4. Perform the following infrared scan tests and inspections and prepare reports:

a. Initial Infrared Scanning: After Substantial Completion, but not more than 60 days after Final Acceptance, perform an infrared scan of each enclosed switch and circuit breaker. Remove front panels so joints and connections are accessible to portable scanner.

b. Follow-up Infrared Scanning: Perform an additional follow-up infrared scan of each enclosed switch and circuit breaker 11 months after date of Substantial Completion.

c. Instruments and Equipment: Use an infrared scanning device designed to measure temperature or to detect significant deviations from normal values. Provide calibration record for device.

5. Test and adjust controls, remote monitoring, and safeties. Replace damaged and malfunctioning controls and equipment.

G. Enclosed switches and circuit breakers will be considered defective if they do not pass tests and inspections.

H. Prepare test and inspection reports.

1. Test procedures used.

2. Include identification of each enclosed switch and circuit breaker tested and describe test results.

3. List deficiencies detected, remedial action taken, and observations after remedial action.

3.06 ADJUSTING

A. Adjust moving parts and operable components to function smoothly, and lubricate as recommended by manufacturer.

B. Set field-adjustable circuit-breaker trip ranges as specified in Section 26 0573 "Overcurrent Protective Device Coordination Study.

END OF SECTION 26 2816

SECTION 26 4313

SURGE PROTECTION FOR LOW-VOLTAGE ELECTRICAL POWER CIRCUITS

PART 1 GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SUMMARY

A. Section includes field-mounted SPDs for low-voltage (120 to 600 V) power distribution and control equipment.

B. Related Requirements:

1. Section 26 2413 "Switchboards" for factory-installed SPDs.
2. Section 26 2416 "Panelboards" for factory-installed SPDs.

1.03 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.

1.04 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Include rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories.
2. Copy of UL Category Code VZCA certification, as a minimum, listing the tested values for VPRs, Inominal ratings, MCOVs, type designations, OCPD requirements, model numbers, system voltages, and modes of protection.

1.05 INFORMATIONAL SUBMITTALS

A. Field quality-control reports.

B. Sample Warranty: For manufacturer's special warranty.

1.06 CLOSEOUT SUBMITTALS

A. Maintenance Data: For SPDs to include in maintenance manuals.

1.07 WARRANTY

A. Manufacturer's Warranty: Manufacturer agrees to replace or replace SPDs that fail in materials or workmanship within specified warranty period.

1. Warranty Period: **Ten** years from date of Substantial Completion.

PART 2 PRODUCTS

2.01 GENERAL SPD REQUIREMENTS

A. SPD with Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

B. Comply with NFPA 70.

C. Comply with UL 1449.

D. MCOV of the SPD shall be the nominal system voltage.

2.02 SERVICE ENTRANCE AND TRANSFER SWITCH SUPPRESSOR

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. ABB USA.
2. Advanced Protection Technologies Inc. (APT).
3. ALLTEC.
4. Atlantic Scientific.
5. Current Technology Inc.
6. Danaher Power Solutions.
7. Eaton.
8. General Electric Company.
9. Intermatic, Inc.
10. LEA International.
11. Leviton Manufacturing Co., Inc.
12. Liebert; a brand of Emerson Electric Co.
13. Northern Technologies, Inc.
14. Raycap, Inc.

B. SPDs: Comply with UL 1449, Type 2.

C. SPDs: Listed and labeled by an NRTL acceptable to authorities having jurisdiction as complying with UL 1449, Type 2

1. SPDs with the following features and accessories:
    a. Integral disconnect switch.
    b. Internal thermal protection that disconnects the SPD before damaging internal suppressor components.
    c. Indicator light display for protection status.
    d. Form-C contacts rated at 5 A and 250-V ac, one normally open and one normally closed, for remote monitoring of protection status. Contacts shall reverse on failure of any surge diversion module or on opening of any current-limiting device. Coordinate with building power monitoring and control system.
    e. Surge counter.

D. Comply with UL 1283.

E. Peak Surge Current Rating: The minimum single-pulse surge current withstand rating per phase shall not be less than 320 kA. The peak surge current rating shall be the arithmetic sum of the ratings of the individual MOVs in a given mode.

F. Protection modes and UL 1449 VPR for grounded wye circuits with 480Y/277 V, three-phase, four-wire circuits shall not exceed the following:

1. Line to Neutral: 1200 V for 480Y/277 V.
2. Line to Ground: 1200 V for 480Y/277 V.
3. Line to Line: 2000 V for 480Y/277 V.

G. SCCR: Equal or exceed 250 kA.

H. Inominal Rating: 20 kA.

2.03 PANEL SUPPRESSORS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   1. ABB USA.
   2. Advanced Protection Technologies Inc. (APT).
   3. ALLTEC.
   4. Atlantic Scientific.
   5. Current Technology Inc.
   6. Danaher Power Solutions.
   7. Eaton.
   8. General Electric Company.
   9. Intermatic, Inc.
   10. LEA International.
   11. Leviton Manufacturing Co., Inc.
   12. Liebert; a brand of Emerson Electric Co.
   13. Northern Technologies, Inc.
   14. Raycap, Inc.

B. SPDs: Comply with UL 1449, Type 2.
   1. Include LED indicator lights for power and protection status.
   2. Internal thermal protection that disconnects the SPD before damaging internal suppressor components.
   3. Include Form-C contacts rated at 5 A and 250-V ac, one normally open and one normally closed, for remote monitoring of protection status. Contacts shall reverse on failure of any surge diversion module or on opening of any current-limiting device. Coordinate with building power monitoring and control system.

C. Peak Surge Current Rating: The minimum single-pulse surge current withstand rating per phase shall not be less than **100 kA**. The peak surge current rating shall be the arithmetic sum of the ratings of the individual MOVs in a given mode.

D. Comply with UL 1283.

2.04 ENCLOSURES

A. Indoor Enclosures: NEMA 250, Type 1.

B. Outdoor Enclosures: NEMA 250, Type 3R.

2.05 CONDUCTORS AND CABLES

A. Power Wiring: Same size as SPD leads, complying with Section 260519 "Low-Voltage Electrical Power Conductors and Cables."

B. Class 2 Control Cables: Multiconductor cable with copper conductors not smaller than No. 18 AWG, complying with Section 260519 "Low-Voltage Electrical Power Conductors and Cables."

C. Class 1 Control Cables: Multiconductor cable with copper conductors not smaller than No. 18 AWG, complying with Section 260519 "Low-Voltage Electrical Power Conductors and Cables."

PART 3 EXECUTION

3.01 INSTALLATION

A. Comply with NECA 1.

B. Install an OCPD or disconnect as required to comply with the UL listing of the SPD.

C. Install SPDs with conductors between suppressor and points of attachment as short and straight as possible, and adjust circuit-breaker positions to achieve shortest and straightest leads. Do not splice and extend SPD leads unless specifically permitted by manufacturer. Do not exceed manufacturer's recommended lead length. Do not bond neutral and ground.

D. Use crimped connectors and splices only. Wire nuts are unacceptable.

E. Wiring:

1. Power Wiring: Comply with wiring methods in Section 26 0519 "Low-Voltage Electrical Power Conductors and Cables."
2. Controls: Comply with wiring methods in Section 26 0519 "Low-Voltage Electrical Power Conductors and Cables."

3.02 FIELD QUALITY CONTROL

A. Perform the following tests and inspections with the assistance of a factory-authorized service representative.

1. Compare equipment nameplate data for compliance with Drawings and Specifications.
2. Inspect anchorage, alignment, grounding, and clearances.
3. Verify that electrical wiring installation complies with manufacturer's written installation requirements.

B. An SPD will be considered defective if it does not pass tests and inspections.

C. Prepare test and inspection reports.

3.03 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.

3.04 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to operate and maintain SPDs.

END OF SECTION 26 4313

SECTION 26 5119
LED INTERIOR LIGHTING

PART 1 GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SUMMARY

A. Section includes the following types of LED luminaires:
   1. Cylinder.
   2. Downlight.
   3. Highbay, linear.
   4. Linear industrial.
   5. Lowbay.
   6. Parking garage.
   7. Recessed linear.
   8. Strip light.
   9. Surface mount, linear.
   10. Surface mount, nonlinear.
   11. Suspended, linear.
   12. Suspended, nonlinear.
   13. Materials.
   14. Finishes.
   15. Luminaire support.

B. Related Requirements:
   1. Section 260923 "Lighting Control Devices" for automatic control of lighting, including time switches, photoelectric relays, occupancy sensors, and multipole lighting relays and contactors.
   2. Section 260943.23 "Relay-Based Lighting Controls" for manual or programmable control systems with low-voltage control wiring or data communication circuits.

1.03 DEFINITIONS

A. CCT: Correlated color temperature.

B. CRI: Color Rendering Index.

C. Fixture: See "Luminaire."

D. IP: International Protection or Ingress Protection Rating.

E. LED: Light-emitting diode.

F. Lumen: Measured output of lamp and luminaire, or both.

G. Luminaire: Complete lighting unit, including lamp, reflector, and housing.

1.04 ACTION SUBMITTALS

A. Product Data: For each type of product.
   1. Arrange in order of luminaire designation.
   2. Include data on features, accessories, and finishes.
   3. Include physical description and dimensions of luminaires.

4. Include emergency lighting units, including batteries and chargers.
5. Include life, output (lumens, CCT, and CRI), and energy efficiency data.
6. Photometric data and adjustment factors based on laboratory tests, complying with IES Lighting Measurements Testing and Calculation Guides, of each luminaire type.
    a. Manufacturers' Certified Data: Photometric data certified by manufacturer's laboratory with a current accreditation under the National Voluntary Laboratory Accreditation Program for Energy Efficient Lighting Products.
    b. Testing Agency Certified Data: For indicated luminaires, photometric data certified by a qualified independent testing agency. Photometric data for remaining luminaires shall be certified by manufacturer.

B. S hop Drawings: For nonstandard or custom luminaires.
1. Include plans, elevations, sections, and mounting and attachment details.
2. Include details of luminaire assemblies. Indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
3. Include diagrams for power, signal, and control wiring.

C. Samples: For each luminaire and for each color and texture with standard factory-applied finish.

D. Samples for Initial Selection: For each type of luminaire with custom factory-applied finishes.
1. Include Samples of luminaires and accessories involving color and finish selection.

E. Samples for Verification: For each type of luminaire.
1. Include Samples of luminaires and accessories to verify finish selection.

F. Product Schedule: For luminaires and lamps. Use same designations indicated on Drawings.

1.05 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Reflected ceiling plan(s) and other details, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of the items involved:
1. Luminaires.
2. Suspended ceiling components.
3. Partitions and millwork that penetrate the ceiling or extend to within 12 inches of the plane of the luminaires.
4. Structural members to which equipment and or luminaires will be attached.
5. Initial access modules for acoustical tile, including size and locations.
6. Items penetrating finished ceiling, including the following:
    a. Other luminaires.
    b. Air outlets and inlets.
    c. Speakers.
    d. Sprinklers.
    e. Access panels.
    f. Ceiling-mounted projectors.
7. Moldings.

B. Qualification Data: For testing laboratory providing photometric data for luminaires.

C. Seismic Qualification Certificates: For luminaires, accessories, and components, from manufacturer.

1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.
2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.

D. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.

E. Product Certificates: For each type of luminaire.

F. Product Test Reports: For each luminaire, for tests performed by manufacturer and witnessed by a qualified testing agency.

G. Sample warranty.

1.06 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For luminaires and lighting systems to include in operation and maintenance manuals.

1. Provide a list of all lamp types used on Project; use ANSI and manufacturers' codes.

1.07 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Lamps: Ten for every 100 of each type and rating installed. Furnish at least one of each type.
2. Diffusers and Lenses: One for every 100 of each type and rating installed. Furnish at least one of each type.
3. Globes and Guards: One for every 20 of each type and rating installed. Furnish at least one of each type.

1.08 QUALITY ASSURANCE

A. Luminaire Photometric Data Testing Laboratory Qualifications: Luminaire manufacturer's laboratory that is accredited under the NVLAP for Energy Efficient Lighting Products.

B. Luminaire Photometric Data Testing Laboratory Qualifications: Provided by an independent agency, with the experience and capability to conduct the testing indicated, that is an NRTL as defined by OSHA in 29 CFR 1910.7, accredited under the NVLAP for Energy Efficient Lighting Products, and complying with the applicable IES testing standards.

C. Provide luminaires from a single manufacturer for each luminaire type.

D. Each luminaire type shall be binned within a three-step MacAdam Ellipse to ensure color consistency among luminaires.

E. Mockups: For interior luminaires in room or module mockups, complete with power and control connections.

1. Obtain Architect's approval of luminaires in mockups before starting installations.
2. Maintain mockups during construction in an undisturbed condition as a standard for judging the completed Work.
3. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.
4. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.09 DELIVERY, STORAGE, AND HANDLING

A. Protect finishes of exposed surfaces by applying a strippable, temporary protective covering before shipping.

1.10 WARRANTY

A. Warranty: Manufacturer and Installer agree to repair or replace components of luminaires that fail in materials or workmanship within specified warranty period.

B. Warranty Period: Five year(s) from date of Substantial Completion.

PART 2 PRODUCTS

2.01 PERFORMANCE REQUIREMENTS

A. Seismic Performance: Luminaires shall withstand the effects of earthquake motions determined according to ASCE 7.

B. Seismic Performance: Luminaires and lamps shall be labeled vibration and shock resistant.

1. The term "withstand" means "the luminaire will remain in place without separation of any parts when subjected to the seismic forces specified and the luminaire will be fully operational during and after the seismic event."

2.02 LUMINAIRE REQUIREMENTS

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

B. Standards:

1. ENERGY STAR certified.
2. California Title 24 compliant.
3. NRTL Compliance: Luminaires for hazardous locations shall be listed and labeled for indicated class and division of hazard by an NRTL.
4. FM Global Compliance: Luminaires for hazardous locations shall be listed and labeled for indicated class and division of hazard by FM Global.
5. UL Listing: Listed for damp location.
6. Recessed luminaires shall comply with NEMA LE 4.

C. Rated lamp life of 50,000 hours to L70.

D. Lamps dimmable from 100 percent to 0 percent of maximum light output.

E. Internal driver.

2.03 MATERIALS

A. Metal Parts:

1. Free of burrs and sharp corners and edges.
2. Sheet metal components shall be steel unless otherwise indicated.
3. Form and support to prevent warping and sagging.

B. Doors, Frames, and Other Internal Access: Smooth operating, free of light leakage under operating conditions, and designed to permit 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.

C. Diffusers and Globes:

1. Acrylic Diffusers: One hundred percent virgin acrylic plastic, with high resistance to yellowing and other changes due to aging, exposure to heat, and UV radiation.
2. Glass: Annealed crystal glass unless otherwise indicated.
3. Lens Thickness: At least 0.125 inch minimum unless otherwise indicated.

D. Housings:

1. Extruded-aluminum housing and heat sink.
2. Powder-coat finish.

E. Factory-Applied Labels: Comply with UL 1598. Include recommended lamps. Locate labels where they will be readily visible to service personnel, but not seen from normal viewing angles when lamps are in place.
   1. Label shall include the following lamp characteristics:
      a. "USE ONLY" and include specific lamp type.
      b. Lamp diameter, shape, size, wattage, and coating.
      c. CCT and CRI for all luminaires.

2.04 METAL FINISHES

A. Variations in finishes are unacceptable in the same piece. Variations in finishes of adjoining components are acceptable if they are within the range of approved Samples and if they can be and are assembled or installed to minimize contrast.

2.05 LUMINAIRE SUPPORT

A. Comply with requirements in Section 260529 "Hangers and Supports for Electrical Systems" for channel and angle iron supports and nonmetallic channel and angle supports.

B. Single-Stem Hangers: 1/2-inch steel tubing with swivel ball fittings and ceiling canopy. Finish same as luminaire.

C. Wires: ASTM A 641/A 641 M, Class 3, soft temper, zinc-coated steel, 12 gage.

D. Rod Hangers: 3/16-inch minimum diameter, cadmium-plated, threaded steel rod.

E. Hook Hangers: Integrated assembly matched to luminaire, line voltage, and equipment with threaded attachment, cord, and locking-type plug.

PART 3 EXECUTION

3.01 EXAMINATION

A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

B. Examine roughing-in for luminaire to verify actual locations of luminaire and electrical connections before luminaire installation. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 TEMPORARY LIGHTING

A. If approved by the Architect, use selected permanent luminaires for temporary lighting. When construction is sufficiently complete, clean luminaires used for temporary lighting and install new lamps.

3.03 INSTALLATION

A. Comply with NECA 1.

B. Install luminaires level, plumb, and square with ceilings and walls unless otherwise indicated.

C. Install lamps in each luminaire.

D. Supports:
   1. Sized and rated for luminaire weight.
   2. Able to maintain luminaire position after cleaning and relamping.
   3. Provide support for luminaire without causing deflection of ceiling or wall.
   4. Luminaire mounting devices shall be capable of supporting a horizontal force of 100 percent of luminaire weight and vertical force of 400 percent of luminaire weight.

E. Flush-Mounted Luminaire Support:
   1. Secured to outlet box.

2. Attached to ceiling structural members at four points equally spaced around circumference of luminaire.
3. Trim ring flush with finished surface.

F. Wall-Mounted Luminaire Support:
1. Attached to structural members in walls.
2. Do not attach luminaires directly to gypsum board.

G. Suspended Luminaire Support:
1. Pendants and Rods: Where longer than 48 inches, brace to limit swinging.
2. Stem-Mounted, Single-Unit Luminaires: Suspend with twin-stem hangers. Support with approved outlet box and accessories that hold stem and provide damping of luminaire oscillations. Support outlet box vertically to building structure using approved devices.
3. Continuous Rows of Luminaires: Use tubing or stem for wiring at one point and tubing or rod for suspension for each unit length of luminaire chassis, including one at each end.
4. Do not use ceiling grid as support for pendant luminaires. Connect support wires or rods to building structure.

H. Ceiling-Grid-Mounted Luminaires:
1. Secure to any required outlet box.
2. Secure luminaire to the luminaire opening using approved fasteners in a minimum of four locations, spaced near corners of luminaire.
3. Use approved devices and support components to connect luminaire to ceiling grid and building structure in a minimum of four locations, spaced near corners of luminaire.

I. Comply with requirements in Section 260519 "Low-Voltage Electrical Power Conductors and Cables" for wiring connections.

3.04 IDENTIFICATION

A. Identify system components, wiring, cabling, and terminals. Comply with requirements for identification specified in Section 260553 "Identification for Electrical Systems."

3.05 FIELD QUALITY CONTROL

A. Perform the following tests and inspections:
1. Operational Test: After installing luminaires, switches, and accessories, and after electrical circuitry has been energized, test units to confirm proper operation.
2. Test for Emergency Lighting: Interrupt power supply to demonstrate proper operation. Verify transfer from normal power to battery power and retransfer to normal.

B. Luminaire will be considered defective if it does not pass operation tests and inspections.

C. Prepare test and inspection reports.

3.06 STARTUP SERVICE

A. Comply with requirements for startup specified in Section 260943.16 "Addressable-Luminaire Lighting Controls."

B. Comply with requirements for startup specified in Section 260943.23 "Relay-Based Lighting Controls."

3.07 ADJUSTING

A. Occupancy Adjustments: When requested within 12 months of date of Substantial Completion, provide on-site assistance in adjusting the direction of aim of luminaires to suit occupied conditions. Make up to two visits to Project during other-than-normal hours for this purpose. Some of this work may be required during hours of darkness.
1. During adjustment visits, inspect all luminaires. Replace lamps or luminaires that are defective.

2. Parts and supplies shall be manufacturer's authorized replacement parts and supplies.
3. Adjust the aim of luminaires in the presence of the Architect.

END OF SECTION 26 5119

SECTION 26 5219
EMERGENCY AND EXIT LIGHTING

PART 1 GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SUMMARY

A. Section Includes:

1. Emergency lighting units.
2. Exit signs.
3. Luminaire supports.

1.03 DEFINITIONS

A. CCT: Correlated color temperature.

B. CRI: Color Rendering Index.

C. Emergency Lighting Unit: A lighting unit with internal or external emergency battery powered supply and the means for controlling and charging the battery and unit operation.

D. Fixture: See "Luminaire" Paragraph.

E. Lumen: Measured output of lamp and luminaire, or both.

F. Luminaire: Complete lighting unit, including lamp, reflector, and housing.

1.04 ACTION SUBMITTALS

A. Product Data: For each type of emergency lighting unit, exit sign, and emergency lighting support.

1. Include data on features, accessories, and finishes.
2. Include physical description of the unit and dimensions.
3. Battery and charger for light units.
4. Include life, output of luminaire (lumens, CCT, and CRI), and energy-efficiency data.
5. Include photometric data and adjustment factors based on laboratory tests, complying with IES LM-45, for each luminaire type.

a. Testing Agency Certified Data: For indicated luminaires and signs, photometric data certified by a qualified independent testing agency. Photometric data for remaining luminaires and signs shall be certified by manufacturer.

b. Manufacturers' Certified Data: Photometric data certified by manufacturer's laboratory with a current accreditation under the National Voluntary Laboratory Accreditation Program for Energy Efficient Lighting Products.

B. Shop Drawings: For nonstandard or custom luminaires.

1. Include plans, elevations, sections, and mounting and attachment details.
2. Include details of equipment assemblies. Indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
3. Include diagrams for power, signal, and control wiring.

C. Samples: For each product and for each color and texture specified.

D. Samples for Initial Selection: For each type of luminaire with factory-applied finishes.

E. Samples for Verification: For each type of luminaire.

1. Include Samples of luminaires and accessories to verify finish selection.

F. Product Schedule:
   1. For emergency lighting units.
   2. For exit signs.

1.05 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Reflected ceiling plan(s) and other details, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of the items involved:
   1. Luminaires.
   2. Suspended ceiling components.
   3. Partitions and millwork that penetrate the ceiling or extend to within 12 inches of the plane of the luminaires.
   4. Structural members to which equipment will be attached.
   5. Size and location of initial access modules for acoustical tile.
   6. Items penetrating finished ceiling including the following:
      a. Other luminaires.
      b. Air outlets and inlets.
      c. Speakers.
      d. Ceiling-mounted projectors.
      e. Sprinklers.
      f. Access panels.
   7. Moldings.

B. Qualification Data: For testing laboratory providing photometric data for luminaires.

C. Product Certificates: For each type of luminaire.

D. Seismic Qualification Data: For luminaires, accessories, and components, from manufacturer.
   1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.
   2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.
   3. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.
   4. Provide seismic qualification certificate for each piece of equipment.

E. Product Test Reports: For each luminaire for tests performed by manufacturer and witnessed by a qualified testing agency.

F. Sample Warranty: For manufacturer's special warranty.

1.06 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For luminaires and lighting systems to include in emergency, operation, and maintenance manuals.
   1. Provide a list of all lamp types used on Project; use ANSI and manufacturers' codes.

1.07 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
   1. Lamps: 10 for every 100 of each type and rating installed. Furnish at least one of each type.

2. Luminaire-mounted, emergency battery pack: One for every 20 emergency lighting units. Furnish at least one of each type.
3. Diffusers and Lenses: One for every 100 of each type and rating installed. Furnish at least one of each type.
4. Globes and Guards**:** One for every 20 of each type and rating installed. Furnish at least one of each type.

1.08 QUALITY ASSURANCE

A. Luminaire Photometric Data Testing Laboratory Qualifications: Luminaire manufacturer's laboratory that is accredited under the National Volunteer Laboratory Accreditation Program for Energy Efficient Lighting Products.

B. Luminaire Photometric Data Testing Laboratory Qualifications: Provided by an independent agency, with the experience and capability to conduct the testing indicated, that is an NRTL as defined by OSHA in 29 CFR 1910.7, accredited under the National Volunteer Laboratory Accreditation Program for Energy Efficient Lighting Products, and complying with the applicable IES testing standards.

C. FM Global Compliance: Luminaires for hazardous locations shall be listed and labeled for indicated class and division of hazard by FM Global.

D. Mockups: For interior luminaires in room or module mockups, complete with power and control connections.
1. Obtain Architect's approval of luminaires and signs in mockups before starting installations.
2. Maintain mockups during construction in an undisturbed condition as a standard for judging the completed Work.
3. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.
4. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.09 DELIVERY, STORAGE, AND HANDLING

A. Protect finishes of exposed surfaces by applying a strippable, temporary protective covering before shipping.

1.10 WARRANTY

A. Warranty: Manufacturer and Installer agree to repair or replace components of luminaires that fail in materials or workmanship within specified warranty period.
1. Warranty Period: Two year(s) from date of Substantial Completion.

B. Special Warranty for Emergency Lighting Batteries: Manufacturer's standard form in which manufacturer of battery-powered emergency lighting unit agrees to repair or replace components of rechargeable batteries that fail in materials or workmanship within specified warranty period.
1. Warranty Period for Emergency Power Unit Batteries: Five years from date of Substantial Completion. Full warranty shall apply for first year and prorated warranty for the remaining four years.
2. Warranty Period for Self-Powered Exit Sign Batteries: Two years from date of Substantial Completion. Full warranty shall apply for first year and prorated warranty for the remaining six years.

PART 2 PRODUCTS

2.01 PERFORMANCE REQUIREMENTS

A. Seismic Performance: Luminaires shall withstand the effects of earthquake motions determined according to ASCE/SEI 7.

1. The term "withstand" means "the luminaire will remain in place without separation of any parts when subjected to the seismic forces specified and the luminaire will be fully operational during and after the seismic event."

2.02 GENERAL REQUIREMENTS FOR EMERGENCY LIGHTING

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

B. NRTL Compliance: Fabricate and label emergency lighting units, exit signs, and batteries to comply with UL 924.

C. Comply with NFPA 70 and NFPA 101.

D. Lamps for Operation: LEDs; 50,000 hours minimum rated lamp life.

E. Comply with NEMA LE 4 for recessed luminaires.

F. Internal Type Emergency Power Unit: Self-contained, modular, battery-inverter unit, factory mounted within luminaire body.

1. Operation: Relay automatically turns lamp on when power-supply circuit voltage drops to 80 percent of nominal voltage or below. Lamp automatically disconnects from battery when voltage approaches deep-discharge level. When normal voltage is restored, relay disconnects lamps from battery, and battery is automatically recharged and floated on charger.
2. Nightlight Connection: Operate lamp continuously at 40 percent of rated light output.
3. Test Push-Button and Indicator Light: Visible and accessible without opening luminaire or entering ceiling space.
    a. Push Button: Push-to-test type, in unit housing, simulates loss of normal power and demonstrates unit operability.
    b. Indicator Light: LED indicates normal power on. Normal glow indicates trickle charge; bright glow indicates charging at end of discharge cycle.
4. Battery: Sealed, maintenance-free, nickel-cadmium type.
5. Charger: Fully automatic, solid-state, constant-current type with sealed power transfer relay.
6. Remote Test: Switch in handheld remote device aimed in direction of tested unit initiates coded infrared signal. Signal reception by factory-installed infrared receiver in tested unit triggers simulation of loss of its normal power supply, providing visual confirmation of either proper or failed emergency response.
7. Integral Self-Test: Factory-installed electronic device automatically initiates code-required test of unit emergency operation at required intervals. Test failure is annunciated by an integral audible alarm and a flashing red LED.

2.03 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. Lamps for AC Operation: LEDs; 50,000 hours minimum rated lamp life.
2. Self-Powered Exit Signs (Battery Type): Internal emergency power unit.

2.04 MATERIALS

A. Metal Parts:

1. Free of burrs and sharp corners and edges.
2. Sheet metal components shall be steel unless otherwise indicated.
3. Form and support to prevent warping and sagging.

B. Doors, Frames, and Other Internal Access:

1. Smooth operating, free of light leakage under operating conditions.
2. Designed to permit relamping without use of tools.
3. Designed to prevent doors, frames, lenses, diffusers, and other components from falling accidentally during relamping and when secured in operating position.

C. Diffusers and Globes:

1. Acrylic: 100 percent virgin acrylic plastic, with high resistance to yellowing and other changes due to aging, exposure to heat, and UV radiation.
2. Lens Thickness: At least 0.125 inch minimum unless otherwise indicated.

D. Housings:

1. Extruded aluminum housing and heat sink.

E. Conduit: Electrical metallic tubing, minimum 3/4 inch diameter.

2.05 METAL FINISHES

A. Appearance of Finished Work: Noticeable variations in same piece are not acceptable. Variations in appearance of adjoining components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

2.06 LUMINAIRE SUPPORT COMPONENTS

A. Comply with requirements in Section 260529 "Hangers and Supports for Electrical Systems" for channel and angle iron supports and nonmetallic channel and angle supports.

B. Support Wires: ASTM A 641/A 641M, Class 3, soft temper, zinc-coated steel, 12 gage.

PART 3 EXECUTION

3.01 EXAMINATION

A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for conditions affecting performance of luminaires.

B. Examine roughing-in for luminaire to verify actual locations of luminaire and electrical connections before luminaire installation.

C. Examine walls, floors, roofs, and ceilings for suitable conditions where emergency lighting luminaires will be installed.

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

3.02 INSTALLATION

A. Comply with NECA 1.

B. Install luminaires level, plumb, and square with ceilings and walls unless otherwise indicated.

C. Install lamps in each luminaire.

D. Supports:

1. Sized and rated for luminaire and emergency power unit weight.
2. Able to maintain luminaire position when testing emergency power unit.
3. Provide support for luminaire and emergency power unit without causing deflection of ceiling or wall.
4. Luminaire-mounting devices shall be capable of supporting a horizontal force of 100 percent of luminaire and emergency power unit weight and vertical force of 400 percent of luminaire weight.

E. Wall-Mounted Luminaire Support:
   1. Attached to structural members in walls.
   2. Do not attach luminaires directly to gypsum board.

F. Suspended Luminaire Support:
   1. Pendants and Rods: Where longer than brace to limit swinging.
   2. Stem-Mounted, Single-Unit Luminaires: Suspend with twin-stem hangers. Support with approved outlet box and accessories that hold stem and provide damping of luminaire oscillations. Support outlet box vertically to building structure using approved devices.
   3. Do not use ceiling grid as support for pendant luminaires. Connect support wires or rods to building structure.

G. Ceiling Grid Mounted Luminaires:
   1. Secure to any required outlet box.
   2. Secure emergency power unit using approved fasteners in a minimum of four locations, spaced near corners of emergency power unit.
   3. Use approved devices and support components to connect luminaire to ceiling grid and building structure in a minimum of four locations, spaced near corners of luminaire.

3.03 IDENTIFICATION

A. Identify system components, wiring, cabling, and terminals. Comply with requirements for identification specified in Section 260553 "Identification for Electrical Systems."

3.04 FIELD QUALITY CONTROL

A. Perform the following tests and inspections:
   1. Test for Emergency Lighting: Interrupt power supply to demonstrate proper operation. Verify transfer from normal power to battery power and retransfer to normal.

B. Luminaire will be considered defective if it does not pass operation tests and inspections.

C. Prepare test and inspection reports.

3.05 STARTUP SERVICE

A. Perform startup service:
   1. Charge emergency power units and batteries minimum of one hour and depress switch to conduct short-duration test.
   2. Charge emergency power units and batteries minimum of 24 hours and conduct one-hour discharge test.

3.06 ADJUSTING

A. Adjustments: Within 12 months of date of Substantial Completion, provide on-site visit to do the following:
   1. Inspect all luminaires. Replace lamps, emergency power units, batteries, signs, or luminaires that are defective.
      a. Parts and supplies shall be manufacturer's authorized replacement parts and supplies.
   2. Conduct short-duration tests on all emergency lighting.

END OF SECTION 26 5219

SECTION 26 5619
LED EXTERIOR LIGHTING

PART 1 GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SUMMARY

A. Section Includes:

1. Exterior solid-state luminaires that are designed for and exclusively use LED lamp technology.
2. Luminaire supports.
3. Luminaire-mounted photoelectric relays.

B. Related Requirements:

Division 26, Section 26 5119, LED Interior Lighting, for interior Luminaires, and accessories.

1.03 DEFINITIONS

A. CCT: Correlated color temperature.

B. CRI: Color rendering index.

C. Luminaire: See "Luminaire."

D. IP: International Protection or Ingress Protection Rating.

E. Lumen: Measured output of lamp and luminaire, or both.

F. Luminaire: Complete lighting unit, including LEDs, Drivers, Reflector, and Housing.

1.04 ACTION SUBMITTALS

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

B. Product Data: For each type of luminaire.

1. Arrange in order of luminaire schedule designation.
2. Include data on features, accessories, and finishes.
3. Include physical description and dimensions of luminaire.
4. LEDs, include life, output (lumens, CCT, and CRI), and energy-efficiency data.
5. Photometric data and adjustment factors based on laboratory tests, complying with IES Lighting Measurements Testing and Calculation Guides, of each luminaire type. The adjustment factors shall be for LEDs and accessories identical to those indicated for the luminaire as applied in this Project; IES LM-79 and IES LM-80
    a. Manufacturer's Certified Data: Photometric data certified by manufacturer's laboratory with a current accreditation under the NVLAP for Energy Efficient Lighting Products.
    b. Testing Agency Certified Data: For indicated luminaires, photometric data certified by a qualified independent testing agency. Photometric data for remaining luminaires shall be certified by manufacturer.
6. Wiring diagrams for power, control, and signal wiring. Wiring diagrams for control system showing both factory-installed and field-installed wiring for specific system of this Project, and differentiating between factory-installed and field-installed wiring.
7. Photoelectric relays.
8. Means of attaching luminaires to supports and indication that the attachment is suitable for components involved.

9. Luminaire, LEDs, Drivers, Poles, and accessories. Include data on features, Poles, accessories, finishes, and the following:
    a. Outline drawings indicating dimensions and principal features of Luminaire and Poles.
    b. Electrical Ratings and Photometric Data: Certified results of independent laboratory tests for Luminaires and LEDs.
10. Wind Resistance Calculations: Certified by a registered professional engineer
11. Anchor-Bolt Templates: Keyed to specific **poles** and certified by manufacturer.
12. Field test reports indicating and interpreting test results specified in Part 3 of this section.
13. Maintenance data for products to include in the operation and maintenance manual specified in Division 1.
14. Product certificates signed by manufacturers of lighting units certifying that their products comply with specified requirements.

C. Include lighting calculations for each space using the following reflectance's, 75,45,20, and working plane height of 30" AFF for comparison to Basis of Design

D. Shop Drawings: For nonstandard or custom luminaires.
1. Include plans, elevations, sections, and mounting and attachment details.
2. Include details of luminaire assemblies. Indicate dimensions, weights, loads, and required clearances, method of field assembly, components, and location and size of each field connection.
3. Include diagrams for power, signal, and control wiring.

E. Samples: For each luminaire and for each color and texture indicated with factory-applied finish.

F. Delegated-Design Submittal: For luminaire supports.
1. Include design calculations for luminaire supports and seismic restraints.

1.05 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Plans, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of the items involved:
1. Luminaires.
2. Structural members to which luminaires will be attached.
3. Underground utilities and structures.
4. Existing underground utilities and structures.
5. Above-grade utilities and structures.
6. Existing above-grade utilities and structures.
7. Building features.
8. Vertical and horizontal information.

B. Qualification Data: For testing laboratory providing photometric data for luminaires.

C. Seismic Qualification Data: For luminaires, accessories, and components, from manufacturer.
1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.
2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.
3. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.

D. Product Certificates: For each type of the following:

1. Luminaire.
2. Photoelectric relay.

E. Product Test Reports: For each luminaire, for tests performed by manufacturer and witnessed by a qualified testing agency.

F. Source quality-control reports.

G. Sample warranty.

1.06 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For luminaires to include in operation and maintenance manuals.

1. Provide a list of all LED types used on Project. Use ANSI and manufacturers' codes.

1.07 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. LEDs: One for every 50 of each type and rating installed. Furnish at least one of each type.
2. Glass, Acrylic, and Plastic Lenses, Covers, and Other Optical Parts: One for every 100 of each type and rating installed. Furnish at least one of each type.
3. Diffusers and Lenses: One for every 50 of each type and rating installed. Furnish at least one of each type.
4. Globes and Guards: One for every 50 of each type and rating installed. Furnish at least one of each type.

1.08 QUALITY ASSURANCE

A. Luminaire Photometric Data Testing Laboratory Qualifications: Luminaire manufacturers' laboratory that is accredited under the NVLAP for Energy Efficient Lighting Products.

B. Luminaire Photometric Data Testing Laboratory Qualifications: Provided by an independent agency, with the experience and capability to conduct the testing indicated, that is an NRTL as defined by OSHA in 29 CFR 1910.7, accredited under the NVLAP for Energy Efficient Lighting Products and complying with applicable IES testing standards.

C. Provide luminaires from a single manufacturer for each luminaire type.

D. Listing and Labeling: Provide Luminaires and accessories specified in this Section that are listed and labeled for their indicated use and installation conditions on Project.

1. Special Listing and Labeling: Provide Luminaires for use underwater that are specifically listed and labeled for such use. Provide Luminaires for use in hazardous (classified) locations that are listed and labeled for the specific hazard.
2. The Terms "Listed" and "Labeled": As defined in the National Electrical Code, Article 100.
3. Electrical Component Standard: Provide components that comply with NFPA 70 and that are listed and labeled by UL where available.

E. Each luminaire type shall be binned within a three-step MacAdam Ellipse to ensure color consistency among luminaires.

F. Installer Qualifications: An authorized representative who is trained and approved by manufacturer.

G. Mockups: For exterior luminaires, complete with power and control connections.

1. Obtain Architect's approval of luminaires in mockups before starting installations.
2. Maintain mockups during construction in an undisturbed condition as a standard for judging the completed work.

3. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.
4. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.09 DELIVERY, STORAGE, AND HANDLING

A. General: Store poles on decay-resistant treated skids at least 12 inches above grade and vegetation. Support pole to prevent distortion and arrange to provide free air circulation

B. Protect finishes of exposed surfaces by applying a strippable, temporary protective covering prior to shipping.

C. Metal Poles: Retain factory-applied pole wrappings until just before pole installation. For poles with nonmetallic finishes, handle with web fabric straps

1.10 FIELD CONDITIONS

A. Verify existing and proposed utility structures prior to the start of work associated with luminaire installation.

B. Mark locations of exterior luminaires for approval by Architect prior to the start of luminaire installation.

1.11 WARRANTY

A. Warranty for all luminaire types: Manufacturer and Installer agree to repair or replace any and all components of luminaires that fail in materials or workmanship within specified warranty period.

1. Warranty Period: Manufacturer and Installer agree to repair or replace components of luminaires that fail in materials or workmanship for Five years from date of Substantial Completion.
2. The warranty specified in this Article shall not deprive the Owner of other rights the Owner may have under other provisions of the Contract Documents and shall be in addition to, and run concurrent with, other warranties made by the Contractor under requirements of the Contract Documents
3. Failures include, but are not limited to, the following:
    a. Structural failures, including luminaire support components.
    b. Faulty operation of luminaires and accessories.
    c. Deterioration of metals, metal finishes, and other materials beyond normal weathering. Warranty against perforation or erosion of finish due to weathering.
    d. Color Retention: Warranty against fading, staining, and chalking due to effects of weather and solar radiation
    e. Installation defects that may create faulty issues.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Products: Luminaires on this project have been prior approved and only those indicated on Luminaire Schedule are allowed to bid this project.

2.02 PERFORMANCE REQUIREMENTS

A. Seismic Performance: Luminaires shall withstand the effects of earthquake motions determined according to SCE/SEI 7.

B. Seismic Performance: Luminaires and LEDs shall be labeled vibration and shock resistant.

1. The term "withstand" means "the luminaire will remain in place without separation of any parts when subjected to the seismic forces specified and the luminaire will be fully operational during and after the seismic event."

2.03 LUMINAIRE REQUIREMENTS

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

B. NRTL Compliance: Luminaires shall be listed and labeled for indicated class and division of hazard by an NRTL.

C. FM Global Compliance: Luminaires for hazardous locations shall be listed and labeled for indicated class and division of hazard by FM Global.

D. UL Compliance: Comply with UL 1598 and listed for wet location where indicated in Luminaire schedule.

E. Bulb shape complying with ANSI C79.1.

F. CRI of minimum 80.

G. CCT of 4100 K or as indicated in the luminaire schedule.

H. L70 LED life of 50,000 minimum hours.

I. Internal driver.

J. Nominal Operating Voltage: Multi-Tap Drivers - 120 V or 277 V.

K. In-line Fusing: Separate in-line fuse for each luminaire.

L. LED Rating: LED marked for outdoor use.

M. Source Limitations: Obtain luminaires from single source from a single manufacturer.

N. Source Limitations: For luminaires, obtain each color, grade, finish, type, and variety of luminaire from single source with resources to provide products of consistent quality in appearance and physical properties.

O. Housings: Rigidly formed, weather- and light-tight enclosures that will not warp, sag, or deform in use. Provide filter/breather for enclosed Luminaires.

P. Exposed Hardware Material: Stainless steel.

Q. Plastic Parts: High resistance to yellowing and other changes due to aging, exposure to heat, and UV radiation.

R. Lenses and Refractors: Materials as indicated. Use heat- and aging-resistant, resilient gaskets to seal and cushion lens and refractor mounting in Luminaire doors.

2.04 MATERIALS

A. Metal Parts: Free of burrs and sharp corners and edges.

B. Sheet Metal Components: Stainless steel. Form and support to prevent warping and sagging.

C. Doors, Frames, and Other Internal Access: Smooth operating, free of light leakage under operating conditions, and designed to permit re-lamping without use of tools. Designed to prevent doors, frames, lenses, diffusers, and other components from falling accidentally during re-lamping and when secured in operating position. Doors shall be removable for cleaning or replacing lenses.

D. Diffusers and Globes:

1. Acrylic Diffusers: 100 percent virgin acrylic plastic, with high resistance to yellowing and other changes due to aging, exposure to heat, and UV radiation.
2. Glass: Annealed crystal glass unless otherwise indicated.
3. Lens Thickness: At least 0.125 inch (3.175 mm) minimum unless otherwise indicated.

E. Lens and Refractor Gaskets: Use heat- and aging-resistant resilient gaskets to seal and cushion lenses and refractors in luminaire doors.

F. 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.

G. Housings:
1. Rigidly formed, weather- and light-tight enclosure that will not warp, sag, or deform in use.
2. Provide filter/breather for enclosed luminaires.

H. Factory-Applied Labels: Comply with UL 1598. Include recommended lamps. Labels shall be located where they will be readily visible to service personnel, but not seen from normal viewing angles when lamps are in place.
1. Label shall include the following lamp characteristics:
a. "USE ONLY" and include specific lamp type.
b. Lamp diameter, shape, size, wattage and coating.
c. CCT and CRI for all luminaires.

2.05 FINISHES

A. Variations in Finishes: Noticeable variations in same piece are unacceptable. Variations in appearance of adjoining components are not acceptable. Arm, Bracket, and Tenon Mount will match poles' finish.

B. 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, 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 or SSPC-SP 8.
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.

C. Mountings, Fastenings, and Appurtenances: Corrosion-resistant items compatible with support components. Use materials that will not cause galvanic action at contact points. Use mountings that correctly position luminaire to provide indicated light distribution.

2.06 LUMINAIRE SUPPORT COMPONENTS

A. Comply with requirements in Section 260529 "Hangers and Supports for Electrical Systems" for channel and angle iron supports and nonmetallic channel and angle supports.

B. Pole-Mounted Luminaires: Conform to AASHTO LTS-3.

C. Wind-load strength of total support assembly, including pole, arms, appurtenances, base, and anchorage, is adequate to carry itself plus Luminaires indicated at indicated heights above grade without failure, permanent deflection, or whipping in steady winds of 100 Mi./Hr. with a gust factor of 1.3.

D. Poles: Provide factory installed vibration dampers.

E. Pole Shafts: Round, straight.

F. Pole Bases: Anchor type with galvanized steel hold-down or anchor bolts, leveling nuts, and bolt covers.

G. Poles: Steel tubing conforming to ASTM A 500, Grade B, carbon steel with a minimum yield of 46,000 psi. Poles are 1-piece construction up to 40 feet in length and have access handhole in wall.

H. Metal Pole Grounding Provisions: Welded 1/2-inch threaded lug, accessible through handhole.

I. Steel Mast Arms: Fabricated from 2-inch NPS (DN50) black steel pipe, continuously welded to pole attachment plate with span and rise as indicated.

J. Metal Pole Brackets: Designed to match pole metal. Provide cantilever brackets without underbrace, in sizes and styles indicated, with straight tubular end section to accommodate Luminaire.

K. Pole-Top Tenons: Fabricated to support Luminaire or Luminaires and brackets indicated and securely fastened to pole top.

L. Concrete for Pole Foundations: Comply with structural details for the base required for Poles on this project. Details in this division drawings indicate electrical information and do not call out any structural information.

1. Construct according to Division 3, Section 03 3000, Cast-in-Place Concrete.
2. Comply with details and manufacturer's recommendations for reinforcing, anchor bolts, nuts, and washers. Verify anchor-bolt templates by comparing with actual pole bases furnished.
3. Finish: Trowel and rub smooth parts exposed to view

M. Embedded Poles: Set poles to indicated depth, but not less than 1/6 of pole length below finish grade. Dig holes large enough to permit use of tampers the full depth of hole. Backfill in 6-inch layers and thoroughly tamp each layer so compaction of backfill is equal to or greater than that of undisturbed earth.

N. Pole Installation: Use web fabric slings (not chain or cable) to raise and set poles.

O. Luminaire Attachment: Fasten to indicated structural supports.

P. Luminaire Attachment with Adjustable Features or Aiming: Attach fixtures and supports to allow aiming for indicated light distribution.

Q. Provide LED Luminaires with indicated LEDs according to manufacturer's written instructions. Replace malfunctioning LEDs.

PART 3 EXECUTION

3.01 EXAMINATION

A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

B. Examine roughing-in for luminaire electrical conduit to verify actual locations of conduit connections before luminaire installation.

C. Examine walls, roofs, and overhang ceilings for suitable conditions where luminaires will be installed.

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

3.02 TEMPORARY LIGHTING

A. If approved by the Architect, use selected permanent luminaires for temporary lighting. When construction is substantially complete, clean luminaires used for temporary lighting and install new lamps.

3.03 GENERAL INSTALLATION REQUIREMENTS

A. Comply with NECA 1.

B. Use fastening methods and materials selected to resist seismic forces defined for the application and approved by manufacturer.

C. Install lamps in each luminaire.

D. Fasten luminaire to structural support.

1. Sized and rated for luminaire weight.
2. Able to maintain luminaire position after cleaning and relamping.

3. Support luminaires without causing deflection of finished surface.
4. Luminaire-mounting devices shall be capable of supporting a horizontal force of 100 percent of luminaire weight and a vertical force of 400 percent of luminaire weight.

E. Wall-Mounted Luminaire Support:
1. Attached using through bolts and backing plates on either side of wall.

F. Wiring Method: Install cables in raceways. Conceal raceways and cables.

G. Set Luminaires securely according to manufacturer's written instructions and approved Shop Drawings. Install luminaires level, plumb, and square with finished grade unless otherwise indicated. Install luminaires at height and aiming angle as indicated on Drawings.

H. Coordinate layout and installation of luminaires with other construction.

I. Luminaire Attachment with Adjustable Features or Aiming: Attach fixtures and supports to allow aiming for indicated light distribution. Adjust luminaires that require field adjustment or aiming once luminaire is in place .

J. Comply with requirements in Section 260519 "Low-Voltage Electrical Power Conductors and Cables" and Section 260533 "Raceways and Boxes for Electrical Systems" for wiring connections and wiring methods.

K. Provide LED Luminaires with indicated LEDs according to manufacturer's written instructions. Replace malfunctioning LEDs

3.04 GROUNDING

A. Ground fixtures and metal poles according to Division 26, Section 26 0526, Grounding and Bonding for Electrical Systems.
1. Poles: Install 10-foot driven ground rod at each pole.
2. Nonmetallic Poles: Ground metallic components of lighting unit and foundations. Connect fixtures to grounding system with No. 6 AWG conductor, minimum

3.05 CORROSION PREVENTION

A. Steel Conduits: Comply with Section 260533 "Raceways and Boxes for Electrical Systems." In concrete foundations, wrap conduit with 0.010-inch- (0.254-mm-) thick, pipe-wrapping plastic tape applied with a 50 percent overlap.

3.06 IDENTIFICATION

A. Identify system components, wiring, cabling, and terminals. Comply with requirements for identification specified in Section 260553 "Identification for Electrical Systems."

3.07 FIELD QUALITY CONTROL

A. Inspect each installed luminaire for damage. Replace damaged luminaires and components.

B. Give advance notice of dates and times for field tests.

C. Provide instruments to make and record test results. Use photometers with calibration referenced to National Institute of Standards and Technology (NIST) standards.

D. Perform the following tests and inspections with the assistance of a factory-authorized service representative:
1. Operational Test: After installing luminaires, control system, and accessories, and after electrical circuitry has been energized, test units to confirm proper operation.
2. Verify operation of photoelectric controls.
3. Check for intensity of illumination.
4. Check for uniformity of illumination.
5. Check for excessively noisy Driver.

E. Illumination Tests:

1. Measure light intensities at night. Use photometers with calibration referenced to NIST standards. Comply with the following IES testing guide(s):
    a. IES LM-5.
    b. IES LM-50.
    c. IES LM-52.
    d. IES LM-64.
    e. IES LM-72.

F. Luminaire will be considered defective if it does not pass tests and inspections. Replace or repair damaged and malfunctioning units, make necessary adjustments, and retest. Repeat procedure until all units operate properly

G. Prepare a written report of tests, inspections, observations, and verifications indicating and interpreting results. If adjustments are made to lighting system, retest to demonstrate compliance with standards.

3.08 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain luminaires.

3.09 ADJUSTING

A. Clean units after installation. Use methods and materials recommended by manufacturer. Adjust aimable fixtures to provide required light intensities.

B. Occupancy Adjustments: When requested within 12 months of date of Substantial Completion, provide on-site assistance in adjusting the direction of aim of luminaires to suit occupied conditions. Make up to two visits to Project during other-than-normal hours for this purpose. Some of this work may be required during hours of darkness.

1. During adjustment visits, inspect all luminaires. Replace LEDs or luminaires that are defective.
2. Parts and supplies shall be manufacturer's authorized replacement parts and supplies.
3. Adjust the aim of luminaires in the presence of the Architect.

3.10 EXTERIOR LIGHTING FIXTURE SCHEDULE

A. The luminaire schedule located in the construction drawings describes each type of luminaire for the project. Manufacturer’s catalog numbers are given for convenience. Where discrepancies occur between catalog numbers and the descriptive information, the descriptive information shall take precedence. Some required features, options, accessory equipment or special order requirements may not be included in the catalog number.

END OF SECTION 26 5619

SECTION 27 0526

GROUNDING AND BONDING FOR COMMUNICATIONS SYSTEMS

PART 1 GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SUMMARY

A. Section Includes:
   1. Grounding conductors.
   2. Grounding connectors.
   3. Grounding busbars.
   4. Grounding labeling.

1.03 DEFINITIONSBCT: Bonding conductor for telecommunications.

A. TGB: Telecommunications grounding busbar.

B. TMGB: Telecommunications main grounding busbar.

C. Service Provider: The operator of a service that provides telecommunications transmission delivered over access provider facilities.

1.04 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Shop Drawings: For communications equipment room signal reference grid. Include plans, elevations, sections, details, and attachments to other work.

1.05 INFORMATIONAL SUBMITTALS

A. As-Built Data: Plans showing as-built locations of grounding and bonding infrastructure, including the following:
   1. Ground and roof rings.
   2. BCT, TMGB, TGBs, and routing of their bonding conductors.

B. Qualification Data: For Installer, installation supervisor, and field inspector.

C. Field quality-control reports.

1.06 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For grounding to include in emergency, operation, and maintenance manuals.
   1. In addition to items specified in Section 017823 "Operation and Maintenance Data," include the following:
      a. Result of the ground-resistance test, measured at the point of BCT connection.
      b. Result of the bonding-resistance test at each TGB and its nearest grounding electrode.

PART 2 PRODUCTS

2.01 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 467 for grounding and bonding materials and equipment.

C. Comply with TIA-607-B.

2.02 CONDUCTORS

A. Comply with UL 486A-486B.

B. Insulated Conductors: Stranded copper wire, green or green with yellow stripe insulation, insulated for 600 V, and complying with UL 83.

1. Ground wire for custom-length equipment ground jumpers shall be No. 6 AWG, 19-strand, UL-listed, Type THHN wire.
2. Cable Tray Equipment Grounding Wire: No. 6 AWG.

C. Cable Tray Grounding Jumper:

1. Not smaller than No. 6 AWG and not longer than 12 inches. If jumper is a wire, it shall have a crimped grounding lug with two holes and long barrel for two crimps. If jumper is a flexible braid, it shall have a one-hole ferrule. Attach with grounding screw or connector provided by cable tray manufacturer.
2. Not smaller than No. 10 AWG and not longer than 12 inches. If jumper is a wire, it shall have a crimped grounding lug with one hole and standard barrel for one crimp. If jumper is a flexible braid, it shall have a one- or two-hole ferrule. Attach with grounding screw or connector provided by cable tray manufacturer.

D. Bare Copper Conductors:

1. Solid Conductors: ASTM B 3.
2. Stranded Conductors: ASTM B 8.
3. Tinned Conductors: ASTM B 33.
4. Bonding Cable: 28 kcmils, 14 strands of No. 17 AWG conductor, and 1/4 inch in diameter.
5. Bonding Conductor: No. 4 or No. 6 AWG, stranded conductor.
6. Bonding Jumper: Tinned-copper tape, braided conductors terminated with two-hole copper ferrules; 1-5/8 inches wide and 1/16 inch thick.

2.03 CONNECTORS

A. Irreversible connectors listed for the purpose. Listed by an NRTL as complying with NFPA 70 for specific types, sizes, and combinations of conductors and other items connected. Comply with UL 486A-486B.

B. Compression Wire Connectors: Crimp-and-compress connectors that bond to the conductor when the connector is compressed around the conductor. Comply with UL 467.

1. Electroplated tinned copper, C and H shaped.

C. Busbar Connectors: Cast silicon bronze, solderless compression type, mechanical connector; with a long barrel and two holes spaced on 5/8- or 1-inch centers for a two-bolt connection to the busbar.

D. Welded Connectors: Exothermic-welding kits of types recommended by kit manufacturer for materials being joined and installation conditions.

2.04 GROUNDING BUSBARS

A. TMGB: Predrilled, wall-mounted, rectangular bars of hard-drawn solid copper, 1/4 by 4 inches in cross section, length as indicated on Drawings. The busbar shall be NRTL listed for use as TMGB and shall comply with TIA-607-B.

1. Predrilling shall be with holes for use with lugs specified in this Section.
2. Mounting Hardware: Stand-off brackets that provide a 4-inch clearance to access the rear of the busbar. Brackets and bolts shall be stainless steel.
3. Stand-off insulators for mounting shall be Lexan or PVC. Comply with UL 891 for use in 600-V switchboards, impulse tested at 5000 V.

B. TGB: Predrilled rectangular bars of hard-drawn solid copper, 1/4 by 2 inches in cross section, length as indicated on Drawings. The busbar shall be for wall mounting, shall be NRTL listed as complying with UL 467, and shall comply with TIA-607-B.

1. Predrilling shall be with holes for use with lugs specified in this Section.
2. Mounting Hardware: Stand-off brackets that provide at least a 2-inch clearance to access the rear of the busbar. Brackets and bolts shall be stainless steel.
3. Stand-off insulators for mounting shall be Lexan or PVC. Comply with UL 891 for use in 600-V switchboards, impulse tested at 5000 V.

2.05 IDENTIFICATION

A. Comply with requirements for identification products in Section 270553 "Identification for Communications Systems."

PART 3 EXECUTION

3.01 EXAMINATION

A. Examine the ac grounding electrode system and equipment grounding for compliance with requirements for maximum ground-resistance level and other conditions affecting performance of grounding and bonding of the electrical system.

B. Inspect the test results of the ac grounding system measured at the point of BCT connection.

C. Prepare written report, endorsed by Installer, listing conditions detrimental to performance of the Work.

D. Proceed with connection of the BCT only after unsatisfactory conditions have been corrected.

3.02 INSTALLATION

A. Bonding shall include the ac utility power service entrance, the communications cable entrance, and the grounding electrode system. The bonding of these elements shall form a loop so that each element is connected to at least two others.

B. Comply with NECA 1.

C. Comply with TIA-607-B.

3.03 APPLICATION

A. Conductors: Install solid conductor for No. 8 AWG and smaller and stranded conductors for No. 6 AWG and larger unless otherwise indicated.

1. The bonding conductors between the TGB and structural steel of steel-frame buildings shall not be smaller than No. 6 AWG.
2. The bonding conductors between the TMGB and structural steel of steel-frame buildings shall not be smaller than No. 6 AWG.

B. Underground Grounding Conductors: Install bare tinned-copper conductor, No. 2 AWG minimum.

C. 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.
4. Connections to Structural Steel: Welded connectors.

D. Conductor Support:

1. Secure grounding and bonding conductors at intervals of not less than 36 inches.

E. Grounding and Bonding Conductors:

1. Install in the straightest and shortest route between the origination and termination point, and no longer than required. The bend radius shall not be smaller than eight times the diameter of the conductor. No one bend may exceed 90 degrees.
2. Install without splices.

3. Support at not more than 36-inch intervals.
4. Install grounding and bonding conductors in 3/4-inch PVC conduit until conduit enters a telecommunications room. The grounding and bonding conductor pathway through a plenum shall be in EMT. Conductors shall not be installed in EMT unless otherwise indicated.
    a. If a grounding and bonding conductor is installed in ferrous metallic conduit, bond the conductor to the conduit using a grounding bushing that complies with requirements in Section 270528 "Pathways for Communications Systems," and bond both ends of the conduit to a TGB.

3.04 GROUNDING ELECTRODE SYSTEM

A. The BCT between the TMGB and the ac service equipment ground shall not be smaller than No. 3/0 AWG.

3.05 GROUNDING BUSBARS

A. Indicate locations of grounding busbars on Drawings. Install busbars horizontally, on insulated spacers 2 inches minimum from wall, 12 inches above finished floor unless otherwise indicated.

B. Where indicated on both sides of doorways, route bus up to top of door frame, across top of doorway, and down; connect to horizontal bus.

3.06 CONNECTIONS

A. Bond metallic equipment in a telecommunications equipment room to the grounding busbar in that room, using equipment grounding conductors not smaller than No. 6 AWG.

B. Stacking of conductors under a single bolt is not permitted when connecting to busbars.

C. Assemble the wire connector to the conductor, complying with manufacturer's written instructions and as follows:
    1. Use crimping tool and the die specific to the connector.
    2. Pretwist the conductor.
    3. Apply an antioxidant compound to all bolted and compression connections.

D. Primary Protector: Bond to the TMGB with insulated bonding conductor.

E. Interconnections: Interconnect all TGBs with the TMGB with the telecommunications backbone conductor. If more than one TMGB is installed, interconnect TMGBs using the grounding equalizer conductor. The telecommunications backbone conductor and grounding equalizer conductor size shall not be less than 2 kcmils/linear foot (1 sq. mm/linear meter) of conductor length, up to a maximum size of No. 3/0 AWG unless otherwise indicated.

F. Telecommunications Enclosures and Equipment Racks: Bond metallic components of enclosures to the telecommunications bonding and grounding system.. Bond the equipment grounding busbar to the TGB No. 2 AWG bonding conductors.

G. Structural Steel: Where the structural steel of a steel frame building is readily accessible within the room or space, bond each TGB and TMGB to the vertical steel of the building frame.

H. Electrical Power Panelboards: Where an electrical panelboard for telecommunications equipment is located in the same room or space, bond each TGB to the ground bar of the panelboard.

I. Shielded Cable: Bond the shield of shielded cable to the TGB in communications rooms and spaces. Comply with TIA-568-C.1 and TIA-568-C.2 when grounding shielded balanced twisted-pair cables.

J. Rack- and Cabinet-Mounted Equipment: Bond powered equipment chassis to the cabinet or rack grounding bar. Power connection shall comply with NFPA 70; the equipment grounding conductor in the power cord of cord- and plug-connected equipment shall be considered as a supplement to bonding requirements in this Section.

K. Access Floors: Bond all metal parts of access floors to the TGB.

L. Equipment Room Signal Reference Grid: Provide a low-impedance path between telecommunications cabinets, equipment racks, and the reference grid, using No. 6 AWG bonding conductors.

1. Install the conductors in grid pattern on 4-foot centers, allowing bonding of one pedestal from each access floor tile.
2. Bond the TGB of the equipment room to the reference grid at two or more locations.
3. Bond all conduits and piping entering the equipment room to the TGB at the perimeter of the room.

3.07 GROUNDING UNDERGROUND DISTRIBUTION SYSTEM COMPONENTS

A. Duct-Bank Grounding Conductor: Bury 12 inches above duct bank when indicated as part of duct-bank installation.

B. Comply with IEEE C2 grounding requirements.

C. Grounding Manholes and Handholes: Install a driven ground rod through manhole or handhole floor, close to wall, and set rod depth so 4 inches extends 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.

D. 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, bonding conductor. Train conductors level or plumb around corners and fasten to manhole walls. Connect grounding conductors to cable armor and cable shields according to written instructions by manufacturer of splicing and termination kits.

3.08 IDENTIFICATION

A. Labels shall be preprinted or computer-printed type.

1. Label TMGB(s) with "fs-TMGB," where "fs" is the telecommunications space identifier for the space containing the TMGB.
2. Label TGB(s) with "fs-TGB," where "fs" is the telecommunications space identifier for the space containing the TGB.
3. Label the BCT and each telecommunications backbone conductor at its attachment point: "WARNING! TELECOMMUNICATIONS BONDING CONDUCTOR. DO NOT REMOVE OR DISCONNECT!"

3.09 FIELD QUALITY CONTROL

A. Perform tests and inspections.

B. Tests and Inspections:

1. Inspect physical and mechanical condition. Verify tightness of accessible, bolted, electrical connections with a calibrated torque wrench according to manufacturer's written instructions.
2. Test the bonding connections of the system using an ac earth ground-resistance tester, taking two-point bonding measurements in each telecommunications equipment room containing a TMGB and a TGB and using the process recommended by BICSI TDMM. Conduct tests with the facility in operation.
    a. Measure the resistance between the busbar and the nearest available grounding electrode. The maximum acceptable value of this bonding resistance is 100 milliohms.

3. Test for ground loop currents using a digital clamp-on ammeter, with a full-scale of not more than 10 A, displaying current in increments of 0.01 A at an accuracy of plus/minus 2.0 percent.

    a. With the grounding infrastructure completed and the communications system electronics operating, measure the current in every conductor connected to the TMGB**.** Maximum acceptable ac current level is 1 A.

C. Excessive Ground Resistance: If resistance to ground at the BCT exceeds 5 ohms, notify Architect promptly and include recommendations to reduce ground resistance.

D. Grounding system will be considered defective if it does not pass tests and inspections.

E. Prepare test and inspection reports.

END OF SECTION 27 0526

SECTION 27 0528
PATHWAYS FOR COMMUNICATIONS SYSTEMS

PART 1 GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SUMMARY

A. Section Includes:

1. Metal conduits and fittings.
2. Nonmetallic conduits and fittings.
3. Hooks.
4. Boxes, enclosures, and cabinets.
5. Polymer-concrete handholes and boxes for exterior underground cabling.

1.03 DEFINITIONS

A. GRC: Galvanized rigid conduit.

B. IMC: Intermediate metal conduit.

1.04 ACTION SUBMITTALS

A. Product data for the following:

1. Surface pathways
2. Wireways and fittings.
3. Boxes, enclosures, and cabinets.
4. Underground handholes and boxes.

1.05 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Pathway routing plans, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of items involved:

1. Structural members in paths of pathway groups with common supports.
2. HVAC and plumbing items and architectural features in paths of conduit groups with common supports.
3. Underground ducts, piping, and structures in location of underground enclosures and handholes.

B. Qualification Data: For professional engineer.

C. Seismic Qualification Data: Seismic rating for all pathway racks, enclosures, cabinets, equipment racks, and their mounting provisions, including those for internal components, from manufacturer.

1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.
2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.
3. Detailed description of equipment anchorage devices on which certification is based and their installation requirements.
4. Detailed description of conduit support devices and interconnections on which certification is based and their installation requirements.

D. Source quality-control reports.

PART 2 PRODUCTS

2.01 METAL CONDUITS AND FITTINGS

A. Description: Metal raceway of circular cross section with manufacturer-fabricated fittings.

B. General Requirements for Metal Conduits and Fittings:

1. Listed and labeled as defined in NFPA 70, by a nationally recognized testing laboratory, and marked for intended location and application.
2. Comply with TIA-569-D.

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 GRC.

1. Comply with NEMA RN 1.
2. Coating Thickness: 0.040 inch, minimum.

F. EMT: Comply with ANSI C80.3 and UL 797.

G. Fittings for Metal Conduit: Comply with NEMA FB 1 and UL 514B.

1. Conduit Fittings for Hazardous (Classified) Locations: Comply with UL 1203 and NFPA 70.
2. Fittings for EMT:
   a. Material: Steel.
   b. Type: compression.
3. Expansion Fittings: PVC or steel to match conduit type, complying with UL-467, rated for environmental conditions where installed, and including flexible external bonding jumper.
4. Coating for Fittings for PVC-Coated Conduit: Minimum thickness of 0.040 inch, with overlapping sleeves protecting threaded joints.

H. Joint Compound for IMC, 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.

2.02 NONMETALLIC CONDUITS AND FITTINGS

A. Description: Nonmetallic raceway of circular section with manufacturer-fabricated fittings.

B. General Requirements for Nonmetallic Conduits and Fittings:

1. Listed and labeled as defined in NFPA 70, by an NRTL, and marked for intended location and application.
2. Comply with TIA-569-D.

C. RNC: Type EPC-40-PVC, complying with NEMA TC 2 and UL 651 unless otherwise indicated.

D. Fittings: Comply with NEMA TC 3; match to conduit or tubing type and material.

E. Solvents and Adhesives: As recommended by conduit manufacturer.

2.03 HOOKS

A. Description: Prefabricated sheet metal cable supports for telecommunications cable.

B. Listed and labeled as defined in NFPA 70, by an NRTL, and marked for intended location and application.

C. Comply with TIA-569-D.

D. Galvanized steel.

E. J shape.

2.04 BOXES, ENCLOSURES, AND CABINETS

A. Description: Enclosures for communications.

B. General Requirements for Boxes, Enclosures, and Cabinets:

1. Comply with TIA-569-D.
2. Boxes, enclosures, and cabinets installed in wet locations shall be listed and labeled as defined in NFPA 70, by an NRTL, and marked for use in wet locations.
3. Box extensions used to accommodate new building finishes shall be of same material as recessed box.
4. Device Box Dimensions: 4 inches square by 2-1/8 inches deep.

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, aluminum, Type FD, with gasketed cover.

E. Metal Floor Boxes:

1. Material: Cast metal.
2. Type: Fully adjustable.
3. Shape: Rectangular.
4. 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.

F. Nonmetallic Floor Boxes: Nonadjustable, round.

1. Nonmetallic floor boxes shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

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. Nonmetallic Outlet and Device Boxes: Comply with NEMA OS 2 and UL 514C.

1. Interior Panels: Steel; all sides finished 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.
6. Nonmetallic cabinets shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

2.05 POLYMER-CONCRETE HANDHOLES

A. Description: Molded of sand and aggregate; bound together with polymer resin; and reinforced with steel, fiberglass, or a combination of the two.

B. General Requirements for Polymer Concrete Handholes:

1. Boxes and handholes for use in underground systems shall be listed and labeled as defined in NFPA 70, by an NRTL, and marked for intended location and application.
2. Boxes installed in wet areas shall be listed and labeled as defined in NFPA 70, by an NRTL, and marked for intended location and application.
3. Comply with TIA-569-D and SCTE 77.

C. Configuration: Designed for flush burial with integral closed bottom unless otherwise indicated.

D. Cover: Weatherproof, secured by tamper-resistant locking devices and having structural load rating consistent with enclosure and handhole location.

1. Cover Finish: Nonskid finish shall have a minimum coefficient of friction of 0.50.
2. Cover Legend: Molded lettering, "COMMUNICATIONS".

E. Conduit Entrance Provisions: Conduit-terminating fittings shall mate with entering ducts for secure, fixed installation in enclosure wall.

F. Handholes 12 Inches Wide by 24 Inches Long and Larger: Have inserts for cable racks and pulling-in irons installed before concrete is poured.

2.06 SOURCE QUALITY CONTROL FOR UNDERGROUND ENCLOSURES

A. Handhole and Pull-Box Prototype Test: Test prototypes of handholes and boxes for compliance with SCTE 77. Strength tests shall be for specified tier ratings of products supplied.

1. Tests of materials shall be performed by an independent testing agency.
2. Strength tests of complete boxes and covers shall be by either an independent testing agency or manufacturer. A qualified registered professional engineer shall certify tests by manufacturer.
3. Testing machine pressure gages shall have current calibration certification complying with ISO 9000 and ISO 10012, and traceable to NIST standards.

PART 3 EXECUTION

3.01 PATHWAY APPLICATION

A. Outdoors: Apply pathway products as specified below unless otherwise indicated:

1. Exposed Conduit: GRC.
2. Concealed Conduit, Aboveground: GRC.
3. Underground Conduit: RNC, Type EPC-40-PVC, direct buried concrete encased where under drive areas.
4. Boxes and Enclosures, Aboveground: NEMA 250, Type 3R

B. Indoors: Apply pathway products as specified below unless otherwise indicated:

1. Exposed, Not Subject to Physical Damage: EMT.
2. Exposed, Not Subject to Severe Physical Damage: EMT.
3. Exposed and Subject to Severe Physical Damage: GRC. Pathway locations include the following:
   a. Loading dock.
   b. Corridors used for traffic of mechanized carts, forklifts, and pallet-handling units.
   c. Mechanical rooms.
4. Concealed in Ceilings and Interior Walls and Partitions: EMT.
5. Damp or Wet Locations: GRC.
6. Pathways for Optical-Fiber or Communications-Cable Risers in Vertical Shafts: Riser-type, communications-cable pathway EMT.
7. Boxes and Enclosures: NEMA 250, Type 1, except use NEMA 250, Type 4 stainless steel units in institutional and commercial kitchens and damp or wet locations.

C. Minimum Pathway Size: 3/4-inch trade size for copper and aluminum cables, and 1 inch for optical-fiber cables.

D. Pathway Fittings: Compatible with pathways 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 compression, steel fittings. Comply with NEMA FB 2.10.

E. Do not install aluminum conduits, boxes, or fittings in contact with concrete or earth.

F. Install surface pathways only where indicated on Drawings.

G. Do not install nonmetallic conduit where ambient temperature exceeds 120 deg F (49 deg C).

3.02 INSTALLATION

A. Comply with the following standards for installation requirements except where requirements on Drawings or in this Section are stricter:
1. NECA 1.
2. NECA/BICSI 568.
3. TIA-569-D.
4. NECA 101
5. NECA 102.
6. NECA 105.
7. NECA 111.

B. Comply with NFPA 70 limitations for types of pathways allowed in specific occupancies and number of floors.

C. Comply with requirements in Section 078413 "Penetration Firestopping" for firestopping materials and installation for penetrations through fire-rated walls, ceilings, and assemblies.

D. Comply with requirements in Section 270528.29 "Hangers and Supports for Communications Systems" for hangers and supports.

E. Comply with requirements in Section 270544 "Sleeves and Sleeve Seals for Communications Pathways and Cabling" for sleeves and sleeve seals for communications.

F. Keep pathways at least 6 inches away from parallel runs of flues and steam or hot-water pipes. Install horizontal pathway runs above water and steam piping.

G. Complete pathway installation before starting conductor installation.

H. Arrange stub-ups so curved portions of bends are not visible above finished slab.

I. Install no more than the equivalent of two 90-degree bends in any pathway run. Support within 12 inches of changes in direction. Utilize long radius ells for all optical-fiber cables.

J. Conceal rigid conduit within finished walls, ceilings, and floors unless otherwise indicated. Install conduits parallel or perpendicular to building lines.

K. Support conduit within 12 inches of enclosures to which attached.

L. **Slabs: DO NOT EMBED PATHWAYS IN SLABS ON GRADE OR ELEVATED SLABS**.

M. Stub-ups to Above Recessed Ceilings:
1. Use EMT, for pathways.
2. Use a conduit bushing or insulated fitting to terminate stub-ups not terminated in hubs or in an enclosure.

N. Threaded Conduit Joints, Exposed to Wet, Damp, Corrosive, or Outdoor Conditions: Apply listed compound to threads of pathway and fittings before making up joints. Follow compound manufacturer's written instructions.

O. Coat field-cut threads on PVC-coated pathway with a corrosion-preventing conductive compound prior to assembly.

P. Terminate threaded conduits into threaded hubs or with locknuts on inside and outside of boxes or cabinets. Install insulated bushings on conduits terminated with locknuts.

Q. Install pathways square to the enclosure and terminate at enclosures with locknuts. Install locknuts hand tight plus one additional quarter-turn.

R. Do not rely on locknuts to penetrate nonconductive coatings on enclosures. Remove coatings in the locknut area prior to assembling conduit to enclosure, to assure a continuous ground path.

S. Cut conduit perpendicular to the length. For conduits of 2-inch trade size and larger, use roll cutter or a guide to ensure cut is straight and perpendicular to the length.

T. Install pull wires in empty pathways. Use polypropylene or monofilament plastic line with not less than 200-lb (90-kg) tensile strength. Leave at least 12 inches of slack at each end of pull wire. Secure pull wire, so it cannot fall into conduit. Cap pathways designated as spare alongside pathways in use.

U. Install pathway-sealing fittings at accessible locations according to NFPA 70 and fill them with listed sealing compound. For concealed pathways, 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 pathway-sealing fittings according to NFPA 70.

V. Install devices to seal pathway 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 pathways at the following points:

1. Where conduits pass from warm to cold locations, such as boundaries of refrigerated spaces.
2. Where an underground service pathway enters a building or structure.
3. Where otherwise required by NFPA 70.

W. Comply with manufacturer's written instructions for solvent welding PVC conduit and fittings.

X. Expansion-Joint Fittings:

1. Install in each run of aboveground RNC that is located where environmental temperature change may exceed 30 deg F (17 deg C), and that has straight-run length that exceeds 25 feet (7.6 m). Install in each run of aboveground RMC and EMT that is located where environmental temperature change may exceed 100 deg F (55 deg C), and that has straight-run length that exceeds 100 feet (30 m).
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 (70 deg C) temperature change.
   b. Outdoor Locations Exposed to Direct Sunlight: 155 deg F (86 deg C) temperature change.
   c. Indoor Spaces Connected with Outdoors without Physical Separation: 125 deg F (70 deg C) temperature change.
   d. Attics**:** 135 deg F (75 deg C) 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 (0.06 mm per meter of length of straight run per deg C) of temperature change for PVC conduits. Install fitting(s) that provide expansion and contraction for at least 0.000078 inch per foot of length of straight run per deg F (0.0115 mm per meter of length of straight run per deg C) of temperature change for metal conduits.

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. Install conduit supports to allow for expansion movement.

Y. Hooks:

1. Size to allow a minimum of 25 percent future capacity without exceeding design capacity limits.
2. Shall be supported by dedicated support wires. Do not use ceiling grid support wire or support rods.
3. Hook spacing shall allow no more than 6 inches of slack. The lowest point of the cables shall be no less than 6 inches adjacent to ceilings, mechanical ductwork and fittings, luminaires, power conduits, power and telecommunications outlets, and other electrical and communications equipment.
4. Space hooks no more than 5 feet o.c.
5. Provide a hook at each change in direction.

Z. Mount boxes at heights indicated on Drawings. If mounting heights of boxes are not individually indicated, give priority to ADA requirements. Install boxes with height measured to bottom of box unless otherwise indicated.

AA. Recessed Boxes in Masonry Walls: Saw-cut opening for box in center of cell of masonry block, and install box flush with surface of wall. Prepare block surface to provide a flat surface for a raintight connection between box and cover plate or supported equipment and box.

BB. Horizontally separate boxes mounted on opposite sides of walls, so they are not in the same vertical channel.

CC. Support boxes of three gangs or more from more than one side by spanning two framing members or mounting on brackets specifically designed for the purpose.

DD. Fasten junction and pull boxes to or support from building structure. Do not support boxes by conduits.

EE. Set metal floor boxes level and flush with finished floor surface.

FF. Set nonmetallic floor boxes level. Trim after installation to fit flush with finished floor surface.

3.03 INSTALLATION OF UNDERGROUND CONDUIT

A. Direct-Buried Conduit:

1. Excavate trench bottom to provide firm and uniform support for conduit. Prepare trench bottom as specified in Section 312000 "Earth Moving" for pipe of less than 6 inches in nominal diameter.
2. Install backfill as specified in Section 312000 "Earth Moving."
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 as specified in Section 312000 "Earth Moving."
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 around conduit 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 270553 "Identification for Communications Systems."

3.04 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 handholes with bottom below frost line, below grade.

E. 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.

F. 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.

3.05 SLEEVE AND SLEEVE-SEAL INSTALLATION FOR COMMUNICATIONS PENETRATIONS

A. Install sleeves and sleeve seals at penetrations of exterior floor and wall assemblies. Comply with requirements in Section 270544 "Sleeves and Sleeve Seals for Communications Pathways and Cabling."

3.06 FIRESTOPPING

A. Install firestopping at penetrations of fire-rated floor and wall assemblies. Comply with requirements in Section 078413 "Penetration Firestopping."

3.07 PROTECTION

A. Protect coatings, finishes, and cabinets from damage or 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 27 0528

SECTION 27 0528.29

HANGERS AND SUPPORTS FOR COMMUNICATIONS SYSTEMS

PART 1 GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SUMMARY

A. Section Includes:

1. Steel slotted support systems for communication raceways.
2. Conduit and cable support devices.
3. Support for conductors in vertical conduit.
4. Mounting, anchoring, and attachment components, including powder-actuated fasteners, mechanical expansion anchors, concrete inserts, clamps, through bolts, toggle bolts, and hanger rods.

B. Related Requirements:

1. Section 270548 "Seismic Controls for Communications Systems" for products and installation requirements necessary for compliance with seismic criteria.

1.03 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for the following:
   a. Slotted support systems, hardware, and accessories.
   b. Clamps.
   c. Hangers.
   d. Sockets.
   e. Eye nuts.
   f. Fasteners.
   g. Anchors.
   h. Saddles.
   i. Brackets.
2. Include rated capacities and furnished specialties and accessories.

B. Shop Drawings: Signed and sealed by a qualified professional engineer**.** For fabrication and installation details for communications hangers and support systems.

1. Trapeze hangers. Include product data for components.
2. Steel slotted-channel systems.
3. Aluminum slotted-channel systems.
4. Nonmetallic slotted-channel systems.
5. Equipment supports.
6. Vibration Isolation Base Details: Detail fabrication, including anchorages and attachments to structure and to supported equipment. Include adjustable motor bases, rails, and frames for equipment mounting.

C. Delegated-Design Submittal: For hangers and supports for communications systems.

1. Include design calculations and details of trapeze hangers.

2. Include design calculations for seismic restraints.

1.04 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Reflected ceiling plan(s) and other details, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of the items involved:

1. Suspended ceiling components.
2. Ductwork, piping, fittings, and supports.
3. Structural members to which hangers and supports will be attached.
4. Size and location of initial access modules for acoustical tile.
5. Items penetrating finished ceiling, including the following:
   a. Luminaires.
   b. Air outlets and inlets.
   c. Speakers.
   d. Sprinklers.
   e. Access panels.
   f. Projectors.

B. Seismic Qualification Certificates: For hangers and supports for communications equipment and 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.

C. Welding certificates.

1.05 QUALITY ASSURANCE

A. Welding Qualifications: Qualify procedures and personnel according to AWS D1.1/D1.1M.

PART 2 PRODUCTS

2.01 PERFORMANCE REQUIREMENTS

A. Delegated Design: Engage a qualified professional engineer, as defined in Section 014000 "Quality Requirements," to design hanger and support system.

B. Seismic Performance: Hangers and supports shall withstand the effects of earthquake motions determined according to ASCE/SEI 7.

1. The term "withstand" means "the supported equipment and systems will remain in place without separation of any parts when subjected to the seismic forces specified and the system will be fully operational after the seismic event."
2. Component Importance Factor: 1.5.

C. Surface-Burning Characteristics: Comply with ASTM E 84; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.

1. Flame Rating: Class 1.
2. Self-extinguishing according to ASTM D 635.

2.02 SUPPORT, ANCHORAGE, AND ATTACHMENT COMPONENTS

A. Steel Slotted Support Systems: Preformed steel channels and angles with minimum 13/32-inch- diameter holes at a maximum of 8 inches o.c. in at least one surface.

1. Standard: Comply with MFMA-4 factory-fabricated components for field assembly.

2. Material for Channel, Fittings, and Accessories: Galvanized steel.
3. Channel Width: Selected for applicable load criteria 1-5/8 inches (41.25 mm) 1).
4. Metallic Coatings: Hot-dip galvanized after fabrication and applied according to MFMA-4.
5. Nonmetallic Coatings: Manufacturer's standard PVC, polyurethane, or polyester coating applied according to MFMA-4.
6. Painted Coatings: Manufacturer's standard painted coating applied according to MFMA-4.
7. Protect finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.

B. Conduit and Cable Support Devices: Steel clamps, hangers, and associated fittings, designed for types and sizes of raceway or cable to be supported.

C. Support for Conductors in Vertical Conduit: Factory-fabricated assembly consisting of threaded body and insulating wedging plug or plugs for non-armored communications 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 made of malleable iron.

D. Structural Steel for Fabricated Supports and Restraints: ASTM A 36/A 36M steel plates, shapes, and bars; black and galvanized.

E. Mounting, Anchoring, and Attachment Components: Items for fastening electrical items or their supports to building surfaces include the following:

1. Powder-Actuated Fasteners: Threaded-steel stud for use in hardened portland cement concrete, steel, or wood, with tension, shear, and pullout capacities appropriate for supported loads and building materials where used.
2. Mechanical-Expansion Anchors: Insert-wedge-type zinc-coated steel for use in hardened portland cement concrete, with tension, shear, and pullout capacities appropriate for supported loads and building materials where used.
3. Concrete Inserts: Steel or malleable-iron, slotted support system units are similar to MSS Type 18 units and comply with MFMA-4 or MSS SP-58.
4. Clamps for Attachment to Steel Structural Elements: MSS SP-58 units are suitable for attached structural element.
5. Through Bolts: Structural type, hex head, and high strength. Comply with ASTM A 325.
6. Toggle Bolts: All-steel springhead type.
7. Hanger Rods: Threaded steel.

2.03 FABRICATED METAL EQUIPMENT SUPPORT ASSEMBLIES

A. Description: Welded or bolted structural-steel shapes, shop or field fabricated to fit dimensions of supported equipment.

B. Materials: Comply with requirements in Section 055000 "Metal Fabrications" for steel shapes and plates.

PART 3 EXECUTION

3.01 APPLICATION

A. Comply with the following standards for application and installation requirements of hangers and supports, except where requirements on Drawings or in this Section are stricter:

1. NECA 1.
2. NECA/BICSI 568.
3. TIA-569-D.
4. NECA 101

5. NECA 102.
6. NECA 105.
7. NECA 111.

B. Comply with requirements in Section 078413 "Penetration Firestopping" for firestopping materials and installation for penetrations through fire-rated walls, ceilings, and assemblies.

C. Comply with requirements for pathways specified in Section 270528 "Pathways for Communications Systems."

D. Maximum Support Spacing and Minimum Hanger Rod Size for Raceway: Space supports for EMTs, IMCs, and RMCs as required by scheduled in NECA 1, where its Table 1 lists maximum spacings that are less than those stated in NFPA 70. Minimum rod size shall be 1/4 inch in diameter.

E. Multiple Raceways or Cables: Install trapeze-type supports fabricated with steel slotted or other 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 two-bolt conduit clamps.

F. 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.

3.02 SUPPORT INSTALLATION

A. Raceway Support Methods: In addition to methods described in NECA 1, EMT may be supported by openings through structure members, according to NFPA 70.

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 (90 kg).

C. Mounting and Anchorage of Surface-Mounted Equipment and Components: Anchor and fasten communications 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: Use approved toggle-type bolts on hollow masonry units and expansion anchor fasteners on solid masonry units.
4. To Existing Concrete: Use 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.
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 comply with seismic-restraint strength and anchorage requirements.

D. Drill holes for expansion anchors in concrete at locations and to depths that avoid the need for reinforcing bars.

3.03 INSTALLATION OF FABRICATED METAL SUPPORTS

A. Comply with installation requirements in Section 055000 "Metal Fabrications" for site-fabricated metal supports.

B. Cut, fit, and place miscellaneous metal supports accurately in location, alignment, and elevation to support and anchor communications materials and equipment.

C. Field Welding: Comply with AWS D1.1/D1.1M.

3.04 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. Touchup: Comply with requirements in Section 099113 "Exterior Painting", Section 099123 "Interior Painting" for cleaning and touchup painting of field welds, bolted connections, and abraded areas of shop paint on miscellaneous metal.

C. Galvanized Surfaces: Clean welds, bolted connections, and abraded areas, and apply galvanizing-repair paint to comply with ASTM A 780.

END OF SECTION 27 0528.29

SECTION 27 0544

SLEEVES AND SLEEVE SEALS FOR COMMUNICATIONS PATHWAYS AND CABLING

PART 1 GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SUMMARY

A. Section Includes:

1. Sleeves for pathway and cable penetration of non-fire-rated construction walls and floors.
2. Sleeve-seal systems.
3. Sleeve-seal fittings.
4. Grout.
5. Silicone sealants.

B. Related Requirements:

1. Section 078413 "Penetration Firestopping" for penetration firestopping installed in fire-resistance-rated walls, horizontal assemblies, and smoke barriers, with and without penetrating items.

1.03 ACTION SUBMITTALS

A. Product Data: For each type of product.

PART 2 PRODUCTS

2.01 SLEEVES

A. Wall Sleeves:

1. Steel Pipe Sleeves: ASTM A 53/A 53M, Type E, Grade B, Schedule 40, zinc coated, plain ends.
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:

1. Material: Galvanized-steel sheet.
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.

2.02 SLEEVE-SEAL SYSTEMS

A. Description: Modular sealing device, designed for field assembly, to fill annular space between sleeve and pathway or cable.

1. Sealing Elements: EPDM rubber interlocking links shaped to fit surface of pipe. Include type and number required for pipe material and size of pipe.
2. Pressure Plates: Carbon steel.
3. Connecting Bolts and Nuts: Carbon steel, with corrosion-resistant coating, of length required to secure pressure plates to sealing elements.

2.03 SLEEVE-SEAL FITTINGS

A. Description: Manufactured plastic, sleeve-type, waterstop assembly made for embedding in concrete slab or wall. Unit shall have plastic or rubber waterstop collar with center opening to match piping OD.

2.04 GROUT

A. Description: Nonshrink; recommended for interior and exterior sealing openings in non-fire-rated walls or floors.

B. Standard: ASTM C 1107/C 1107M, Grade B, post-hardening and volume-adjusting, dry, hydraulic-cement grout.

C. Design Mix: 5000-psi (34.5-MPa), 28-day compressive strength.

D. Packaging: Premixed and factory packaged.

2.05 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.

PART 3 EXECUTION

3.01 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 pathway or cable, using joint sealant appropriate for size, depth, and location of joint. Comply with requirements in Section 079200 "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 pathway or cable unless sleeve seal is to be installed or unless seismic criteria require different clearance.
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.
5. Install sleeves for floor penetrations. Extend sleeves installed in floors 2 inches above finished floor level. Install sleeves during erection of floors.

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 pathways and cables with flexible boot-type flashing units applied in coordination with roofing work.

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 pathway or cable and sleeve for installing sleeve-seal system.

3.02 SLEEVE-SEAL-SYSTEM INSTALLATION

A. Install sleeve-seal systems in sleeves in exterior concrete walls and slabs-on-grade at pathway entries into building.

B. Install type and number of sealing elements recommended by manufacturer for pathway or cable material and size. Position pathway or cable in center of sleeve. Assemble mechanical sleeve seals and install in annular space between pathway or cable and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.

3.03 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 27 0544

SECTION 27 0553

IDENTIFICATION FOR COMMUNICATIONS SYSTEMS

PART 1 GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SUMMARY

A. Section Includes:

1. Color and legend requirements for labels and signs.
2. Labels.
3. Bands and tubes.
4. Tapes.
5. Signs.
6. Cable ties.
7. Fasteners for labels and signs.

1.03 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for communications identification products.

B. Samples: For each type of label and sign to illustrate composition, size, colors, lettering style, mounting provisions, and graphic features of identification products.

C. Identification Schedule:

1. Outlets: Scaled drawings indicating location and proposed designation.
2. Backbone Cabling: Riser diagram showing each communications room, backbone cable, and proposed backbone cable designation.
3. Racks: Scaled drawings indicating location and proposed designation.
4. Patch Panels: Enlarged scaled drawings showing rack row, number, and proposed designations.

PART 2 PRODUCTS

2.01 PERFORMANCE REQUIREMENTS

A. Comply with NFPA 70 and TIA 606-B.

B. Comply with ANSI Z535.4 for safety signs and labels.

C. Adhesive-attached labeling materials, including label stocks, laminating adhesives, and inks used by label printers, shall comply with UL 969.

2.02 COLOR AND LEGEND REQUIREMENTS

A. Raceways: Colored raceways are required. Refer to section 260533 for requirements.

B. Equipment Identification Labels:

1. Black letters on a white field.

2.03 LABELS

A. Vinyl Wraparound Labels: Preprinted, flexible labels laminated with a clear, weather- and chemical-resistant coating and matching wraparound clear adhesive tape for securing label ends.

B. Snap-Around Labels: Slit, pre-tensioned, flexible, preprinted, color-coded acrylic sleeves, with diameters sized to suit diameters of raceway or cable they identify, that stay in place by gripping action.

C. Self-Adhesive Wraparound Labels: Preprinted, 3-mil-thick, polyester flexible labels with acrylic pressure-sensitive adhesive.

1. Self-Lamination: Clear; UV-, weather- and chemical-resistant; self-laminating protective shields over the legend. Labels sized such that the clear shield overlaps the entire printed legend.
2. Marker for Labels: Permanent, waterproof black ink marker recommended by tag manufacturer.
3. Marker for Labels: Machine-printed, permanent, waterproof black ink recommended by printer manufacturer.

D. Self-Adhesive Labels: Polyester, thermal, transfer-printed, 3-mil-thick, multicolor, weather- and UV-resistant, pressure-sensitive adhesive labels, configured for intended use and location.

1. Minimum Nominal Size:
   a. 1-1/2 by 6 inches for raceway and conductors.
   b. 3-1/2 by 5 inches for equipment.
   c. As required by authorities having jurisdiction.

2.04 BANDS AND TUBES

A. Snap-Around, Color-Coding Bands: Slit, pre-tensioned, flexible, solid-colored acrylic sleeves, 2 inches long, with diameters sized to suit diameters of raceway or cable they identify, that stay in place by gripping action.

2.05 UNDERGROUND-LINE WARNING TAPE

A. Tape:

1. Recommended by manufacturer for the method of installation and suitable to identify and locate underground 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 degradation when exposed to acids, alkalis, and other destructive substances commonly found in soils.

B. Color and Printing:

1. Comply with ANSI Z535.1, ANSI Z535.2, ANSI Z535.3, and ANSI Z535.4.
2. Inscriptions for Orange-Colored Tapes: "TELEPHONE CABLE, CATV CABLE, COMMUNICATIONS CABLE, OPTICAL-FIBER CABLE".

2.06 SIGNS

A. Baked-Enamel Signs:

1. Preprinted aluminum signs, high-intensity reflective, 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.

B. Metal-Backed Butyrate Signs:

1. Weather-resistant, nonfading, preprinted, cellulose-acetate butyrate signs, with 0.0396-inch galvanized-steel backing, punched and drilled for fasteners, 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.

C. Laminated-Acrylic or Melamine-Plastic Signs:

1. Engraved legend.
2. Thickness:
    a. For signs up to 20 sq. in., minimum 1/16 inch thick.
    b. For signs larger than 20 sq. in., 1/8 inch thick.
    c. Engraved legend with black letters on white face.
    d. Punched or drilled for mechanical fasteners with 1/4-inch (6.4-mm) grommets in corners for mounting.
    e. Framed with mitered acrylic molding and arranged for attachment at applicable equipment.

2.07 CABLE TIES

A. General-Purpose Cable Ties: Fungus inert, self-extinguishing, one piece, self-locking, and Type 6/6 nylon.
    1. Minimum Width: 3/16 inch.
    2. Tensile Strength at 73 deg F according to ASTM D 638: 12,000 psi.
    3. Temperature Range: Minus 40 to plus 185 deg F.
    4. Color: Black, except where used for color-coding.

B. UV-Stabilized Cable Ties: Fungus inert, designed for continuous exposure to exterior sunlight, self-extinguishing, one piece, self-locking, and Type 6/6 nylon.
    1. Minimum Width: 3/16 inch.
    2. Tensile Strength at 73 deg F according to ASTM D 638: 12,000 psi.
    3. Temperature Range: Minus 40 to plus 185 deg F.
    4. Color: Black.

C. Plenum-Rated Cable Ties: Self-extinguishing, UV stabilized, one piece, and self-locking.
    1. Minimum Width: 3/16 inch.
    2. Tensile Strength at 73 deg F according to ASTM D 638: 7000 psi.
    3. UL 94 Flame Rating: 94V-0.
    4. Temperature Range: Minus 50 to plus 284 deg F.
    5. Color: Black.

2.08 MISCELLANEOUS IDENTIFICATION PRODUCTS

A. Paint: Comply with requirements in painting Sections for paint materials and application requirements. Retain 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

3.01 PREPARATION

A. Self-Adhesive Identification Products: Before applying communications identification products, clean substrates of substances that could impair bond, using materials and methods recommended by manufacturer of identification product.

3.02 INSTALLATION

A. Verify and coordinate identification names, abbreviations, colors, and other features with requirements in other Sections requiring identification applications, Drawings, Shop Drawings, manufacturer's wiring diagrams, and operation and maintenance manual. Use consistent designations throughout Project.

B. Install identifying devices before installing acoustical ceilings and similar concealment.

C. Verify identity of each item before installing identification products.

D. Coordinate identification with Project Drawings, manufacturer's wiring diagrams, and operation and maintenance manual.

E. Apply identification devices to surfaces that require finish after completing finish work.

F. Install signs with approved legend to facilitate proper identification, operation, and maintenance of communications systems and connected items.

G. Elevated Components: Increase sizes of labels, signs, and letters to those appropriate for viewing from the floor.

H. Vinyl Wraparound Labels:

1. Secure tight to surface of raceway or cable at a location with high visibility and accessibility.
2. Attach labels that are not self-adhesive type with clear vinyl tape, with adhesive appropriate to the location and substrate.
3. Provide label 6 inches from cable end.

I. Snap-Around Labels:

1. Secure tight to surface at a location with high visibility and accessibility.
2. Provide label 6 inches from cable end.

J. Self-Adhesive Wraparound Labels:

1. Secure tight to surface at a location with high visibility and accessibility.
2. Provide label 6 inches from cable end.

K. Self-Adhesive Labels:

1. On each item, install unique designation label that is consistent with wiring diagrams, schedules, and operation and maintenance manual.
2. 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.

L. Snap-Around, Color-Coding Bands: Secure tight to surface at a location with high visibility and accessibility.

M. Underground-Line Warning Tape:

1. During backfilling of trenches, install continuous underground-line warning tape directly above cable or raceway 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.
2. Limit use of underground-line warning tape to direct-buried cables.
3. Install underground-line warning tape for direct-buried cables and cables in raceways.

N. Cable Ties: General purpose, except as listed below:

1. Outdoors: UV-stabilized nylon.
2. In Spaces Handling Environmental Air: Plenum rated.

3.03 IDENTIFICATION SCHEDULE

A. Install identification materials and devices at locations for most convenient viewing without interference with operation and maintenance of equipment. Install access doors or panels to provide view of identifying devices.

B. Identify conductors, cables, and terminals in enclosures and at junctions, terminals, pull points, and locations with high visibility. Identify by system and circuit designation.

C. Accessible Fittings for Raceways and Cables within Buildings: Identify covers of each junction and pull box with self-adhesive labels containing wiring system legend.

1. System legends shall be as follows:
    a. Telecommunications.

D. Faceplates: Label individual faceplates with self-adhesive labels. Place label at top of faceplate. Each faceplate shall be labeled with its individual, sequential designation, numbered clockwise when entering room from primary egress, composed of the following, in the order listed:
    1. Wiring closet designation.
    2. Colon.
    3. Faceplate number.

E. Equipment Room Labeling:
    1. Racks, Frames, and Enclosures: Identify front and rear of each with self-adhesive labels containing equipment designation.
    2. Data Outlets: Label each outlet with a self-adhesive label indicating the following, in the order listed:
        a. Room number being served.
        b. Colon.
        c. Faceplate number.

F. Backbone Cables: Label each cable with a vinyl-wraparound label snap-around label, self-adhesive wraparound label indicating the location of the far or other end of the backbone cable. Patch panel or punch down block where cable is terminated should be labeled identically.

G. Horizontal Cables: Label each cable with a vinyl-wraparound label snap-around label self-adhesive wraparound label indicating the following, in the order listed:
    1. Room number.
    2. Colon.
    3. Faceplate number.

H. Locations of Underground Lines: Underground-line warning tape for copper, coaxial, hybrid copper/fiber, and optical-fiber cable.

I. Instructional Signs: Self-adhesive labels.

J. Warning Labels for Indoor Cabinets, Boxes, and Enclosures: Baked-enamel warning signs.
    1. Apply to exterior of door, cover, or other access.

K. Equipment Identification Labels:
    1. Indoor Equipment: Baked-enamel signs.
    2. Outdoor Equipment: Laminated-acrylic or melamine-plastic sign.
    3. Equipment to Be Labeled:
        a. Communications cabinets.
        b. Uninterruptible power supplies.
        c. Computer room air conditioners.
        d. Fire-alarm and suppression equipment.
        e. Egress points.
        f. Power distribution components.

END OF SECTION 27 0553

SECTION 27 1100

COMMUNICATIONS EQUIPMENT ROOM FITTINGS

PART 1 GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SUMMARY

A. Section Includes:

1. Backboards.
2. Boxes, enclosures, and cabinets.

1.03 DEFINITIONS

A. Access Provider: An operator that provides a circuit path or facility between the service provider and user. An access provider can also be a service provider.

B. BICSI: Building Industry Consulting Service International.

C. RCDD: Registered communications distribution designer.

D. Service Provider: The operator of a telecommunications transmission service delivered through access provider facilities.

E. TGB: Telecommunications grounding bus bar.

F. TMGB: Telecommunications main grounding bus bar.

1.04 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for equipment racks and cabinets.
2. Include rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories.

B. Shop Drawings: For communications equipment room fittings. Include plans, elevations, sections, details, and attachments to other work.

1. Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
2. Equipment Racks and Cabinets: Include workspace requirements and access for cable connections.
3. Grounding: Indicate location of grounding bus bar and its mounting detail showing standoff insulators and wall mounting brackets.

1.05 INFORMATIONAL SUBMITTALS

A. Qualification Data: For qualified layout technician, installation supervisor, and field inspector.

B. Seismic Qualification Data: Certificates, 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. Base certification on the maximum number of components capable of being mounted in each rack type. Identify components on which certification is based.
3. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.

1.06 QUALITY ASSURANCE

A. Installer Qualifications: Cabling installer must have personnel certified by BICSI on staff.

1. Layout Responsibility: Preparation of Shop Drawings shall be under direct supervision of Technician.
2. Installation Supervision: Installation shall be under direct supervision of Technician, who shall be present at all times when Work of this Section is performed at Project site.
3. Field Inspector: Currently registered by BICSI as Technician to perform the on-site inspection.

PART 2 PRODUCTS

2.01 PERFORMANCE REQUIREMENTS

A. Seismic Performance: Equipment shall withstand the effects of earthquake motions determined according to ASCE/SEI 7.

1. The term "withstand" means "the unit will remain in place without separation of any parts when subjected to the seismic forces specified and the unit will be fully operational after the seismic event."

2.02 BACKBOARDS

A. Backboards: Plywood, fire-retardant treated, 3/4 by 48 by 96 inches.

B. Backboard Paint: Pre-painted.

2.03 BOXES, ENCLOSURES, AND CABINETS

A. General Requirements for Boxes, Enclosures, and Cabinets: Boxes, enclosures, and cabinets shall be listed and labeled for intended location and use.

B. Sheet Metal Outlet and Device Boxes: Comply with NEMA OS 1 and UL 514A.

C. Cast-Metal Outlet and Device Boxes: Comply with NEMA FB 1, Type FD, aluminum, with gasketed cover.

D. Nonmetallic Outlet and Device Boxes: Comply with NEMA OS 2 and UL 514C.

E. Small Sheet Metal Pull and Junction Boxes: NEMA OS 1.

F. Cast-Metal Access, Pull, and Junction Boxes: Comply with NEMA FB 1 and UL 1773, cast aluminum with gasketed cover.

G. Box extensions used to accommodate new building finishes shall be of same material as recessed box.

H. Device Box Dimensions: 4 inches square by 2-1/8 inches deep.

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.
2. Interior Panels: Steel; all sides finished 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.
6. Nonmetallic cabinets shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

PART 3 EXECUTION

3.01 ENTRANCE FACILITIES

A. Contact telecommunications service provider and arrange for installation of demarcation point, protected entrance terminals, and a housing when so directed by service provider.

B. Comply with requirements in Section 270528 "Pathways for Communications Systems" for materials and installation requirements for underground pathways.

3.02 INSTALLATION

A. Comply with NECA 1.

B. Comply with BICSI's "Telecommunications Distribution Methods Manual" for layout of communications equipment spaces.

C. Comply with BICSI's "Information Technology Systems Installation Methods Manual" for installation of equipment in communications equipment spaces.

D. Coordinate layout and installation of communications equipment in tracks and in room. Coordinate service entrance configuration with service provider.

1. Meet jointly with systems providers, equipment suppliers, and Owner to exchange information and agree on details of equipment configurations and installation interfaces.
2. Record agreements reached in meetings and distribute them to other participants.
3. Adjust configurations and locations of distribution frames, cross-connects, and patch panels in equipment rooms to accommodate and optimize configurations and space requirements of communications equipment.
4. Adjust configurations and locations of equipment with distribution frames, cross-connects, and patch panels of cabling systems of other communications, electronic safety and security, and related systems that share space in equipment room.

E. Coordinate location of power raceways and receptacles with locations of communications equipment requiring electrical power to operate.

F. Backboards:

1. Install from 6 inches to 8 feet, 6 inches above finished floor. If plywood is fire rated, ensure that fire-rating stamp is visible after installation.
2. Paint all sides of backboard with two coats of paint, leaving fire rating stamp visible.
3. Comply with requirements for backboard installation in BICSI's "Information Technology Systems Installation Methods Manual" and TIA-569-D.

3.03 SLEEVE AND SLEEVE SEAL INSTALLATION FOR ELECTRICAL PENETRATIONS

A. Install sleeves and sleeve seals at penetrations of exterior floor and wall assemblies. Comply with requirements in Section 270544 "Sleeves and Sleeve Seals for Communications Pathways and Cabling."

3.04 FIRESTOPPING

A. Comply with requirements in Section 078413 "Penetration Firestopping."

B. Comply with TIA-569-D, Annex A, "Firestopping."

C. Comply with BICSI's "Information Technology Systems Installation Methods Manual," "Firestopping Practices" Ch.

END OF SECTION 27 1100

SECTION 28 3111

DIGITAL, ADDRESSABLE FIRE-ALARM SYSTEM

PART 1 GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SUMMARY

A. This Section includes fire alarm systems, including manual stations, detectors, signal equipment, controls, and devices. Note that this is a performance based specification. Equipment/device quantities and locations indicated are diagrammatic. Design of the fire alarm system, including device placements, selection and quantities, shall be by a NICET level III designer in accordance with the requirements of the New Mexico State Fire Marshall's Office (NMSFMO). The design shall be approved by the NMSFMO. Refer to additional submission requirements below.

B. Section Includes:

1. Fire-alarm control unit.
2. Manual fire-alarm boxes.
3. System smoke detectors.
4. Heat detectors.
5. Notification appliances.
6. Magnetic door holders.
7. Remote annunciator.
8. Graphic annunciator.
9. Addressable interface device.
10. Digital alarm communicator transmitter.
11. Network communications.
12. System printer.

1.03 DEFINITIONS

A. EMT: Electrical Metallic Tubing.

B. FACP: Fire Alarm Control Panel.

C. HLI: High Level Interface.

D. NICET: National Institute for Certification in Engineering Technologies.

E. PC: Personal computer.

F. VESDA: Very Early Smoke-Detection Apparatus.

1.04 ACTION SUBMITTALS

A. Product Data: For each type of product, including furnished options and accessories.

1. Include construction details, material descriptions, dimensions, profiles, and finishes.
2. Include rated capacities, operating characteristics, and electrical characteristics.

B. Shop Drawings: For fire-alarm system.

1. Comply with recommendations and requirements in the "Documentation" section of the "Fundamentals" chapter in NFPA 72.
2. Include plans, elevations, sections, details, and attachments to other work.
3. Include details of equipment assemblies. Indicate dimensions, weights, loads, required

clearances, method of field assembly, components, and locations. Indicate conductor sizes, indicate termination locations and requirements, and distinguish between factory and field wiring.

4. Detail assembly and support requirements.
5. Include voltage drop calculations for notification-appliance circuits.
6. Include battery-size calculations.
7. Include input/output matrix.
8. Include statement from manufacturer that all equipment and components have been tested as a system and meet all requirements in this Specification and in NFPA 72.
9. Include performance parameters and installation details for each detector.
10. Verify that each duct detector is listed for complete range of air velocity, temperature, and humidity possible when air-handling system is operating.
11. Provide program report showing that air-sampling detector pipe layout balances pneumatically within the airflow range of the air-sampling detector.
12. Include plans, sections, and elevations of heating, ventilating, and air-conditioning ducts, drawn to scale; coordinate location of duct smoke detectors and access to them.
    a. Show critical dimensions that relate to placement and support of sampling tubes, detector housing, and remote status and alarm indicators.
    b. Show field wiring required for HVAC unit shutdown on alarm.
    c. Show field wiring and equipment required for HVAC unit shutdown on alarm and override by firefighters' control system.
    d. Show field wiring and equipment required for HVAC unit shutdown on alarm and override by firefighters' smoke-evacuation system.
    e. Locate detectors according to manufacturer's written recommendations.
    f. Show air-sampling detector pipe routing.
13. Include voice/alarm signaling-service equipment rack or console layout, grounding schematic, amplifier power calculation, and single-line connection diagram.
14. Include floor plans to indicate final outlet locations showing address of each addressable device. 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 III, Level IV minimum.
        c. Licensed or certified by authorities having jurisdiction.

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.

1.05 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Installer.

B. Submission to Authorities Having Jurisdiction: In addition to routine submission of the above material, make an identical submission to the authorities having jurisdiction. Shop drawing submission to the New Mexico State Fire Marshall (NMSFM) shall meet all requirements stated in the New Mexico State Fire Marshall's Office Plans Review Submittal Requirements and Information publication. Include Professional Engineer's seal, and design by a NICET Level III technician as part of the preparation and submission of the shop drawings. Upon receipt of comments from the authorities having jurisdiction, submit them for review. Resubmit if required to make clarifications or revisions to obtain approval. Do not proceed with any work prior to approval from the NMSFM

C. Seismic Qualification Data: Certificates, for fire-alarm control unit, 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.

D. Field quality-control reports.

E. Sample Warranty: For special warranty

1.06 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For fire-alarm systems and components to include in emergency, operation, and maintenance manuals.

1. In addition to items specified in Section 017823 "Operation and Maintenance Data," include the following and deliver copies to authorities having jurisdiction:
   a. Comply with the "Records" section of the "Inspection, Testing and Maintenance" chapter in NFPA 72.
   b. Provide "Fire Alarm and Emergency Communications System Record of Completion Documents" according to the "Completion Documents" Article in the "Documentation" section of the "Fundamentals" chapter in NFPA 72.
   c. Complete wiring diagrams showing connections between all devices and equipment. Each conductor shall be numbered at every junction point with indication of origination and termination points.
   d. Riser diagram.
   e. Device addresses.
   f. Air-sampling system sample port locations and modeling program report showing layout meets performance criteria.
   g. Record copy of site-specific software.
   h. Provide "Inspection and Testing Form" according to the "Inspection, Testing and Maintenance" chapter in NFPA 72, and include the following:
      1) Equipment tested.
      2) Frequency of testing of installed components.
      3) Frequency of inspection of installed components.
      4) Requirements and recommendations related to results of maintenance.
      5) Manufacturer's user training manuals.
   i. Manufacturer's required maintenance related to system warranty requirements.

j. Abbreviated operating instructions for mounting at fire-alarm control unit and each annunciator unit.

B. Software and Firmware Operational Documentation:

1. Software operating and upgrade manuals.
2. Program Software Backup: On magnetic media or compact disk, complete with data files.
3. Device address list.
4. Printout of software application and graphic screens.

1.07 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Lamps for Remote Indicating Lamp Units: Quantity equal to 10 percent of amount installed, but no fewer than one unit.
2. Lamps for Strobe Units: Quantity equal to 10 percent of amount installed, but no fewer than one unit.
3. Smoke Detectors, Fire Detectors, and Flame Detectors: Quantity equal to 10 percent of amount of each type installed, but no fewer than one unit of each type.
4. Detector Bases: Quantity equal to two percent of amount of each type installed, but no fewer than one unit of each type.
5. Keys and Tools: One extra set for access to locked or tamperproofed components.
6. Audible and Visual Notification Appliances: One of each type installed.
7. Fuses: Two of each type installed in the system. Provide in a box or cabinet with compartments marked with fuse types and sizes.
8. Filters for Air-Sampling Detectors: Quantity equal to two percent of amount of each type installed, but no fewer than one unit of each type.
9. Air-Sampling Fan: Quantity equal to one for every five detectors, but no fewer than one unit of each type.

1.08 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 an NRTL (nationally recognized testing laboratory).

D. NFPA Certification: Obtain certification according to NFPA 72 by a UL-listed alarm company.

E. NFPA Certification: Obtain certification according to NFPA 72 in the form of a placard by an FM Global-approved alarm company.

F. NFPA Certification: Obtain certification according to NFPA 72.

1.09 SEQUENCING AND SCHEDULING

A. Existing Fire-Alarm Equipment: Maintain existing equipment fully operational until new equipment has been tested and accepted. As new equipment is installed, label it "NOT IN SERVICE" until it is accepted. Remove labels from new equipment when put into service, and label existing fire-alarm equipment "NOT IN SERVICE" until removed from the building.

B. Equipment Removal: After acceptance of new fire-alarm system, remove existing disconnected fire-alarm equipment and wiring.

1.10 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: Five years from date of Substantial Completion.

PART 2 PRODUCTS

2.1 SYSTEM DESCRIPTION

A. Manufacturers: Subject to compliance with requirements, provide products by the following:
   1. Notifier

B. Noncoded, UL-certified addressable system, with multiplexed signal transmission and chime/strobe evacuation.

C. Automatic sensitivity control of certain smoke detectors.

D. All components provided shall be listed for use with the selected system.

E. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

2.2 SYSTEMS OPERATIONAL DESCRIPTION

A. Fire-alarm signal initiation shall be by one or more of the following devices and systems:
   1. Manual stations.
   2. Heat detectors.
   3. Smoke detectors.
   4. Duct smoke detectors.
   5. Carbon monoxide detectors.
   6. Automatic sprinkler system water flow.
   7. Pre-action system.
   8. Fire-extinguishing system operation.
   9. Fire standpipe system.
   10. Dry system pressure flow switch.

B. Fire-alarm signal shall initiate the following actions:
   1. Continuously operate alarm notification appliances.
   2. Identify alarm and specific initiating device at fire-alarm control unit, connected network control panels, off-premises network control panels, and remote annunciators.
   3. Transmit an alarm signal to the remote alarm receiving station.
   4. Unlock electric door locks in designated egress paths.
   5. Release fire and smoke doors held open by magnetic door holders.
   6. Activate voice/alarm communication system.
   7. Switch heating, ventilating, and air-conditioning equipment controls to fire-alarm mode.
   8. Activate smoke-control system (smoke management) at firefighters' smoke-control system panel.
   9. Activate stairwell and elevator-shaft pressurization systems.
   10. Close smoke dampers in air ducts of designated air-conditioning duct systems.
   11. Activate pre-action system.
   12. Activate emergency lighting control.
   13. Activate emergency shutoffs for gas and fuel supplies.
   14. Record events in the system memory.
   15. Record events by the system printer.

16. 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. Alert and Action signals of air-sampling detector system.
4. Independent fire-detection and -suppression systems.
5. User disabling of zones or individual devices.
6. 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.
10. Voice signal amplifier failure.
11. Hose cabinet door open.

E. System Supervisory Signal Actions:
1. Initiate notification appliances.
2. Identify specific device initiating the event at fire-alarm control unit**,** connected network control panels, off-premises network control panels, and remote annunciators.
3. Record the event on system printer.
4. After a time delay of 200 seconds, transmit a trouble or supervisory signal to the remote alarm receiving station.
5. Transmit system status to building management system.
6. Display system status on graphic annunciator.

2.3 PERFORMANCE REQUIREMENTS

A. Seismic Performance: Fire-alarm control unit and raceways shall withstand the effects of earthquake motions determined according to ASCE/SEI 7.
1. The term "withstand" means "the unit will remain in place without separation of any parts from the device when subjected to the seismic forces specified and the unit will be fully operational after the seismic event."

2.4 FIRE-ALARM CONTROL UNIT

A. General Requirements for Fire-Alarm Control Unit:
1. Field-programmable, microprocessor-based, modular, power-limited design with electronic modules, complying with UL 864.
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 zone.

3. Addressable Control Circuits for Operation of Notification Appliances and Mechanical Equipment: The FACP shall be listed for releasing service.

B. Alphanumeric Display and System Controls: Arranged for interface between human operator at fire-alarm control unit and addressable system components including annunciation and supervision. Display alarm, supervisory, and component status messages and the programming and control menu.

1. Annunciator and Display: Liquid-crystal type, 80 characters, minimum.

2. Keypad: Arranged to permit entry and execution of programming, display, and control commands.

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, three line(s) of 80 characters, minimum.

2. Keypad: Arranged to permit entry and execution of programming, display, and control commands and to indicate control commands to be entered into the system for control of smoke-detector sensitivity and other parameters.

D. Initiating-Device, Notification-Appliance, and Signaling-Line Circuits:

1. Pathway Class Designations: NFPA 72, Class A.

2. Install no more than 100 addressable devices on each signaling-line circuit.

3. 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. Door Controls: Door hold-open devices that are controlled by smoke detectors at doors in smoke-barrier walls shall be connected to fire-alarm system.

H. Remote Smoke-Detector Sensitivity Adjustment: Controls shall select specific addressable smoke detectors for adjustment, display their current status and sensitivity settings, and change those settings. Allow controls to be used to program repetitive, time-scheduled, and automated changes in sensitivity of specific detector groups. Record sensitivity adjustments and sensitivity-adjustment schedule changes in system memory, and print out the final adjusted values on system printer.

I. Transmission to Remote Alarm Receiving Station: Automatically transmit alarm, supervisory, and trouble signals to a remote alarm station.

1. Status Annunciator: Indicate the status of various voice/alarm speaker zones and the status of firefighters' two-way telephone communication zones.
2. Preamplifiers, amplifiers, and tone generators shall automatically transfer to backup units, on primary equipment failure.

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, supervisory 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.

1. Batteries: Sealed lead calcium.

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.

2.5 PREACTION SYSTEM

A. Initiate Pre-signal Alarm: This function shall cause an audible and visual alarm and indication to be provided at the FACP. Activation of an initiation device connected as part of a preaction system shall be annunciated at the FACP only, without activation of the general evacuation alarm.

2.6 MANUAL FIRE-ALARM BOXES

A. General Requirements for Manual Fire-Alarm Boxes: Comply with UL 38. Boxes shall be finished in red with molded, raised-letter operating instructions in contrasting color; shall show visible indication of operation; and shall be mounted on recessed outlet box. If indicated as

surface mounted, provide manufacturer's surface back box.

1. Single-action mechanism, pull-lever type; with integral addressable module arranged to communicate manual-station status (normal, alarm, or trouble) to fire-alarm control unit.
2. 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.
3. Station Reset: Key- or wrench-operated switch.
4. Indoor Protective Shield: Factory-fabricated, clear plastic enclosure hinged at the top to permit lifting for access to initiate an alarm. Lifting the cover actuates an integral battery-powered audible horn intended to discourage false-alarm operation.
5. Weatherproof Protective Shield: Factory-fabricated, clear plastic enclosure hinged at the top to permit lifting for access to initiate an alarm.

2.7 SYSTEM SMOKE DETECTORS

A. General Requirements for System Smoke Detectors:

1. Comply with UL 268; operating at 24-V dc, nominal.
2. Detectors shall be four-wire type.
3. Integral Addressable Module: Arranged to communicate detector status (normal, alarm, or trouble) to fire-alarm control unit.
4. Base Mounting: Detector and associated electronic components shall be mounted in a twist-lock module that connects to a fixed base. Provide terminals in the fixed base for connection to building wiring.
5. Self-Restoring: Detectors do not require resetting or readjustment after actuation to restore them to normal operation.
6. Integral Visual-Indicating Light: LED type, indicating detector has operated and power-on status.
7. Remote Control: Unless otherwise indicated, detectors shall be digital-addressable type, individually monitored at fire-alarm control unit for calibration, sensitivity, and alarm condition and individually adjustable for sensitivity by fire-alarm control unit.
   a. Rate-of-rise temperature characteristic of combination smoke- and heat-detection units shall be selectable at fire-alarm control unit for 15 or 20 deg F (8 or 11

      deg C) per minute.
   b. Fixed-temperature sensing characteristic of combination smoke- and heat-detection units shall be independent of rate-of-rise sensing and shall be settable at fire-alarm control unit to operate at 135 or 155 deg F (57 or 68 deg C).
   c. Multiple levels of detection sensitivity for each sensor.
   d. Sensitivity levels based on time of day.

B. Photoelectric Smoke Detectors:

1. Detector address shall be accessible from fire-alarm control unit and shall be able to identify the detector's location within the system and its sensitivity setting.
2. An operator at fire-alarm control unit, having the designated access level, shall be able to manually access the following for each detector:
   a. Primary status.
   b. Device type.
   c. Present average value.
   d. Present sensitivity selected.
   e. Sensor range (normal, dirty, etc.).

C. Duct Smoke Detectors: Photoelectric type complying with UL 268A.

1. Detector address shall be accessible from fire-alarm control unit and shall be able to identify the detector's location within the system and its sensitivity setting.
2. An operator at fire-alarm control unit, having the designated access level, shall be able to manually access the following for each detector:
    a. Primary status.
    b. Device type.
    c. Present average value.
    d. Present sensitivity selected.
    e. Sensor range (normal, dirty, etc.).
3. Weatherproof Duct Housing Enclosure: NEMA 250, Type 4X; NRTL listed for use with the supplied detector 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.
6. Relay Fan Shutdown: Fully programmable relay rated to interrupt fan motor-control circuit.

2.8 PROJECTED BEAM SMOKE DETECTORS

A. Projected Beam Light Source and Receiver: Designed to accommodate small angular movements and continue to operate and not cause nuisance alarms.

B. Detector Address: Accessible from fire-alarm control unit and able to identify the detector's location within the system and its sensitivity setting.

C. An operator at fire-alarm control unit, having the designated access level, shall be able to manually access the following for each detector:

1. Primary status.
2. Device type.
3. Present average value.
4. Present sensitivity selected.
5. Sensor range (normal, dirty, etc.).

2.9 CARBON MONOXIDE DETECTORS

A. General: Carbon monoxide detector listed for connection to fire-alarm system.

1. Mounting: Adapter plate for outlet box mounting.
2. Testable by introducing test carbon monoxide into the sensing cell.
3. Detector shall provide alarm contacts and trouble contacts.
4. Detector shall send trouble alarm when nearing end-of-life, power supply problems, or internal faults.
5. Comply with UL 2075.
6. Locate, mount, and wire according to manufacturer's written instructions.
7. Provide means for addressable connection to fire-alarm system.
8. Test button simulates an alarm condition.

2.10 MULTICRITERIA DETECTORS

A. Mounting: Adapter plate for outlet box mounting.

B. Integral Addressable Module: Arranged to communicate detector status (normal, alarm, or trouble) to fire-alarm control unit.

C. Automatically adjusts its sensitivity by means of drift compensation and smoothing algorithms. The detector shall send trouble alarm if it is incapable of compensating for existing conditions.

D. Test button tests all sensors in the detector.

E. An operator at fire-alarm control unit, having the designated access level, shall be able to manually access the following for each detector:

1. Primary status.
2. Device type.
3. Present sensitivity selected.
4. Sensor range (normal, dirty, etc.).

F. Sensors: The detector shall be comprised of four sensing elements including a smoke sensor, a carbon monoxide sensor, an infrared sensor, and a heat sensor.

1. Smoke sensor shall be photoelectric type as described in "System Smoke Detectors" Article.
2. Carbon monoxide sensor shall be as described in "Carbon Monoxide Detectors" Article.
3. Heat sensor shall be as described in "Heat Detectors" Article.
4. Each sensor shall be separately listed according to requirements for its detector type.

2.11 HEAT DETECTORS

A. General Requirements for Heat Detectors: Comply with UL 521.

1. Temperature sensors shall test for and communicate the sensitivity range of the device.

B. Heat Detector, Combination Type: Actuated by either a fixed temperature of 135 deg F (57 deg C) or a rate of rise that exceeds 15 deg F (8 deg C) per minute unless otherwise indicated.

1. Mounting: Adapter plate for outlet box mounting.
2. Integral Addressable Module: Arranged to communicate detector status (normal, alarm, or trouble) to fire-alarm control unit.

2.12 NOTIFICATION APPLIANCES

A. General Requirements for Notification Appliances: Individually addressed, connected to a signaling-line circuit, equipped for mounting as indicated, and with screw terminals for system connections.

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.

B. Chimes, High-Level Output: Vibrating type, 81-dBA minimum rated output.

C. 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.
6. Mounting Faceplate: Factory finished, white.

D. 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.

2.13 MAGNETIC DOOR HOLDERS

A. Description: Units are equipped for wall or floor mounting as indicated and are complete with matching doorplate.
1. Electromagnets: Require no more than 3 W to develop 25-lbf (111-N) holding force.
2. Wall-Mounted Units: Flush mounted unless otherwise indicated.
3. Rating: 24-V ac or dc.
4. Rating: 120-V ac.

B. Material and Finish: Match door hardware.

2.14 GRAPHIC ANNUNCIATOR

A. Graphic Annunciator Workstation: PC-based, with fire-alarm annunciator software with historical logging, report generation, and a graphic interface showing all alarm points in the system. PC with operating system software, minimum hard drive, digital display monitor, with wireless keyboard and mouse.

2.15 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.

2.16 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 elevator controller to initiate elevator recall and 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.

2.17 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.
   4. Manual test report function and manual transmission clear indication.
   5. Communications failure with the central station or fire-alarm control unit.

D. Digital data transmission shall include the following:
   1. Address of the alarm-initiating device.
   2. Address of the supervisory signal.
   3. Address of the trouble-initiating device.
   4. Loss of ac supply.
   5. Loss of power.
   6. Low battery.
   7. Abnormal test signal.
   8. Communication bus failure.

E. Secondary Power: Integral rechargeable battery and automatic charger.

F. Self-Test: Conducted automatically every 24 hours with report transmitted to central station.

2.18 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.

2.19 SYSTEM PRINTER

A. Printer shall be listed and labeled as an integral part of fire-alarm system.

2.20 DEVICE GUARDS

A. Description: Welded wire mesh of size and shape for the manual station, smoke detector, gong, or other device requiring protection.
   1. Factory fabricated and furnished by device manufacturer.
   2. Finish: Paint of color to match the protected device.

2.21 FIRE ALARM WIRE AND CABLE

A. General Wire and Cable Requirements: NRTL listed and labeled as complying with NFPA 70, Article 760.

B. Signaling Line Circuits: Twisted, shielded pair, size as recommended by system manufacturer.
   1. Circuit Integrity Cable: Twisted shielded pair, NFPA 70, Article 760, Classification CI, for power-limited fire alarm signal service Type FPL. NRTL listed and labeled as complying with UL 1424 and UL 2196 for a two-hour rating.

C. Non-Power-Limited Circuits: Solid-copper conductors with 600-V rated, 75 deg C, color-coded insulation, and complying with requirements in UL 2196 for a two-hour rating.

1. Low-Voltage Circuits: No. 16 AWG, minimum, in pathway.
2. Line-Voltage Circuits: No. 12 AWG, minimum, in pathway.

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. Connecting to Existing Equipment: Verify that existing fire-alarm system is operational before making changes or connections.

1. Connect new equipment to existing control panel in existing part of the building.
2. Connect new equipment to existing monitoring equipment at the supervising station.
3. Expand, modify, and supplement existing control monitoring equipment as necessary to extend existing control monitoring functions to the new points. New components shall be capable of merging with existing configuration without degrading the performance of either system.

C. Equipment Mounting: Install fire-alarm control unit on concrete base. Comply with requirements for concrete base specified in Section 033000 "Cast-in-Place Concrete."

1. Install seismic bracing. Comply with requirements in Section 270548.16 "Seismic Controls for Communications Systems."
2. Install dowel rods to connect concrete base to concrete floor. Unless otherwise indicated, install dowel rods on 18-inch centers around the full perimeter of concrete base.
3. For supported equipment, install epoxy-coated anchor bolts that extend through concrete base and anchor into structural concrete floor.
4. Place and secure anchorage devices. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
5. Install anchor bolts to elevations required for proper attachment to supported equipment.

D. Equipment Mounting: Install fire-alarm control unit on finished floor.

1. Comply with requirements for seismic-restraint devices specified in Section 270548.16 "Seismic Controls for Communications Systems."

E. Install wall-mounted equipment, with tops of cabinets not more than 78 inches above the finished floor.

1. Comply with requirements for seismic-restraint devices specified in Section 270548.16

"Seismic Controls for Communications Systems."

F. Manual Fire-Alarm Boxes:

1. Install manual fire-alarm box in the normal path of egress within 60 inches of the exit doorway.
2. Mount manual fire-alarm box on a background of a contrasting color.
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.

G. 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 (910 mm)** 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.

H. 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.

I. 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.

J. Air-Sampling Smoke Detectors: If using multiple pipe runs, the runs shall be pneumatically balanced.

K. Elevator Shafts: Coordinate temperature rating and location with sprinkler rating and location. Do not install smoke detectors in sprinklered elevator shafts.

L. 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.

M. 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.

N. 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.

O. 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.

P. Device Location-Indicating Lights: Locate in public space near the device they monitor.

Q. Antenna for Radio Alarm Transmitter: Mount to building structure where indicated. Use mounting arrangement and substrate connection that resists 100-mph (160-km/h) wind load with a gust factor of 1.3 without damage.

3.3 PATHWAYS

A. Pathways shall be installed in EMT.

B. 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 087100 "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. Magnetically held-open doors.
5. Electronically locked doors and access gates.
6. Alarm-initiating connection to elevator recall system and components.
7. Alarm-initiating connection to activate emergency lighting control.
8. Alarm-initiating connection to activate emergency shutoffs for gas and fuel supplies.
9. Supervisory connections at valve supervisory switches.
10. Supervisory connections at low-air-pressure switch of each dry-pipe sprinkler system.
11. Supervisory connections at elevator shunt-trip breaker.
12. Data communication circuits for connection to building management system.
13. Data communication circuits for connection to mass notification system.
14. Supervisory connections at fire-extinguisher locations.
15. Supervisory connections at fire-pump power failure including a dead-phase or phase- reversal condition.
16. Supervisory connections at fire-pump engine control panel.

3.5 IDENTIFICATION

A. Identify system components, wiring, cabling, and terminals. Comply with requirements for identification specified in Section 270553 "Identification for Communications Systems."

B. Install framed instructions in a location visible from fire-alarm control unit.

3.6 GROUNDING

A. Ground fire-alarm control unit and associated circuits; comply with IEEE 1100. Install a ground wire from main service ground to fire-alarm control unit.

B. Ground shielded cables at the control panel location only. Insulate shield at device location.

3.7 FIELD QUALITY CONTROL

A. Field tests shall be witnessed by Architect.

B. Manufacturer's Field Service: Engage a factory-authorized service representative to test and inspect components, assemblies, and equipment installations, including connections.

C. Perform tests and inspections.

D. Perform the following tests and inspections with the assistance of a factory-authorized service representative:

1. Visual Inspection: Conduct visual inspection prior to testing.

a. Inspection shall be based on completed record Drawings and system documentation that is required by the "Completion Documents, Preparation" table in the "Documentation" section of the "Fundamentals" chapter in NFPA 72.

b. Comply with the "Visual Inspection Frequencies" table in the "Inspection" section of the "Inspection, Testing and Maintenance" chapter in NFPA 72; retain the "Initial/Reacceptance" column and list only the installed components.

2. System Testing: Comply with the "Test Methods" table in the "Testing" section of the "Inspection, Testing and Maintenance" chapter in NFPA 72.

3. Test audible appliances for the public operating mode according to manufacturer's written instructions. Perform the test using a portable sound-level meter complying with Type 2 requirements in ANSI S1.4.

4. Test audible appliances for the private operating mode according to manufacturer's written instructions.

5. Test visible appliances for the public operating mode according to manufacturer's written instructions.

6. Factory-authorized service representative shall prepare the "Fire Alarm System Record of Completion" in the "Documentation" section of the "Fundamentals" chapter in NFPA 72 and the "Inspection and Testing Form" in the "Records" section of the "Inspection, Testing and Maintenance" chapter in NFPA 72.

E. Reacceptance Testing: Perform reacceptance testing to verify the proper operation of added or replaced devices and appliances.

F. Fire-alarm system will be considered defective if it does not pass tests and inspections.

G. Prepare test and inspection reports.

H. Maintenance Test and Inspection: Perform tests and inspections listed for weekly, monthly, quarterly, and semiannual periods. Use forms developed for initial tests and inspections.

I. Annual Test and Inspection: One year after date of Substantial Completion, test fire-alarm system complying with visual and testing inspection requirements in NFPA 72. Use forms developed for initial tests and inspections.

3.8 MAINTENANCE SERVICE

A. Initial Maintenance Service: Beginning at Substantial Completion, maintenance service shall include 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 3111

SECTION 32 8423

UNDERGROUND SPRINKLERS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Pipe and fittings, valves, sprinkler heads, emitters, bubblers, and accessories.

B. Control system.

C. RELATED REQUIREMENTS
   1. Section 31 2317 - Trenching: Excavating and backfilling for irrigation piping.

D. ADMINISTRATIVE REQUIREMENTS
   1. Coordination: Coordinate the work with site backfilling, landscape grading and delivery of plant life.

E. SUBMITTALS
   1. See Section 01 3000 - Administrative Requirements, for submittal procedures.
   2. Product Data: Provide component and control system and wiring diagrams.
   3. Shop Drawings: Indicate piping layout to water source, location of sleeves under pavement, location and coverage of sprinkler heads, components, plant and landscaping features, site structures, schedule of fittings to be used.
   4. Operation and Maintenance Data:
      a. Provide instructions for operation and maintenance of system and controls, seasonal activation and shutdown, and manufacturer's parts catalog.
      b. Provide schedule indicating length of time each valve is required to be open to provide a determined amount of water.
      c. Maintenance Materials: Provide the following for Owner's use in maintenance of project.
         1) See Section 01 6000 - Product Requirements, for additional provisions.
         2) Extra Sprinkler Heads: One of each type and size.

PART 2 PRODUCTS

2.01 IRRIGATION SYSTEM

A. Electric solenoid controlled underground irrigation system, with low point self drain.
   1. Source Power: 120 volt.
   2. Low Voltage Controls: 24 volt.

B. Manufacturers:
   1. Rain Bird Sales, Inc;: www.rainbird.com.
   2. Toro Company: www.toro.com.
   3. Weathermatic: www.weathermatic.com.
   4. Substitutions: See Section 01 6000 - Product Requirements.

2.02 PIPE MATERIALS

A. Use rigid, unplasticized polyvinyl chloride (PVC) 1120, 1220 National Sanitation Foundation (NSF) approved pipe, extruded from material meeting requirements of Cell Classification 12454-A or 12454-B, ASTM Standard D1784, with integral belled end suitable for solvent welding.

B. Use Class 160, SDR-26, rated at 160 PSI (11 bar), conforming to dimensions and tolerances established by ASTM Standard D2241. Use PVC pipe rated at higher pressures than Class 160 in cases where small nominal diameters are not manufactured in Class 160.

(or)

C. Use Class 200, SDR-21, rated at 200 PSI (13,8 bar), conforming to dimensions and tolerances established by ASTM Standard D2241. Use PVC pipe rated at higher pressures than Class 200 in the cases where small nominal diameters are not manufactured in Class 200.

(or)

D. Use Schedule 40 conforming to dimensions and tolerances established by ASTM Standard D1785; UV radiation resistant.

E. Use Schedule 40, Type 1, PVC solvent weld fittings conforming to ASTM Standards D2466 and D1784 for PVC pipe. Use primer approved by pipe manufacturer. Solvent cement to conform to ASTM Standard D2564, of type approved by pipe manufacturer.

F. Use PVC Schedule 80 nipples and PVC Schedule 40 or 80 threaded fittings for threaded pipe connections as specified on the drawings and details.

G. Threaded joint sealant: Use non-hardening, nontoxic pipe thread sealant formulated for use on threaded connections and approved by pipe fitting or valve manufacturer.

2.03 OUTLETS

A. General Information

1. Provide low-volume point-source emission devices, manufactured by Rain Bird, to efficiently deliver irrigation water at the plant root zone as indicated on construction drawings.
2. Rain Bird Single-outlet Xeri-Bug™ Emitters
   A. Available model numbers with self-piercing barb inlet: 1) XB-05PC (Blue); 0.5 GPH (1,89 lph)
   2) XB-10PC (Black); 1.0 GPH (3,79 lph) 3) XB-20PC (Red); 2.0 GPH (7,57 lph)

   B. Single-outlet Xeri-Bug Emitter specifications and features include:
      1) Available with three inlet options:
         (a) Self-piercing barb inlet; Emitters with self-piercing barb inlet permit one-step insertion into 1/2" (13 mm) or 3/4" (19 mm) drip tubing when installed with Rain Bird Xeriman tool.
      2) External surfaces constructed from UV resistant acetyl materials
      3) Self-flushing to minimize clogging
      4) Color-coded to identify flow rate;
         (a) Blue emitter indicates a flow rate of 0.5 GPH (1,89 lph)
         (b) Black emitter indicates a flow rate of 1.0 GPH (3,79 lph)
         (c) Red emitter indicates a flow rate of 2.0 GPH (7,57 lph)
      5) Pressure-compensating over the pressure range of 15 to 50 PSI (1,0 to 3,5 bar) with consistent flow rate of [0.5 GPH (1,89 lph)] or [1.0 GPH (3,79 lph)] or [2.0 GPH (7,57 lph)] over this pressure range
3. Rain Bird Single-outlet Pressure-Compensating Modules
   A. Available model numbers with self-piercing inlet barb:
      1) PC-05: light brown, 5 GPH (18,95 lph)
      2) PC-07: violet, 7 GPH (26,53 lph) 3) PC-10: green, 10 GPH (37,90 lph)
      4) PC-12: dark brown, 12 GPH (45,48 lph) 5) PC-18: white, 18 GPH (68,22 lph)
      6) PC-24: orange, 24 GPH (90,96 lph)

   B. Pressure-Compensating Module specifications and features include:
      1) Available with three inlet options:
         (a) Self-piercing barb inlet; Emitters with self-piercing barb inlet permit one-step insertion into 1/2" (13 mm) or 3/4" (19 mm) drip tubing when installed with Rain Bird Xeriman tool.
         (b) 10-32 threaded inlet; Emitters with 10-32 threaded inlet allow threaded connection into PolyFlex Riser, 1032 Thread Adapter, or 1800 Xeri-Bubbler Adapter
         (c) ½" FPT Threaded inlet allow threaded connection to ½" PVC riser.

2) External surfaces constructed from UV resistant acetyl materials
3) Color-coded to identify flow rate;
   (a) Tan outlet indicates a flow rate of 5 GPH (18,93 lph)
   (b) Violet outlet indicates a flow rate of 7 GPH (26,50 lph)
   (c) Green outlet indicates a flow rate of 10 GPH (37,85 lph)
   (d) Dark brown outlet indicates a flow rate of 12 GPH (45,42 lph)
   (e) White outlet indicates a flow rate of 18 GPH (68,13 lph)
   (f) Orange outlet indicates a flow rate of 24 GPH (90,84 lph)
4) Pressure-compensating over the pressure range of 10 to 50 PSI (0.7 to 3,5 bar) with consistent flow rate of [5 GPH (18,93 lph)] or [7 GPH 26,50 lph)] or [10 GPH (37,85 lph)] or [12 GPH (45,42 lph)] or [18 GPH (68,13 lph)] or [24 GPH (90,84 lph)] over this pressure range.

4. Rain Bird Drip Irrigation Accessories
   A. 1/4" (6,4 mm) Barb Transfer Fittings
   B. Available model numbers:
      1) XBF1CONN:1/4" (6,4 mm) Barb Connector
      2) XBF2EL: 1/4" (6,4 mm) Barb x Barb Elbow
      3) XBFTEE: 1/4" (6,4 mm) Barb x Barb Tee
   C. 1/4" (6,4 mm) Barb Transfer Fittings specifications and features include:
      1) Three fitting configurations:
         (a) Connector
         (b) Elbow
         (c) Tee
      2) Designed for connections of Rain Bird XQ 1/4" (6,4 mm) distribution tubing with an ID of 0.17" (4,3 mm)
      3) Barbed on one end to permit easy insertion into any 1/2" (13 mm) or 3/4" (19 mm) polyethylene tubing using a Rain Bird Xeriman® tool (XM-TOOL)
      4) Constructed from UV resistant acetyl.
      5) Operating pressure range between 0 to 50 PSI (0 to 3.5 bar)
5. Rain Bird Diffuser Bug Cap
   A. Available model numbers:
      1) DBC-025 (Black); for potable water source
      2) DBC-025-PPL (Purple); for non-potable water source
   B. Diffuser Bug Cap specifications and features include:
      1) Barb inlet designed to fit into 1/4" (6,4 mm) distribution tubing with ID of 0.16" (4 mm)
      2) Flanged shield designed to diffuse water to minimize soil erosion at emission point
      3) Constructed from polyethylene material
      4) Operating pressure range between be 0 to 50 PSI (0 to 3,5 bar)
6. Hunter MP Rotator Lawn Sprinklers
   A. Operating Pressure
      1) The MP Rotator shall operate between 25-55 psi (1.7-3.8 bar; 170-380 kPa).
      2) The recommended operating pressure is 40 psi (2.8 bar; 280 kPa).
   B. Flow Rates
      1) The flow rates shall depend on the MP Rotator model.
      2) As the arc and radius are adjusted, the flow rate shall change to maintain matched precipitation.
   C. Radius Description
      1) The radius of throw shall depend on the MP Rotator model.
      2) At the recommended 40 psi operating pressure, full or part circle sprinklers shall be capable of up to 25% radius reduction using a stainless steel radius adjustment screw.
      3) The radius reduction screw shall have a slip clutch mechanism to prevent internal damage if turned past the minimum or maximum radius settings

4) The radius reduction screw shall reduce the pressure and flow upstream of the adjustable orifice thereby maintaining stream integrity.

2.04 VALVES

A. Arc Adjustment

1) The part circle sprinkler shall have an infinitely adjustable arc from 45° to 105°, 90° to 210° or between 210° to 270° using the stainless steel arc ring depending on the model selected.
2) The full circle sprinkler shall irrigate a full 360°.
3) The 45° to 105° model shall not require coverage from adjacent sprinklers closer than 3' from the head.
4) Arc adjustment shall be effective only while the sprinkler is popped up and shall be ineffective when the sprinkler is popped down.
5) When turned past the minimum or maximum arc limits the adjustment mechanism shall have a ratcheting action to prevent internal damage.

B. Application Rate

1) Models MP1000, MP2000, MP3000, MP3500, MP Corner, MP Strips shall produce and maintain a matched precipitation rate no greater than 0.6" per hour throughout the arc adjustment range and radius adjustment range, (up to 25% of radius reduction), when spaced at 50% of wetted diameter.

C. Double-Pop

1) When installed in a pop-up sprinkler body, the MP Rotator rotor shall pop-up after the body stem is fully extended. Upon decreasing pressure, the MP Rotator rotor shall retract before the retraction of the sprinkler body stem.
2) The MP Rotator itself shall pop-up at approximately 15 psi (1.0 bar; 100 kPa).

D. The MP Rotator shall be available in the following options:

1) Standard MP Rotator Series (approximately 0.4 in./hr. precipitation rate)
MP-2000-90, MP-2000-210, MP-2000-360 for a 13-21 ft. radius when operating at 25-55 psi.

E. Plastic Material Description

1) The adjustable orifice shall be manufactured from polyurethane and acetal plastic materials for durability and adjustability.
2) The acetal material shall have UV stabilizers for outdoor applications.

F. Metal Component Materials

1) The radius adjustment screw, arc ring, spring, and internal collar shall be made of stainless steel.
2) The stator that drives the speed of rotation inside the silicone chamber shall be made of brass.

G. Filter Screen Description

1) Each MP Rotator shall come with a detachable filter screen.
2) The filter screens shall be made of polypropylene.
3) Screen mesh size shall be dependent on the MP Rotator model.
4) 40 mesh: MP1000, MP2000, MP Corner, MP Strips, MP800SR360, MP815

H. Nozzle Threads

1) Models MP1000, MP2000, MP3000, MP3500, MP Corner, MP Strips, MP800SR, and MP815 shall be able to be installed in pop-up bodies having a 5/8-27 UNS male threaded stem at all common pop-up heights.
2) Models MP1000HT, MP2000HT, MP3000HT, MP Corner HT, MP Strip HT shall be able to be installed in pop-up bodies having a 5/8-28 UNS female threaded stem at all common pop-up heights.

I. Viscous Drive

1) 1) The viscous fluid used to maintain the speed of rotation of the MP Rotator shall be made of a silicone material.
2) 2) The silicone chamber shall be sealed with EPDM rubber seals.
3) The brass stator inside the silicone chamber shall control the speed of rotation.

A. Rain Bird Control Zone Kits General Information

1. Provide control zone kits manufactured by Rain Bird as indicated on construction drawings.
2. Control zone kit assemblies for dripline irrigation zones must include control valve, filtration, and pressure regulation components sized to meet the hydraulic demands and flow requirements of the zones that they service.

B. Rain Bird Low Flow Control Zone Kit for dripline zones with flows from 0.2 to 5.0 GPM (0.8 to 18.9 lpm), including low flow valve (LFV) and pressure regulating filter (PRF).

C. Rain Bird Medium Flow Control Zone Kit for dripline zones with flows from 3.0 to 15.0 GPM (11.4 to 56.8 lpm), including Rain Bird DV or ASVF valve and pressure regulating filter (PRF).

1. Available model numbers:
   a. XCZ-100-PRF [1” (25 mm) DV valve and 1” (25 mm) PR filter]
   b. XCZF-100-PRF [1” (25 mm) DV valve with removable flow control handle and 1” (25 mm) PR filter]
   c. XACZ-100-PRF [1” (25 mm) Anti-siphon Valve and 1” (25 mm) PR Filter]
2. DV Valve component specifications must include:
   a. Valve body and bonnet constructed of high impact, weather-resistant plastic, stainless steel and other chemicalUV resistant materials
   b. Energy-efficient, low-power encapsulated solenoid with captured plunger and 90 mesh (200 micron) solenoid filter
   c. External bleed for manual system flushing during start-up, internal bleed for manual zone activation during maintenance operations
   d. Inlet pressure rating: 20 to 120 PSI (1.4 to 8.3 bar)
   e. Female threaded inlet and outlet connections
   f. Anti-siphon valve configuration (XACZ-100-PRF) includes listed features and incorporates atmospheric vacuum breaker with I.A.P.M.O and A.S.S.E. listing approval
3. Pressure Regulating Filter (PRF) combines filtration and pressure regulation in one integrated unit for protection of downstream components of drip irrigation system. PRF component specifications include:
   a. Compact “Y” filter body and cap configuration constructed of glass-filled, UV-resistant polypropylene, with 120 PSI (8,3 bar) operating pressure rating. Maximum dimensions of filter body; Height: 4 1/2" (11,4 cm), Length: 5 1/2" (14 cm), Width: 2" (5,1cm)
   b. Standard 200 mesh (75 micron) filter screen constructed of durable stainless steel attached to a polypropylene frame. Screen is serviceable for cleaning purposes by unscrewing cap from filter body and removing filter element.
   c. Normally-open pressure regulating device with preset outlet pressure of approximately 40 PSI (2,8 bar). Pressure regulating device allows full flow with minimal pressure loss unless inlet pressure is greater than preset level. As inlet pressure increases above preset level, internal spring compresses to reduce downstream pressure.
   d. Male threaded 1” (25 mm) inlet and outlet connections.

2.05 CONTROLS

A. The controller shall be of a hybrid type that combines electro-mechanical and microelectronic circuitry capable of fully automatic or manual operation. The controller shall be housed in a wall-mountable, weather resistant plastic cabinet with a key-locking cabinet door (outdoor models only) suitable for either indoor or outdoor installation.

B. The controller shall have a base unit with 4 stations as well as three expansion slots capable of receiving station modules of three stations each to create a controller of up to 13 stations. Station 13 shall be called an “auxiliary station” and shall have the capability of bypassing an active rain sensor or of functioning as a normal station output. Station timing shall be from 0 minutes to 6 hours. Run time resolution shall be in 1-minute increments from 0 to 59 minutes and 10 minutes from 1 to 6 hours. The LCD shall display "No Run Times" or equivalent icon for 230 VAC models if no run time has been entered for any station in any program.

1. The controller shall have three separate and independent programs which can have different start times, station timing and watering days. Each program shall have up to 4 start times available. The controller shall stack multiple start times in sequence to prevent hydraulic overload. The LCD shall display "No Start Times" or the equivalent icon for 230VAC models if no start time has been entered for any program. The controller shall be capable of operating two 24 VAC solenoid valves per station plus a master valve or remote pump start relay. The controller shall operate on 120 VAC± 20% at 60Hz (230VAC ± 20% at 50Hz for international models). The controller shall have an electronic, diagnostic circuit breaker that shall sense a station with an electrical overload or short circuit and shall bypass that station and continue operating all other stations.
2. The controller shall have a 365-day calendar with a permanent day off feature that allows a day(s) of the week to be turned OFF on any cycle (odd/even/1-31day cycle). A day set to “Permanent Off” shall override the normal repeating schedule and shall display the words “Day Always Off/Day Off” in the LCD screen.
3. The controller shall have a seasonal adjust feature adjustable from 0% to 200% in increments of 10%. Seasonal adjust shall effect all programs simultaneously. If seasonal adjust is set to 0% the LCD shall display “SEASONAL ADJ”(equivalent icon for 230 VAC models).
4. The controller shall have a 12-hour AM/PM or 24 hour military (for 230VAC models) clock with a midnight day change over. The controller shall have a sensor circuit for connection to a rain sensor or to an underground moisture sensor system that will interrupt a scheduled watering under “wet” or “moist” conditions. The controller shall have an indicator on the LCD screen and one LED light to indicate that a sensor is connected and active and that watering has been temporarily disabled.
5. The controller shall have access to a variety of “hidden features” by turning the dial to a specific location on the dial and pushing the ON OFF buttons simultaneously. These features shall include: 1) Save a custom default program 2) Retrieve a custom default program 3) bypass an active rain sensor on the Auxiliary Station 4) Allow the Auxiliary Station to be interrupted by an active rain sensor 5) Clear memory 6) Set a day as “Permanently Off” 7) Set master valve/pump start circuit by station 8) Set programmable delay between station.
6. The controller shall have the following manual operations and manual advances for semiautomatic control:
   A. Run a single valve
   B. Run multiple manually stacked valves
   C. Run a semi-automatic program
   D. Run a test on all valves (all stations with any time assigned regardless of the program) from 1 to 10 minutes
7. The controller shall have a removable battery; programmable front panel (uses a 9 volt battery [not included]) for conveniently programming the controller away from the installation site or for teaching irrigation scheduling.
8. The controller shall have the capacity for the program to be erased allowing the user to start programming with a blank controller.
9. The controller shall have multiple knockouts, sizes and locations, including the back of the cabinet, to facilitate installation and provide a clean professional look.
10. The controller shall have a factory default program that runs 10 minutes every day beginning 8 hours after power resumption.
11. The controller shall have a reset button to reset the controller in the case of micro-controller “lock-up” due to power surges or frequent interruption to the power supply.
12. The controller shall be as manufactured by Rain Bird Corporation, Azusa.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify location of existing utilities.

B. Verify that required utilities are available, in proper location, and ready foruse.

3.02 PREPARATION

A. Layout and stake locations of system components.

B. Review layout requirements with other affected work. Coordinate locations of sleeves under paving to accommodate system.

3.03 TRENCHING

A. Trench and backfill in accordance with Section 31 2317.

B. Trench to accommodate grade changes and slope to drains.

C. Maintain trenches free of debris, material, or obstructions that may damage pipe.

3.04 INSTALLATION

A. Install pipe, valves, controls, and outlets in accordance with manufacturer's instructions.

B. Connect to utilities.

C. Set outlets and box covers at finish grade elevations.

D. Provide for thermal movement of components in system.

E. Use threaded nipples for risers to each outlet.

F. Install control tubing in accordance with manufacturer's instructions. Provide 10 inch expansion coil in irrigation piping at each valve to which controls are connected, and at 100 ft intervals. Bury control tubing beside pipe.

G. Mark valves with neoprene valve markers containing locking device. Set valve markers in pipe risers extending from top of valve to finish grade.

H. After piping is installed, but before outlets are installed and backfilling commences, open valves and flush system with full head of water.

3.05 FIELD QUALITY CONTROL

A. Field inspection and testing will be performed under provisions of Section 01 4000 - Quality Requirements.

B. Prior to backfilling, test system for leakage at main piping to maintain 100 psi pressure for one hour.

C. System is acceptable if no leakage or loss of pressure occurs and system self drains during test period.

3.06 BACKFILLING

A. Provide 3 inch sand cover over piping.

B. Backfill trench and compact to specified subgrade elevation. Protect piping from displacement.

3.07 SYSTEM STARTUP

A. Prepare and start system in accordance with manufacturer's instructions.

B. Adjust control system to achieve time cycles required.

C. Adjust head types for full water coverage as directed.

3.08 CLOSEOUT ACTIVITIES

A. Instruct Owner's personnel in operation and maintenance of system, including adjusting of sprinkler heads. Use operation and maintenance data as basis for demonstration.

3.09 MAINTENANCE

A. See Section 01 7000 - Execution and Closeout Requirements, for additional requirements relating to maintenance service.

B. Provide a separate maintenance contract for specified maintenance service.

C. Provide one complete spring start-up and a fall shutdown by installer, at no extra cost to Owner.

END OF SECTION 32 8423

SECTION 32 9219

SEEDING

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Seeding, mulching and fertilizer.

1.02 RELATED REQUIREMENTS

A. Section 31 2200 - Grading: Preparation of subsoil and placement of topsoil in preparation for the work of this section.

PART 2 PRODUCTS

2.01 SEED MIXTURE

A. Seed Mixture:
   1. Park Blend cool season grass grown by Gardner Turfgrass, Inc., a blend of Kentucky Bluegrass, Ryegrass and Tall Fescue rhizomatous tall fescue.

2.02 SOIL MATERIALS

A. Topsoil: Fertile, agricultural soil, typical for locality, capable of sustaining vigorous plant growth, taken from drained site; free of subsoil, clay or impurities, plants, weeds and roots; pH value of minimum 5.4 and maximum 7.0.

2.03 ACCESSORIES

A. Mulching Material: Oat or wheat straw, free from weeds, foreign matter detrimental to plant life, and dry. Hay or chopped cornstalks are not acceptable.

B. Mulching Material: Hemlock species wood cellulose fiber, dust form, free of growth or germination inhibiting ingredients.

C. Fertilizer: 0.1-0.5 pounds of actual N per 1,000 sq ft per growing month when combined with recommended phospherous potassium. Avoid N applications during hot dry months (July-August).; as recommended for grass, with fifty percent of the elements derived from organic sources; of proportion necessary to eliminate any deficiencies of topsoil, as indicated by analysis.

D. Water: Clean, fresh and free of substances or matter that could inhibit vigorous growth of grass.

E. Erosion Fabric: Jute matting, open weave.

F. Edging: Galvanized steel.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that prepared soil base is ready to receive the work of this Section.

3.02 FERTILIZING

A. Apply fertilizer in accordance with manufacturer's instructions.

B. Apply after smooth raking of topsoil and prior to roller compaction.

C. Do not apply fertilizer at same time or with same machine as will be used to apply seed.

D. Mix thoroughly into upper 2 inches of topsoil.

E. Lightly water to aid the dissipation of fertilizer.

3.03 SEEDING

A. Apply seed at a rate of SEE LANDSCAPE DWGS. lbs per 1000 sq ft evenly in two intersecting directions. Rake in lightly.

B. Do not seed areas in excess of that which can be mulched on same day.

C. Do not sow immediately following rain, when ground is too dry, or during windy periods.

D. Immediately following seeding and compacting, apply mulch to a thickness of 1/8 inches. Maintain clear of shrubs and trees.

E. Apply water with a fine spray immediately after each area has been mulched. Saturate to 4 inches of soil.

F. Following germination, immediately re-seed areas without germinated seeds that are larger than 4 by 4 inches.

3.04 PROTECTION

A. Identify seeded areas with stakes and string around area periphery. Set string height to _____ inches. Space stakes at_____inches.

3.05 MAINTENANCE

A. Provide maintenance of seeded areas for three months from Date of Substantial Completion.

B. Mow grass at regular intervals to maintain at a maximum height of 2-1/2 inches. Do not cut more than 1/3 of grass blade at any one mowing.

C. Water to prevent grass and soil from drying out.

D. Roll surface to remove minor depressions or irregularities.

E. Control growth of weeds. Apply herbicides in accordance with manufacturer's instructions. Remedy damage resulting from improper use of herbicides.

F. Immediately reseed areas that show bare spots.

G. Protect seeded areas with warning signs during maintenance period.

END OF SECTION 32 9219

SECTION 32 9223

SODDING

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Fertilizing.

B. Sod installation.

C. Maintenance.

1.02 RELATED REQUIREMENTS

A. Section 31 2200 - Grading: Topsoil material.

B. Section 31 2200 - Grading: Preparation of subsoil and placement of topsoil in preparation for the work of this section.

1.03 REFERENCE STANDARDS

A. TPI (SPEC) - Guideline Specifications to Turfgrass Sodding; 2006.

PART 2 PRODUCTS

2.01 MATERIALS

A. Sod: TPI (SPEC), Certified Turfgrass Sod quality; cultivated grass sod; type indicated in plant schedule on Drawings; with strong fibrous root system, free of stones, burned or bare spots; containing no more than 5 weeds per 1000 sq. ft. Minimum age of 18 months, with root development that will support its own weight without tearing, when suspended vertically by holding the upper two corners.

1. Cynodon dactylon - Hybrid Bermuda (Tifgreen 328 or Tifway 419Floratam GrassType)
2. Poa pratensis - Kentucky Bluegrass.
3. Lolium perenne - Perennial Ryegrass
4. Thickness: "Thin" sod, minimum 1/2 inch and maximum 1 inch topsoil base.
5. Thickness: "Thick" sod, minimum 1 inch and maximum 1-3/8 inch topsoil base.
6. Cut sod in area not exceeding 1 sq. yd.
7. Machine cut sod and load on pallets in accordance with TPI (SPEC) Guidelines.
8. Topsoil: Type as specified in Section 31 2200.
9. Fertilizer: 0.1-0.5 pounds of actual N per 1,000 sq. ft. per growing month when combined with recommended phosphorous potassium. Avoid N applications during hot dry months (July-August).; recommended for grass, with fifty percent of the elements derived from organic sources; of proportion necessary to eliminate any deficiencies of topsoil, as indicated by analysis.

2.02 ACCESSORIES

A. Edging: Galvanized steel.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that prepared soil base is ready to receive the work of this section.

3.02 FERTILIZING

A. Apply fertilizer in accordance with manufacturer's instructions.

B. Apply after smooth raking of topsoil and prior to installation of sod.

C. Apply fertilizer no more than 48 hours before laying sod.

D. Mix thoroughly into upper 2 inches of topsoil.

E. Lightly water to aid the dissipation of fertilizer.

3.03 LAYING SOD

A. Moisten prepared surface immediately prior to laying sod.

B. Lay sod immediately after delivery to site to prevent deterioration.

C. Lay sod smooth and tight with no open joints visible, and no overlapping; stagger end joints 12 inches minimum. Do not stretch or overlap sod pieces.

D. Where sod is placed adjacent to hard surfaces, such as curbs, pavements, etc., place top elevation of sod 1/2 inch below top of hard surface.

E. Water sodded areas immediately after installation. Saturate sod to 4 inches of soil.

F. After sod and soil have dried, roll sodded areas to ensure good bond between sod and soil and to remove minor depressions and irregularities. Roll sodded areas with a light-weight roller or hand tamped to the satisfaction of the Engineer.

3.04 MAINTENANCE

A. Provide maintenance at no extra cost to Owner; Owner will pay for water.

B. Provide maintenance of sodded areas for three months from Date of Substantial Completion.

C. Mow grass at regular intervals to maintain at a maximum height of 2-1/2 inches. Do not cut more than 1/3 of grass blade at any one mowing.

D. Neatly trim edges and hand clip where necessary.

E. Immediately remove clippings after mowing and trimming.

F. Water to prevent grass and soil from drying out.

G. Roll surface to remove irregularities.

H. Control growth of weeds. Apply herbicides in accordance with manufacturer's instructions. Remedy damage resulting from improper use of herbicides.

I. Immediately replace sod to areas that show deterioration or bare spots.

J. Protect sodded areas with warning signs during maintenance period.

END OF SECTION 32 9223

SECTION 32 9300

PLANTS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. New trees, plants, and ground cover.

B. Relocated trees, plants, and ground cover.

C. Mulch and Fertilizer.

D. Maintenance.

E. Tree Pruning.

1.02 RELATED REQUIREMENTS

A. Section 31 2200 - Grading: Topsoil material.

1.03 REFERENCE STANDARDS

A. ANSI A300 Part 1 - American National Standard for Tree Care Operations -- Tree, Shrub and Other Woody Plant Maintenance -- Standard Practices; 2017.

1.04 SUBMITTALS

A. See Section 01 3000 - Administrative Requirements, for submittal procedures.

B. Maintenance Data: Include cutting and trimming method; types, application frequency, and recommended coverage of fertilizer.

1.05 QUALITY ASSURANCE

A. Nursery Qualifications: Company specializing in growing and cultivating the plants with three years documented experience.

B. Installer Qualifications: Company specializing in installing and planting the plants with three years' experience.

1.06 DELIVERY, STORAGE, AND HANDLING

A. Deliver fertilizer in waterproof bags showing weight, chemical analysis, and name of manufacturer.

B. Protect and maintain plant life until planted.

C. Deliver plant life materials immediately prior to placement. Keep plants moist.

1.07 FIELD CONDITIONS

A. Do not install plant life when ambient temperatures may drop below 35 degrees F or rise above 90 degrees F.

1.08 WARRANTY

A. See Section 01 7800 - Closeout Submittals, for additional warranty requirements.

B. Warranty: Include coverage for one continuous growing season; replace dead or unhealthy plants.

C. Replacements: Plants of same size and species as specified, planted in the next growing season, with a new warranty commencing on date of replacement.

PART 2 PRODUCTS

2.01 PLANTS

A. Plants: Species and size identified in plant schedule, grown in climatic conditions similar to those in locality of the work.

2.02 SOIL AMENDMENT MATERIALS

A. Fertilizer: Containing fifty percent of the elements derived from organic sources; of proportion necessary to eliminate any deficiencies of topsoil, as indicated inanalysis.

B. Bone Meal: Raw, finely ground, commercial grade, minimum of 3 percent nitrogen and 20 percent phosphorous.

C. Water: Clean, fresh, and free of substances or matter that could inhibit vigorous growth of plants.

2.03 MULCH MATERIALS

A. Mulching Material: Fir species wood ground bark, free of growth or germination inhibiting ingredients and composted.

2.04 ACCESSORIES

A. Wrapping Materials: Burlap.

B. Stakes: Softwood lumber, pointed end.

C. Cable, Wire, Eye Bolts and Turnbuckles: Non-corrosive, of sufficient strength to withstand wind pressure and resulting movement of plant life.

D. Plant Protectors: Rubber sleeves over cable to protect plant stems, trunks, andbranches.

E. Decorative Cover: Fir bark chips, one inch minimum and two inch maximum size.

F. Membrane: 20 mil thick, water permeable polyolefin fabric.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that prepared subsoil and planters are ready to receivework.

B. Saturate soil with water to test drainage.

C. Verify that required underground utilities are available, in proper location, and ready for use.

3.02 FERTILIZING

A. Apply fertilizer in accordance with manufacturer's instructions.

B. Apply after initial raking of topsoil.

C. Mix thoroughly into upper 2 inches of topsoil.

D. Lightly water to aid the dissipation of fertilizer.

3.03 PLANTING

A. Place plants for best appearance for review and final orientation byArchitect.

B. Set plants vertical.

C. Remove non-biodegradable root containers.

D. Set plants in pits or beds, partly filled with prepared plant mix, at a minimum depth of 6 inches under each plant. Remove burlap, ropes, and wires, from the rootball.

E. Place bare root plant materials so roots lay in a natural position. Backfill soil mixture in 6 inch layers. Maintain plant life in vertical position.

F. Saturate soil with water when the pit or bed is half full of topsoil and again whenfull.

3.04 PLANT RELOCATION AND RE-PLANTING

A. Relocate plants as indicated by Architect.

B. Replant plants in pits or beds, partly filled with prepared topsoil mixture, at a minimum depth of 6 inches under each plant. Remove burlap, ropes, and wires, from the root ball.

C. Place bare root plant materials so roots lay in a natural position. Backfill soil mixture in 6 inch layers. Maintain plant materials in vertical position.

D. Saturate soil with water when the pit or bed is half full of topsoil and again when full.

3.05 INSTALLATION OF ACCESSORIES

A. Place decorative cover and membrane, where indicated on drawings.

3.06 PLANT SUPPORT

A. Brace plants vertically with plant protector wrapped guy wires and stakes to the following:
   1. Tree Caliper: 1 inch; Tree Support Method: 1 stake with one tie
   2. Tree Caliper: 1 to 2 inches; Tree Support Method: 2 stakes with two ties
   3. Tree Caliper: 2 to 4 inches; Tree Support Method: 3 guy wires with eye bolts and turn buckles
   4. Tree Caliper: Over 4 inches; Tree Support Method: 4 guy wires with eye bolts and turn buckles

3.07 TREE PRUNING

A. Prune trees as recommended in ANSI A300 Part 1.

B. Prune newly planted trees as required to remove dead, broken, and split branches.

3.08 FIELD QUALITY CONTROL

A. Perform field inspection and testing in accordance with Section 01 4000.

B. Plants will be rejected if a ball of earth surrounding roots has been disturbed or damaged prior to or during planting.

3.09 MAINTENANCE

A. Provide maintenance at no extra cost to Owner; Owner will pay for water.

B. Maintain plant life immediately after placement and until plants are well established and exhibit a vigorous growing condition. Continue maintenance until termination of warranty period.

C. Irrigate sufficiently to saturate root system and prevent soil from drying out.

D. Remove dead or broken branches and treat pruned areas or other wounds.

E. Neatly trim plants where necessary.

F. Immediately remove clippings after trimming.

G. Control growth of weeds. Apply herbicides in accordance with manufacturer's instructions.

H. Control insect damage and disease. Apply pesticides in accordance with manufacturers' instructions.

I. Remedy damage from use of herbicides and pesticides.

J. Replace mulch when deteriorated.

K. Maintain wrappings, guys, turnbuckles, and stakes. Adjust turnbuckles to keep guy wires tight. Repair or replace accessories when required.

END OF SECTION 32 9300

SECTION 32 1123

AGGREGATE AND/OR GRADED-CRUSHED AGGREGATE BASE COURSE

PART 1 GENERAL

1.01 UNIT PRICES

A. MEASUREMENT - LUMP SUM
   1. AREA - LUMP SUM

B. PAYMENT FOR QUANTITIES - LUMP SUM

1.02 REFERENCES

A. The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.
   1. AMERICAN ASSOCIATION OF STATE HIGHWAY AND TRANSPORTATION OFFICIALS (AASHTO)

B. AASHTO T 180 (2010) Standard Method of Test for Moisture-Density Relations of Soils Using a 4.54-kg (10-lb) Rammer and a 457-mm (18-in.) Drop

C. AASHTO T 224 (2010) Standard Method of Test for Correction for Coarse Particles in the Soil Compaction Test
   1. ASTM INTERNATIONAL (ASTM)

D. ASTM C117 (2004) Standard Test Method for Materials Finer than 75-um (No. 200) Sieve in Mineral Aggregates by Washing

E. ASTM C128 (2007a) Standard Test Method for Density, Relative Density (Specific Gravity), and Absorption of Fine Aggregate

F. ASTM C131 (2006) Standard Test Method for Resistance to Degradation of Small-Size Coarse Aggregate by Abrasion and Impact in the Los Angeles Machine

G. ASTM C136 (2006) Standard Test Method for Sieve Analysis of Fine and Coarse Aggregates

H. ASTM C29/C29M (2009) Standard Test Method for Bulk Density ("Unit Weight") and Voids in Aggregate

I. ASTM C88 (2005) Standard Test Method for Soundness of Aggregates by Use of Sodium Sulfate or Magnesium Sulfate

J. ASTM D 1556 (2007) Density and Unit Weight of Soil in Place by the Sand-Cone Method

K. ASTM D 1557 (2009) Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbf/ft3) (2700 kN-m/m3)

L. ASTM D 2167 (2008) Density and Unit Weight of Soil in Place by the Rubber Balloon Method

M. ASTM D 2487 (2011) Soils for Engineering Purposes (Unified Soil Classification System)

N. ASTM D 4318 (2010) Liquid Limit, Plastic Limit, and Plasticity Index of Soils

O. ASTM D 5821 (2001; R 2006) Standard Test Method for Determining the Percentage of Fractured Particles in Coarse Aggregate

P. ASTM D 6938 (2010) Standard Test Method for In-Place Density and Water Content of Soil and Soil-Aggregate by Nuclear Methods (Shallow Depth)

Q. ASTM D 75/D 75M (2009) Standard Practice for Sampling Aggregates

R. ASTM E 11 (2010a) Wire Cloth and Sieves for Testing Purposes

1.03 DEFINITIONS

A. For the purposes of this specification, the following definitions apply.

B. AGGREGATE BASE COURSE

1. Aggregate base course (ABC) is well graded, durable aggregate uniformly moistened and mechanically stabilized by compaction.

C. GRADED-CRUSHED AGGREGATE BASE COURSE

1. Graded-crushed aggregate (GCA) base course is well graded, crushed, durable aggregate uniformly moistened and mechanically stabilized by compaction. GCA is similar to ABC, but it has more stringent requirements and it produces a base course with higher strength and stability.

D. DEGREE OF COMPACTION

1. Degree of compaction required, except as noted in the second sentence, is expressed as a percentage of the maximum laboratory dry density obtained by the test procedure presented in ASTM D 1557 abbreviated as a percent of laboratory maximum dry density. Since ASTM D 1557 applies only to soils that have 30 percent or less by weight of their particles retained on the 3/4 inch sieve, the degree of compaction for material having more than 30 percent by weight of their particles retained on the 3/4 inch sieve are expressed as a percentage of the laboratory maximum dry density in accordance with AASHTO T 180 Method D and corrected with AASHTO T 224.

1.04 SYSTEM DESCRIPTION

A. All plant, equipment, and tools used in the performance of the work will be subject to approval before the work is started and shall be maintained in satisfactory working condition at all times. Submit a list of proposed equipment, including descriptive data. Provide adequate equipment having the capability of producing the required compaction, meeting grade controls, thickness control, and smoothness requirements as set forth herein.

1.05 SUBMITTALS

A. Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for Contractor Quality Control approval. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

1. SD-03 Product Data
   a. Plant, Equipment, and Tools; G
   b. Waybills and Delivery Tickets; G
2. SD-06 Test Reports
   a. Sampling and Testing; G
   b. Field Density Tests; G

1.06 QUALITY ASSURANCE

A. Sampling and testing are the responsibility of the Contractor and performed by a testing laboratory approved in accordance with Section 01 45 00.00 10 QUALITY CONTROL. Work requiring testing will not be permitted until the testing laboratory has been inspected and approved. Test the materials to establish compliance with the specified requirements; perform testing at the specified frequency. The Contracting Officer may specify the time and location of the tests. Furnish copies of test results to the Contracting Officer within 24 hours of completion of the tests.

B. SAMPLING

1. Take samples for laboratory testing in conformance with ASTM D 75/D 75M. When deemed necessary, the sampling will be observed bythe Contracting Officer.

C. TESTS
1. Perform the following tests in conformance with the applicable standards listed.
2. SIEVE ANALYSIS
a. Make sieve analysis in conformance with ASTM C117 and ASTM C136. Sieves shall conform to ASTM E 11. .
3. LIQUID LIMIT AND PLASTICITY INDEX
a. Determine liquid limit and plasticity index in accordance with ASTM D4318.
4. MOISTURE-DENSITY DETERMINATIONS
a. Determine the laboratory maximum dry density and optimum moisture content in accordance with ASTM D 1557 .
5. FIELD DENSITY TESTS
a. Measure field density in accordance with ASTM D 1556, ASTM D 2167 or ASTM D 6938.
1) Submit certified copies of test results for approval not less than 30 days before material is required for the work.
2) Submit calibration curves and related test results prior to using the device or equipment being calibrated.
3) Submit copies of field test results within 24 hours after the tests are performed.
6. WEAR TEST
a. Perform wear tests on GCA course material in conformance with ASTM C131.
7. SOUNDNESS
a. Perform soundness tests on GCA in accordance with ASTM C88.
8. WEIGHT OF SLAG
a. Determine weight per cubic foot of slag in accordance with ASTM C29/C29M on the GCAcourse material.

D. TESTING FREQUENCY
1. INITIAL TESTS
a. Perform one of each of the following tests, on the proposed material prior to commencing construction, to demonstrate that the proposed material meets all specified requirements when furnished. If materials from more than one source are going to be utilized, this testing shall be completed for each source.
1) Sieve Analysis [including the No. 635 sieve].
2) Liquid limit and plasticity index.
3) Moisture-density relationship.
4) Wear.
5) Soundness.
2. IN PLACE TESTS
a. Perform each of the following tests on samples taken from the placed and compacted GCA. Samples shall be taken and tested at the rates indicated.
1) Perform density tests on every lift of material placed and at a frequency of one set of tests for every 350 square yards or portion thereof, of completed area.
2) Perform sieve analysis on every lift of material placed and at a frequency of one sieve analysis for every 250 square yards or portion thereof, of material placed.
3) Perform liquid limit and plasticity index tests at the same frequency as the sieve analysis.
4) Measure the total thickness of the base course at intervals, in such a manner as to ensure one measurement for each 300 square yards of base course. Measurements shall be made in 3 inch diameter test holes penetrating the base course.
3. APPROVAL OF MATERIAL
a. Select the source of the material 45 days prior to the time the material will be required in the work. Tentative approval of material will be based on initial test results. Final approval of the materials will be based on sieve analysis, liquid limit, and plasticity index tests performed on samples taken from the completed and fully compacted course(s).

1.07 ENVIRONMENTAL REQUIREMENTS

A. Perform construction when the atmospheric temperature is above 35 degrees F. When the temperature falls below 35 degrees F, protect all completed areas by approved methods against detrimental effects of freezing. Correct completed areas damaged by freezing, rainfall, or other weather conditions to meet specified requirements.

PART 2 PRODUCTS

2.01 AGGREGATES

A. Provide GCA consisting of clean, sound, durable particles of crushed stone, crushed slag, crushed gravel, angular sand, or other approved material. GCA shall be free of silt and clay as defined by ASTM D 2487, organic matter, and other objectionable materials or coatings. The portion retained on the No. 4 sieve is known as coarse aggregate; that portion passing the No. 4 sieve is known as fine aggregate.

B. COARSE AGGREGATE

1. Provide coarse aggregates with angular particles of uniform density. When the coarse aggregate is supplied from more than one source, aggregate from each source shall meet the specified requirements and shall be stockpiled separately.
   a. Crushed Gravel: Crushed gravel shall be manufactured by crushing gravels, and shall meet all the requirements specified below.
   b. Crushed Stone: Provide crushed stone consisting of freshly mined quarry rock, meeting all the requirements specified below.
   c. Crushed Recycled Concrete: Provide crushed recycled concrete consisting of previously hardened portland cement concrete or other concrete containing pozzolanic binder material. The recycled material shall be free of all reinforcing steel, bituminous concrete surfacing, and any other foreign material and shall be crushed and processed to meet the required gradations for coarse aggregate. Reject recycled concrete aggregate exceeding this value. Crushed recycled concrete shall meet all other applicable requirements specified below.
   d. Crushed Slag: Crushed slag shall be an air-cooled blast-furnace product having an air dry unit weight of not less than 70 pcf as determined by ASTM C29/C29M, and shall meet all the requirements specified below.
2. GRADED-CRUSHED AGGREGATE BASE COURSE
   a. GCA coarse aggregate shall not show more than 50 percent loss when subjected to the Los Angeles abrasion test in accordance with ASTM C131. GCA coarse aggregate shall not exhibit a loss greater than 18 percent weighted average, at five cycles, when tested for soundness in magnesium sulfate, or 12 percent weighted average, at five cycles, when tested in sodium sulfate in accordance with ASTM C88. The amount of flat and elongated particles shall not exceed 20 percent for the fraction retained on the 1/2 inch sieve nor 20 percent for the fraction passing the 1/2 inch sieve. A flat particle is one having a ratio of width to thickness greater than 3; an elongated particle is one having a ratio of length to width greater than 3. In the portion retained on each sieve specified, the crushed aggregate shall contain at least 90 percent by weight of crushed pieces having two or more freshly fractured faces determined in accordance with ASTM D 5821. When two fractures are contiguous, the angle between planes of the fractures must be at least 30 degrees in order to count as two fractured faces. Crushed gravel shall be manufactured from gravel particles 90 percent of which by weight are retained on the maximum size sieve listed in TABLE 1.

C. FINE AGGREGATE

1. Fine aggregates shall be angular particles of uniform density. When the fine aggregate is supplied from more than one source, aggregate from each source shall meet the specified requirements.
2. GRADED-CRUSHED AGGREGATE BASE COURSE

   Provide GCA fine aggregate consisting of angular particles produced by crushing stone, slag, or gravel that meets the requirements for wear and soundness specified for GCA coarse aggregate.

D. GRADATION REQUIREMENTS

1. Apply the specified gradation requirements to the completed base course. The aggregates shall be continuously well graded within the limits specified in TABLE 1. Sieves shall conform to ASTM E 11.

TABLE 1. GRADATION OF AGGREGATES PERCENTAGE BY WEIGHT

PASSING SQUARE-MESH SIEVE

SIEVE DESIGNATION	NO. 1	NO. 2	NO. 3
2 INCH	100	----	----
1-1/2 INCH	70-100	100	----
1 INCH	45-80	60-100	100
1/2 INCH	30-60	30-65	40-70
NO. 4	20-50	20-50	20-50
NO. 10	15-40	15-40	15-40
NO. 40	5-25	5-25	5-25
NO. 200	0-8	0-8	0-8

NOTE 1: Particles having diameters less than No. 635 shall not be in excess of 3 percent by weight of the total sample tested.

NOTE 2: The values are based on aggregates of uniform specific gravity. If materials from different sources are used for the coarse and fine aggregates, they shall be tested in accordance with ASTM C127 and ASTM C128 to determine their specific gravities. If the specific gravities vary by more than 10 percent, the percentages passing the various sieves shall be corrected as directed by the Contracting Officer.

2.02 LIQUID LIMIT AND PLASTICITY INDEX

A. Apply liquid limit and plasticity index requirements to the completed course and to any component that is blended to meet the required gradation. The portion of any component or of the completed course passing the No. 40 sieve shall be either nonplastic or have a liquid limit not greater than 25 and a plasticity index not greater than 5.

PART 3 EXECUTION

3.01 GENERAL REQUIREMENTS

A. When the GCA is constructed in more than one layer, clean the previously constructed layer of loose and foreign matter by sweeping with power sweepers or power brooms, except that hand brooms may be used in areas where power cleaning is not practicable. Provide adequate drainage during the entire period of construction to prevent water from collecting or standing on the working area. Provide line and grade stakes as necessary for control. Grade stakes shall be in lines parallel to the centerline of the area under construction and suitably spaced for string lining.

3.02 PREPARATION OF UNDERLYING COURSE

A. Prior to constructing the base course(s), the underlying course or subgrade shall be cleaned of all foreign substances. At the time of construction of the base course(s), the underlying course shall contain no frozen material. The surface of the underlying course or subgrade shall meet specified compaction and surface tolerances. The underlying course shall conform to Section 31 00 00 EARTHWORK. Ruts or soft yielding spots in the underlying courses, areas having inadequate compaction, and deviations of the surface from the requirements set forth herein shall be corrected by loosening and removing soft or unsatisfactory material and by adding approved material, reshaping to line and grade, and recompacting to specified density requirements. For cohesionless underlying courses containing sands or gravels, as defined in ASTM D 2487, the surface shall be stabilized prior to placement of the base course(s). Stabilization shall be accomplished by mixing GCA into the underlying course and compacting by approved methods. The stabilized material shall be considered as part of the underlying course and shall meet all requirements of the underlying course. The finished underlying course shall not be disturbed by traffic or other operations and shall be maintained in a satisfactory condition until the base course is placed.

3.03 INSTALLATION

A. PLACING

1. Place the mixed material on the prepared subgrade or subbase in layers of uniform thickness with an approved spreader. When a compacted layer 6 inches or less in thickness is required, place the material in a single layer. When a compacted layer in excess of 6 inches is required, place the material in layers of equal thickness. No layer shall be thicker than 6 inches or thinner than 3 inches when compacted. The layers shall be so placed that when compacted they will be true to the grades or levels required with the least possible surface disturbance. Where the base course is placed in more than one layer, the previously constructed layers shall be cleaned of loose and foreign matter by sweeping with power sweepers, power brooms, or hand brooms, as directed. Such adjustments in placing procedures or equipment shall be made as may be directed to obtain true grades, to minimize segregation and degradation, to adjust the water content, and to insure an acceptable base course.

B. Grade Control

1. The finished and completed base course shall conform to the lines, grades, and cross sections shown. Underlying material(s) shall be excavated and prepared at sufficient depth for the required base course thickness so that the finished base course and the subsequent surface course will meet the designated grades.

C. EDGES OF BASE COURSE

1. The base course(s)shall be placed so that the completed section will be a minimum of 2 feet wider, on all sides, than the next layer that will be placed above it. Additionally, place approved fill material along the outer edges of the base course in sufficient quantities to compact to the thickness of the course being constructed, or to the thickness of each layer in a multiple layer course, allowing in each operation at least a 2 foot width of this material to be rolled and compacted simultaneously with rolling and compacting of each layer of base course. If this base course material is to be placed adjacent to another pavement section, then the layers for both of these sections shall be placed and compacted along this edge at the same time.

D. Compaction

1. Compact each layer of the base course, as specified, with approved compaction equipment. Maintain water content during the compaction procedure to within plus or minus 2 percent of the optimum water content determined from laboratory tests as specified in this Section. Begin rolling at the outside edge of the surface and proceed to the center, overlapping on successive trips at least one-half the width of the roller. Alternate trips of the roller shall be slightly different lengths. Speed of the roller shall be such that displacement of the aggregate does not occur. In all places not accessible to the rollers, the mixture shall be compacted with hand-operated power tampers. Continue compaction until each layer has a degree of compaction that is at least 100 percent of laboratory maximum density through the full depth of the layer. Make such adjustments in compacting or finishing procedures as may be directed to obtain true grades, to minimize segregation and degradation, to reduce or increase water content, and to ensure a satisfactory base course. Any materials that are found to be unsatisfactory shall be removed and replaced with satisfactory material or reworked, as directed, to meet the requirements of this specification.

E. THICKNESS

1. Construct the compacted thickness of the base course as indicated. No individual layer shall be thicker than 6 inches nor be thinner than 3 inches in compacted thickness. The total compacted thickness of the base course(s) shall be within 1/2 inch of the thickness indicated. Where the measured thickness is more than 1/2 inch deficient, correct such areas by scarifying, adding new material of proper gradation, reblading, and recompacting as directed. Where the measured thickness is more than 1/2 inch thicker than indicated, the course shall be considered as conforming to the specified thickness requirements. Average job thickness shall be the average of all thickness measurements taken for the job, but shall be within 1/4 inch of the thickness indicated. The total thickness of the base course shall be measured at intervals in such a manner as to ensure one measurement for each 300 square yards of base course. Measurements shall be made in 3 inch diameter test holes penetrating the base course.

F. Proof Rolling

1. Proof rolling of the areas indicated shall be in addition to the compaction specified and shall consist of the application of 10 coverages with a heavy pneumatic-tired roller having four or more tires, each loaded to a minimum of 30,000 pounds and inflated to a minimum of 125 psi. In areas designated, apply proof rolling to the top of the underlying material on which the base course is laid and to each layer of base course. Maintain water content of the underlying material at optimum or at the percentage directed from start of compaction to completion of proof rolling of that layer. Water content of each layer of the base course shall be maintained at the optimum percentage directed from start of compaction to completion of proof rolling. Any base course materials or any underlying materials that produce unsatisfactory results by proof rolling shall be removed and replaced with satisfactory materials, recompacted and proof rolled to meet thesespecifications.

G. FINISHING

1. The surface of the top layer of base course shall be finished after final compaction and proof rolling by cutting any overbuild to grade and rolling with a steel-wheeled roller. Thin layers of material shall not be added to the top layer of base course to meet grade. If the elevation of the top layer of base course is 1/2 inch or more below grade, then the top layer should be scarified to a depth of at least 3 inches and new material shall be blended in compacted and proof rolled to bring to grade. Adjustments to rolling and finishing procedures shall be made as directed to minimize segregation and degradation, obtain grades, maintain moisture content, and insure an acceptable base course. Should the surface become rough, corrugated, uneven in texture, or traffic marked prior to completion, the unsatisfactory portion shall be scarified, reworked and recompacted or it shall be replaced as directed.

H. SMOOTHNESS

1. The surface of the top layer shall show no deviations in excess of 3/8 inch when tested with a 12 foot straightedge. Take measurements in successive positions parallel to the centerline of the area to be paved. Measurements shall also be taken perpendicular to the centerline at 25 foot intervals. Deviations exceeding this amount shall be corrected by removing material and replacing with new material, or by reworking existing material and compacting it to meet these specifications.

3.04 TRAFFIC

A. Do not allow traffic on the completed base course.

3.05 MAINTENANCE

A. Maintain the base course in a satisfactory condition until the full pavement section is completed and accepted. Maintenance shall include immediate repairs to any defects and shall be repeated as often as necessary to keep the area intact. Any base course that is not paved over prior to the onset of winter, shall be retested to verify that it still complies with the requirements of this specification. Any area of base course that is damaged shall be reworked or replaced as necessary to comply with this specification.

3.06 DISPOSAL OF UNSATISFACTORY MATERIALS

A. Any unsuitable materials that must be removed shall be disposed of in waste disposal areas indicated. No additional payments will be made for materials that must be replaced.

END OF SECTION 32 1123

SECTION 32 1216

ASPHALT PAVING

PART 1 GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SUMMARY

A. Section Includes:

1. Hot-mix asphalt paving.
2. Pavement-marking paint.

B. Related Sections:

1. Division 32 Sections for other paving installed as part of crosswalks in asphalt pavement areas.
2. Division 32 Section "Concrete Paving Joint Sealants" for joint sealants and fillers at paving terminations.

1.03 DEFINITION

A. Hot-Mix Asphalt Paving Terminology: Refer to ASTM D 8 for definitions of terms.

1.04 SUBMITTALS

A. Product Data: For each type of product indicated. Include technical data and tested physical and performance properties.

1. Job-Mix Designs: Certification, by authorities having jurisdiction, of approval of each job mix proposed for the Work.
2. Job-Mix Designs: For each job mix proposed for the Work.

B. Shop Drawings: Indicate pavement markings, lane separations, and defined parking spaces. Indicate, with international symbol of accessibility, spaces allocated for people with disabilities.

C. Material Certificates: For each paving material, from manufacturer.

D. Material Test Reports: For each paving material.

1.05 QUALITY ASSURANCE

A. Manufacturer Qualifications: A paving-mix manufacturer registered with and approved by authorities having jurisdiction.

B. Testing Agency Qualifications: Qualified according to ASTM D 3666 for testing indicated.

C. Regulatory Requirements: Comply with materials, workmanship, and other applicable requirements of New Mexico Standards for Public Works Construction for asphalt paving work.

1. Measurement and payment provisions and safety program submittals included in standard specifications do not apply to this Section.

D. Pre-installation Conference: Conduct conference at Project site.

1. Review methods and procedures related to hot-mix asphalt paving including, but not limited to, the following:

a. Review proposed sources of paving materials, including capabilities and location of plant that will manufacture hot-mix asphalt.

b. Review condition of subgrade and preparatory work.

c. Review requirements for protecting paving work, including restriction of traffic during installation period and for remainder of construction period.

d. Review and finalize construction schedule and verify availability of materials, Installer's personnel, equipment, and facilities needed to make progress and avoid delays.

1.06 DELIVERY, STORAGE, AND HANDLING

A. Deliver pavement-marking materials to Project site in original packages with seals unbroken and bearing manufacturer's labels containing brand name and type of material, date of manufacture, and directions for storage.

B. Store pavement-marking materials in a clean, dry, protected location within temperature range required by manufacturer. Protect stored materials from direct sunlight.

1.07 PROJECT CONDITIONS

A. Environmental Limitations: Do not apply asphalt materials if subgrade is wet or excessively damp, if rain is imminent or expected before time required for adequate cure, or if the following conditions are not met:

1. Prime Coat: Minimum surface temperature of 60 deg F.

2. Asphalt Base Course: Minimum surface temperature of 40 deg F and rising at time of placement.

3. Asphalt Surface Course: Minimum surface temperature of 60 deg F at time of placement.

B. Pavement-Marking Paint: Proceed with pavement marking only on clean, dry surfaces and at a minimum ambient or surface temperature of 40 deg F for oil-based materials, 55 deg F for water-based materials, and not exceeding 95 deg F.

PART 2 PRODUCTS

2.01 AGGREGATES

A. General: Use materials and gradations that have performed satisfactorily in previous installations.

B. Coarse Aggregate: ASTM D 692, sound; angular crushed stone, crushed gravel, or cured, crushed blast-furnace slag.

C. Fine Aggregate: ASTM D 1073 sharp-edged natural sand or sand prepared from stone, gravel, cured blast-furnace slag, or combinations thereof.

1. For hot-mix asphalt, limit natural sand to a maximum of 20 percent by weight of the total aggregate mass.

D. Mineral Filler: ASTM D 242, rock or slag dust, hydraulic cement, or other inert material.

2.02 ASPHALT MATERIALS

A. Asphalt Binder:

B. Prime Coat: ASTM D 2027, medium-curing cutback asphalt, MC-30 or MC-70.

C. Water: Potable.

2.03 AUXILIARY MATERIALS

A. Herbicide: Commercial chemical for weed control, registered by the EPA. Provide in granular, liquid, or wettable powder form.

B. Sand: ASTM D 1073 Grade Nos. 2 or 3.

C. Pavement-Marking Paint: Conform to the requirements of the NMDOT for white and Blue Traffic line Paints (combination Alkyd & Hypalon - fast drying type).

1. Color: White, Blue As indicated.

D. Glass Beads: AASHTO M 247, Type 1.

E. Wheel Stops: Precast, air-entrained concrete, 2500-psi minimum compressive strength, 4-1/2 inches high by 9 inches wide by 72 inches long. Provide chamfered corners, drainage slots on underside, and holes for anchoring to substrate.

1. Dowels: Galvanized steel, 3/4-inch diameter, 10-inch minimum length.

2.04 MIXES

A. Hot-Mix Asphalt: Dense, hot-laid, hot-mix asphalt plant mixes approved by authorities having jurisdiction and complying with the following requirements:

1. Provide mixes with a history of satisfactory performance in geographical area where Project is located.

2. Base Course: Type 1.

3. Surface Course: SP IV.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that subgrade is dry and in suitable condition to begin paving.

B. Proof-roll subgrade below pavements with heavy pneumatic-tired equipment to identify soft pockets and areas of excess yielding. Do not proof-roll wet or saturated subgrades.

1. Completely proof-roll subgrade in one direction, repeating proof-rolling in direction perpendicular to first direction. Limit vehicle speed to 3 mph.

2. Proof roll with a loaded 10-wheel, tandem-axle dump truck weighing not less than 15 tons.

3. Excavate soft spots, unsatisfactory soils, and areas of excessive pumping or rutting, as determined by Architect, and replace with compacted backfill or fill asdirected.

C. Proceed with paving only after unsatisfactory conditions have beencorrected.

D. Verify that utilities, traffic loop detectors, and other items requiring a cut and installation beneath the asphalt surface have been completed and that asphalt surface has been repaired flush with adjacent asphalt prior to beginning installation of imprinted asphalt.

3.02 SURFACE PREPARATION

A. General: Immediately before placing asphalt materials, remove loose and deleterious material from substrate surfaces. Ensure that prepared subgrade is ready to receivepaving.

B. Herbicide Treatment: Apply herbicide according to manufacturer's recommended rates and written application instructions. Apply to dry, prepared subgrade or surfaceof

compacted-aggregate base before applying paving materials.

1. Mix herbicide with prime coat if formulated by manufacturer for that purpose.

C. Prime Coat: Apply uniformly over surface of compacted unbound-aggregate base course at a rate of 0.15 to 0.50 gal./sq. yd.. Apply enough material to penetrate and seal but not flood surface. Allow prime coat to cure.

1. If prime coat is not entirely absorbed within 24 hours after application, spread sand over surface to blot excess asphalt. Use enough sand to prevent pickup under traffic. Remove loose sand by sweeping before pavement is placed and after volatiles have evaporated.

2. Protect primed substrate from damage until ready to receive paving.

3.03 HOT-MIX ASPHALT PLACING

A. Machine place hot-mix asphalt on prepared surface, spread uniformly, and strike off. Place asphalt mix by hand to areas inaccessible to equipment in a manner that prevents segregation of mix. Place each course to required grade, cross section, and thickness when compacted.

1. Place hot-mix asphalt base course in number of lifts and thicknesses indicated.

2. Place hot-mix asphalt surface course in single lift.

3. Spread mix at minimum temperature of 250 deg F.

4. Begin applying mix along centerline of crown for crowned sections and on high side of one-way slopes unless otherwise indicated.

5. Regulate paver machine speed to obtain smooth, continuous surface free of pulls and tears in asphalt-paving mat.

B. Place paving in consecutive strips not less than 10 feet wide unless infill edge strips of a lesser width are required.

1. After first strip has been placed and rolled, place succeeding strips and extend rolling to overlap previous strips. Complete a section of asphalt base course before placing asphalt surface course.

C. Promptly correct surface irregularities in paving course behind paver. Use suitable hand tools to remove excess material forming high spots. Fill depressions with hot-mix asphalt to prevent segregation of mix; use suitable hand tools to smooth surface.

3.04 JOINTS

A. Construct joints to ensure a continuous bond between adjoining paving sections. Construct joints free of depressions, with same texture and smoothness as other sections of hot-mix asphalt course.

1. Clean contact surfaces and apply tack coat to joints.

2. Offset longitudinal joints, in successive courses, a minimum of 6 inches.

3. Offset transverse joints, in successive courses, a minimum of 24 inches.

4. Construct transverse joints at each point where paver ends a day's work and resumes work at a subsequent time. Construct these joints using either "bulkhead" or "papered" method according to AI MS-22, for both "Ending a Lane" and "Resumption of Paving Operations."

5. Compact joints as soon as hot-mix asphalt will bear roller weight without excessive displacement.

6. Compact asphalt at joints to a density within 2 percent of specified course density.

3.05 COMPACTION

A. General: Begin compaction as soon as placed hot-mix paving will bear roller weight without excessive displacement. Compact hot-mix paving with hot, hand tampers or with vibratory-plate compactors in areas inaccessible to rollers.

1. Complete compaction before mix temperature cools to 185 deg F.

B. Breakdown Rolling: Complete breakdown or initial rolling immediately after rolling joints and outside edge. Examine surface immediately after breakdown rolling for indicated crown, grade, and smoothness. Correct laydown and rolling operations to comply with requirements.

C. Intermediate Rolling: Begin intermediate rolling immediately after breakdown rolling while hot-mix asphalt is still hot enough to achieve specified density. Continue rolling until hot-mix asphalt course has been uniformly compacted to the following density:

1. Average Density: 96 percent of reference laboratory density according to ASTM D 6927, but not less than 94 percent nor greater than 100 percent.

D. Finish Rolling: Finish roll paved surfaces to remove roller marks while hot-mix asphalt is still warm.

E. Edge Shaping: While surface is being compacted and finished, trim edges of pavement to proper alignment. Bevel edges while asphalt is still hot; compact thoroughly.

F. Repairs: Remove paved areas that are defective or contaminated with foreign materials and replace with fresh, hot-mix asphalt. Compact by rolling to specified density and surface smoothness.

G. Protection: After final rolling, do not permit vehicular traffic on pavement until it has cooled and hardened.

H. Erect barricades to protect paving from traffic until mixture has cooled enough not to become marked.

3.06 INSTALLATION TOLERANCES

A. Pavement Thickness: Compact each course to produce the thickness indicated within the following tolerances:

1. Base Course: Plus or minus 1/2 inch.

2. Surface Course: Plus 1/4 inch, no minus.

B. Pavement Surface Smoothness: Compact each course to produce a surface smoothness within the following tolerances as determined by using a 10-foot straightedge applied transversely or longitudinally to paved areas:

1. Base Course: 1/4 inch.

2. Surface Course: 1/8 inch .

3.07 Crowned Surfaces: Test with crowned template centered and at right angle to crown. Maximum allowable variance from template is 1/4 inch.PAVEMENT MARKING

A. Do not apply pavement-marking paint until layout, colors, and placement have been verified with Architect.

B. Allow paving to age for 30 days before starting pavement marking.

C. Sweep and clean surface to eliminate loose material and dust.

D. Apply paint with mechanical equipment to produce pavement markings, of dimensions indicated, with uniform, straight edges. Apply at manufacturer's recommended rates to provide a minimum wet film thickness of 15 mils.

1. Broadcast glass beads uniformly into wet pavement markings at a rate of 6 lb/gal.

3.08 WHEEL STOPS

A. Install wheel stops in bed of adhesive as recommended by manufacturer.

B. Securely attach wheel stops to pavement with not less than two galvanized-steel dowels embedded at one-quarter to one-third points. Securely install dowels into pavement and bond to wheel stop. Recess head of dowel beneath top of wheel stop.

3.09 FIELD QUALITY CONTROL

A. Testing Agency: Owner will engage a qualified testing agency to perform tests and inspections.

B. Thickness: In-place compacted thickness of hot-mix asphalt courses will be determined according to ASTM D 3549.

C. In-Place Density: Testing agency will take samples of uncompacted paving mixtures and compacted pavement according to ASTM D 979.

1. Reference maximum theoretical density will be determined by averaging results from four samples of hot-mix asphalt-paving mixture delivered daily to site, prepared according to ASTM D 2041, and compacted according to job-mix specifications.

2. In-place density of compacted pavement will be determined by testing core samples according to ASTM D 1188 or ASTM D 2726.

   a. One core sample will be taken for every 1000 sq. yd. or less of installed pavement, with no fewer than 3 cores taken.

   b. Field density of in-place compacted pavement may also be determined by nuclear method according to ASTM D 2950 and correlated with ASTM D 1188 or ASTM D 2726.

D. Replace and compact hot-mix asphalt where core tests were taken.

E. Remove and replace or install additional hot-mix asphalt where test results or measurements indicate that it does not comply with specified requirements.

3.10 DISPOSAL

A. Except for material indicated to be recycled, remove excavated materials from Project site and legally dispose of them in an EPA-approved landfill.

1. Do not allow milled materials to accumulate on-site.

END OF SECTION 32 1216

SECTION 32 1313

CONCRETE PAVING

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Concrete sidewalks, integral curbs, and gutters.

1.02 RELATED REQUIREMENTS

A. Section 03 1000 - Concrete Forming and Accessories.

B. Section 03 3000 - Cast-in-Place Concrete.

C. Section 07 9200 - Joint Sealants: Sealing joints.

D. Section 31 2200 - Grading: Preparation of site for paving and base and preparation of subsoil at pavement perimeter for planting.

E. Section 32 1726 - Tactile Warning Surfacing: Plastic tactile and detectable warning tiles for pedestrian walking surfaces.

F. Section 33 0513 - Manholes and Structures: Manholes, including frames; gutter drainage grilles, covers, and frames for placement by this section.

1.03 REFERENCE STANDARDS

A. ACI 211.1 - Standard Practice for Selecting Proportions for Normal, Heavyweight, and Mass Concrete; 1991 (Reapproved 2009).

B. ACI 301 - Specifications for Structural Concrete; 2016.

C. ASTM A1064/A1064M - Standard Specification for Carbon-Steel Wire and Welded Wire Reinforcement, Plain and Deformed, for Concrete; 2017.

D. ASTM C94/C94M - Standard Specification for Ready-Mixed Concrete; 2017a.

E. ASTM D1751 - Standard Specification for Preformed Expansion Joint Filler for Concrete Paving and Structural Construction (Nonextruding and Resilient Bituminous Types); 2004, with Editorial Revision (2013).

1.04 SUBMITTALS

A. See Section 01 3000 - Administrative Requirements, for submittal procedures.

B. Product Data: Provide data on joint filler, admixtures, and curing compound.

PART 2 PRODUCTS

2.01 PAVING ASSEMBLIES

A. Comply with applicable requirements of ACI 301.

B. Concrete Sidewalks and Median Barrier: 3,000 psi 28 day concrete, 4 inches thick, buff color Portland cement, exposed aggregate finish.

2.02 FORM MATERIALS

A. Form Materials: As specified in Section 03 1000, conform to ACI 301.

2.03 REINFORCEMENT

A. Steel Welded Wire Reinforcement: Plain type, ASTM A1064/A1064M; in flat sheets;unfinished.

2.04 CONCRETE MATERIALS

A. Obtain cementitious materials from same source throughout.

B. Concrete Materials: As specified in Section 03 3000.

2.05 ACCESSORIES

A. Slab Isolation Joint Filler: 1/2 inch thick, height equal to slab thickness, with removable top section that will form 1/2 inch deep sealant pocket after removal.

1. Material: ASTM D1751, cellulose fiber.

B. Tactile Warning Surfaces: See Section 32 1726.

2.06 CONCRETE MIX DESIGN

A. Proportioning Normal Weight Concrete: Comply with ACI 211.1 recommendations.

2.07 MIXING

A. Transit Mixers: Comply with ASTM C94/C94M.

2.08 COLOR

A. Sidewalks shall be integrally colored David color Mesquite 677.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify compacted subgrade is acceptable and ready to support paving and imposed loads.

B. Verify gradients and elevations of base are correct.

3.02 SUBBASE

A. Subbase preparation shall follow geotechnical reports recommendations.

3.03 FORMING

A. Place and secure forms to correct location, dimension, profile, and gradient.

3.04 PLACING CONCRETE

A. Ensure reinforcement, inserts, embedded parts, formed joints are not disturbed during concrete placement.

3.05 JOINTS

A. Joints in sidewalks shall occur at maximum 6’-0” O.C.

B. Control joints in sidewalls shall occur at maximum of 30’-0” O.C.

END OF SECTION 32 1313

SECTION 32 1723

PAVEMENT MARKINGS

PART 1 GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SUMMARY

A. Section includes painted markings applied to asphalt pavement.

B. Related Requirements:

1. Section 099113 "Exterior Painting" for painting exterior concrete surfaces other than pavement.

1.03 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1. Review methods and procedures related to marking pavement including, but not limited to, the following:

a. Pavement aging period before application of pavement markings.

b. Review requirements for protecting pavement markings, including restriction of traffic during installation period.

1.04 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Include technical data and tested physical and performance properties.

B. Shop Drawings: For pavement markings.

1. Indicate pavement markings, colors, lane separations, defined parking spaces, and dimensions to adjacent work.

2. Indicate, with international symbol of accessibility, spaces allocated for people with disabilities.

C. Samples: For each exposed product and for each color and texture specified; on rigid backing, 8 inches (200 mm) square.

1.05 FIELD CONDITIONS

A. Environmental Limitations: Proceed with pavement marking only on clean, dry surfaces and at a minimum ambient or surface temperature of [40 deg F (4.4 deg C) for alkyd materials] [55 deg F (12.8 deg C) for water-based materials], and not exceeding 95 deg F (35 deg C).

PART 2 PRODUCTS

2.01 PAVEMENT-MARKING PAINT

A. Pavement-Marking Paint: Latex, waterborne emulsion, lead and chromate free, ready mixed, complying with FS TT-P-1952, Type II, with drying time of less than 45 minutes.

1. Color: As indicated.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that pavement is dry and in suitable condition to begin pavement marking according to manufacturer's written instructions.

B. Proceed with pavement marking only after unsatisfactory conditions have been corrected.

3.02 PAVEMENT MARKING

A. Do not apply pavement-marking paint until layout, colors, and placement have been verified with Architect.

B. Allow paving to age for a minimum of 30 days before starting pavement marking.

C. Sweep and clean surface to eliminate loose material and dust.

D. Apply paint with mechanical equipment to produce pavement markings, of dimensions indicated, with uniform, straight edges. Apply at manufacturer's recommended rates to provide a minimum wet film thickness of 15 mils (0.4 mm) with three passes.

1. Apply graphic symbols and lettering with paint-resistant, die-cut stencils, firmly secured to pavement. Mask an extended area beyond edges of each stencil to prevent paint application beyond the stencil. Apply paint so that it cannot run beneath the stencil.

2. Broadcast glass beads uniformly into wet markings at a rate of 6 lb/gal. (0.72 kg/L).

3.03 PROTECTING AND CLEANING

A. Protect pavement markings from damage and wear during remainder of construction period.

B. Clean spillage and soiling from adjacent construction using cleaning agents and procedures recommended by manufacturer of affected construction.

END OF SECTION 32 1723

SECTION 32 1726

TACTILE WARNING SURFACING

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Plastic tactile and detectable warning tiles for pedestrian walking surfaces.

1.02 RELATED REQUIREMENTS

A. Section 03 3000 - Cast-in-Place Concrete: Concrete for sidewalks and platforms.

1.03 REFERENCE STANDARDS

A. 49 CFR 37 - Transportation Services for Individuals with Disabilities (ADA); current edition.

B. ADA Standards - Americans with Disabilities Act (ADA) Standards for Accessible Design; 2010.

C. ASTM A666 - Standard Specification for Annealed or Cold-Worked Austenitic Stainless Steel Sheet, Strip, Plate, and Flat Bar; 2015.

D. ATBCB PROWAG - Proposed Accessibility Guidelines for Pedestrian Facilities in the Public Right-of-Way; 2011.

1.04 SUBMITTALS

A. See Section 01 3000 - Administrative Requirements, for submittal procedures.

B. Product Data: Submit manufacturer's product data, standard details, details specific to this project; written installation and maintenance instructions.

PART 2 PRODUCTS

2.01 TACTILE AND DETECTABLE WARNING DEVICES

A. Plastic Tactile and Detectable Warning Tiles: ADA Standards compliant, glass fiber and carbon fiber reinforced, exterior grade, matte finish polyester sheet with truncated dome pattern, solid color throughout, internal reinforcing of sheet and of truncated domes, integral radius cut lines on back face of tile; with factory applied removable protective sheeting.

1. Installation Method: Cast in place replaceable.
2. Shape: Rectangular.
3. Pattern: In-line pattern of truncated domes complying with ADA Standards.
4. Edge: Square.
5. Joint: Butt.
6. Color: As selected by Architect from manufacturer's standard range.

2.02 ACCESSORIES

A. Fasteners: ASTM A666, Type 304 stainless steel

1. Type: Countersunk, color matched composite sleeve anchors
2. Size: 1/4 inch diameter and 1-1/2 inches long.

PART 3 EXECUTION

3.01 INSTALLATION, GENERAL

A. Install in accordance with manufacturer's written instructions.

1. Do not install damaged, warped, bowed, dented, abraded, or otherwise defective units.
2. Do not install when ambient or substrate temperature has been below 40 degrees F during the preceding 8 daylight hours.

B. Field Adjustment:

1. Locate relative to curb line in compliance with ATBCB PROWAG, Sections 304 and 305.
2. Orient so dome pattern is aligned with the direction of ramp.

C. Install units fully seated to substrate, square to straight edges and flat to required slope.

D. Align units so that tops of adjacent units are flush and joints between units are uniform in width.

3.02 INSTALLATION, CAST IN PLACE PLASTIC TILES

A. Concrete:

1. See Section 03 3000.
2. Slump: 4 to 7 percent.

B. Tamp and vibrate units as recommended by manufacturer.

C. Place and position weights on units while concrete cures as recommended by manufacturer. Ensure no voids or air pockets exist between top surface of concrete and underside of units.

3.03 CLEANING PLASTIC UNITS

A. Remove protective plastic sheeting within 24 hours of installation.

B. Remove excess sealant or adhesive from joints and edges.

C. Clean four days prior to date of scheduled inspection.

END OF SECTION 32 1726

SECTION 32 3313

SITE BICYCLE RACKS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Exterior bicycle racks.

1.02 RELATED REQUIREMENTS

A. Section 03 3000 - Cast-in-Place Concrete: Mounting surface for bicycle racks.

1.03 REFERENCE STANDARDS

A. ASTM A53/A53M - Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless; 2012.

PART 2 PRODUCTS

2.01 BICYCLE RACKS

A. Exterior Bicycle Racks: Device allows user-provided lock to simultaneously secure one wheel and part of the frame on each bicycle parked or racked.
   1. Style: Serpentine rack formed from a continuous round pipe.
   2. Capacity: five and seven bicycles.
   3. Mounting, Ground: In-ground anchor.
   4. Finish: Powder coat, maintenance-free and weather-resistant.
   5. Color: As selected by Architect from manufacturer's standard range.
   6. Accessories: In-ground grout cover.

B. Materials:
   1. Pipe: Carbon steel, ASTM A53/A53M, Schedule 40.

PART 3 EXECUTION

3.01 INSTALLATION

A. Install in accordance with manufacturer's instructions.

B. Install level, plumb, square, and correctly located as indicated on drawings.

C. In-Ground Anchor Installation:
   1. Prepare holes in size according to manufacturer’s instructions.
   2. Place anchoring bolts through the holes in pipe.
   3. Lower rack into holes, ensuring the bottom of lower bends are at least 1-1/2 inch from the ground.
   4. Place concrete.
   5. Level rack before concrete sets.
   6. Support until dry.

END OF SECTION 32 3313

SECTION 33 0500

COMMON WORK RESULTS FOR UTILITIES

PART 1 GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SUMMARY

A. This Section includes

B. the following:

1. Piping installation.

2. Piping joint construction.

1.03 DEFINITIONS

A. Exposed Installations: Exposed to view outdoors or subject to outdoor ambient temperatures and weather conditions.

B. Concealed Installations: Concealed from view and protected from weather conditions and physical contact by building occupants but subject to outdoor ambient temperatures. Examples include installations within unheated shelters.

C. ABS: Acrylonitrile-butadiene-styrene plastic.

D. PVC: Polyvinyl chloride plastic.

1.04 SUBMITTALS

A. Product Data: For the following:

1. Identification devices.

1.05 QUALITY ASSURANCE

A. Steel Support Welding: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."

B. Steel Piping Welding: Qualify processes and operators according to ASME Boiler and Pressure Vessel Code: Section IX, "Welding and Brazing Qualifications."

1. Comply with provisions in ASME B31 Series, "Code for Pressure Piping."

2. Certify that each welder has passed AWS qualification tests for welding processes involved and that certification is current.

C. Comply with ASME A13.1 for lettering size, length of color field, colors, and viewing angles of identification devices.

1.06 DELIVERY, STORAGE, AND HANDLING

A. Deliver pipes and tubes with factory-applied end caps. Maintain end caps through shipping, storage, and handling to prevent pipe end damage and to prevent entrance of dirt, debris, and moisture.

B. Store plastic pipes protected from direct sunlight. Support to prevent sagging and bending.

1.07 COORDINATION

A. Coordinate installation of required supporting devices and set sleeves in poured-in-place concrete and other structural components as they are constructed.

B. Coordinate installation of identifying devices after completing covering and painting if devices are applied to surfaces.

C. Coordinate size and location of concrete bases. Formwork, reinforcement, and concrete requirements are specified in Division 03.

PART 2 PRODUCTS

2.01 PIPING JOINING MATERIALS

A. Pipe-Flange Gasket Materials: Suitable for chemical and thermal conditions of piping system contents.

1. ASME B16.21, nonmetallic, flat, asbestos free, 1/8-inch maximum thickness, unless otherwise indicated.

a. Full-Face Type: For flat-face, Class 125, cast-iron and cast-bronze flanges.

b. Narrow-Face Type: For raised-face, Class 250, cast-iron and steel flanges.

2. AWWA C110, rubber, flat face, 1/8 inch thick, unless otherwise indicated; and full-face or ring type, unless otherwise indicated.

B. Plastic, Pipe-Flange Gasket, Bolts, and Nuts: Type and material recommended by piping system manufacturer, unless otherwise indicated.

C. Solvent Cements for Joining Plastic Piping:

1. PVC Piping: ASTM D 2564. Include primer according to ASTM F 656.

D. Fiberglass Pipe Adhesive: As furnished or recommended by pipe manufacturer.

2.02 TRANSITION FITTINGS

A. AWWA Transition Couplings NPS 2 (DN 50) and Larger:

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:

2. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Cascade Waterworks Mfg. Co.

b. Dresser, Inc.; DMD Div.

c. Ford Meter Box Company, Inc. (The); Pipe Products Div.

d. JCM Industries.

e. Smith-Blair, Inc.

3. Description: AWWA C219, metal sleeve-type coupling for underground pressure piping.

B. Plastic-to-Metal Transition Fittings:

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:

2. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Spears Manufacturing Co.

3. Description: PVC one-piece fitting with manufacturer's Schedule 80 equivalent dimensions; one end with threaded brass insert, and one solvent-cement-joint end.

4. Description: ASTM C 1173 with elastomeric sleeve, ends same size as piping to be joined, and corrosion-resistant metal band on each end.

2.03 IDENTIFICATION DEVICES

A. General: Products specified are for applications referenced in other Division 33 Sections. If more than single type is specified for listed applications, selection is Installer'soption.

2.04 FLOWABLE FILL

A. Description: Low-strength-concrete, flowable-slurry mix.

1. Cement: ASTM C 150, Type I, portland.

2. Density: 115- to 145-lb/cu. ft.

3. Aggregates: ASTM C 33, natural sand, fine.

4. Admixture: ASTM C 618, fly-ash mineral.

5. Water: Comply with ASTM C 94/C 94M.

6. Strength: 100 to 200 psig (690 to 1380 kPa)at 28 days.

PART 3 EXECUTION

3.01 PIPING INSTALLATION

A. Install piping according to the following requirements and Division 33 Sections specifying piping systems.

B. 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.

C. Install piping to permit valve servicing.

D. Install piping at indicated slopes.

E. Install piping free of sags and bends.

F. Install fittings for changes in direction and branch connections.

G. Select system components with pressure rating equal to or greater than system operating pressure.

H. Sleeves are not required for core-drilled holes.

3.02 PIPING JOINT CONSTRUCTION

A. Join pipe and fittings according to the following requirements and Division 33 Sections specifying piping systems.

B. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.

C. Remove scale, slag, dirt, and debris from inside and outside of pipe and fittings before assembly.

D. Pressure-Sealed Joints: Assemble joints for plain-end copper tube and mechanical pressure seal fitting with proprietary crimping tool to according to fitting manufacturer's written instructions.

E. Plastic 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 Pressure Piping: Join schedule number ASTM D 1785, PVC pipe and PVC socket fittings according to ASTM D 2672. Join other-than-schedule-number PVC pipe and socket fittings according to ASTM D 2855.

3. PVC Nonpressure Piping: Join according to ASTM D 2855.

F. Plastic Pressure Piping Gasketed Joints: Join according to ASTM D 3139.

G. Plastic Nonpressure Piping Gasketed Joints: Join according to ASTM D 3212.

END OF SECTION 33 0500

SECTION 33 0513

MANHOLES AND STRUCTURES

PART 1 GENERAL

1.01 SUMMARY

A. Section Includes:
   1. Modular precast concrete manhole and structures with tongue-and-groove joints with masonry transition to cover frame, covers, anchorage, and accessories.
   2. Bedding and cover materials.

B. Related Requirements:
   1. Section 03 10 00 - Concrete Forming and Accessories: Erecting forms and bracing them against movement.
   2. Section 03 20 00 - Concrete Reinforcing: Installation of reinforcing steel.
   3. Section 03 30 00 - Cast-in-Place Concrete: Concrete type for manhole base pad construction.
   4. Section 04 05 14 - Masonry Mortaring and Grouting: Execution requirements for mortar and grout as specified in this Section.
   5. Section 04 20 00 - Unit Masonry: Product requirements for clay brick units for use in manhole and structure construction.
   6. Section 31 05 13 - Soils for Earthwork: Soil for backfill in trenches.
   7. Section 31 23 16 - Excavation: Excavating for manholes and structures.
   8. Section 31 23 23 - Fill: Compaction requirements for precast concrete manholes and structures specified in this Section.
   9. Section 33 05 16.13 - Precast Concrete Utility Structures: Execution requirements for utility structures affected by this Section.

1.02 REFERENCE STANDARDS

A. American Concrete Institute:
   1. ACI 318 - Building Code Requirements for Structural Concrete.

B. ASTM International:
   1. ASTM A48 - Standard Specification for Gray Iron Castings.
   2. ASTM A123 - Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products.
   3. ASTM C478 - Standard Specification for Precast Reinforced Concrete Manhole Sections.
   4. ASTM C497 - Standard Test Methods for Concrete Pipe, Manhole Sections, or Tile.
   5. ASTM C913 - Standard Specification for Precast Concrete Water and Wastewater Structures.

1.03 SUBMITTALS

A. Section 01 33 00 - Submittal Procedures: Requirements for submittals.

B. Product Data: Submit cover and frame construction, features, configuration and dimensions.

C. Shop Drawings: Indicate manhole and structure locations, elevations, piping, sizes and elevations of penetrations.

D. Manufacturer's Certificate: Certify that products meet or exceed specified requirements.

1.04 QUALITY ASSURANCE

A. Perform Work according to NM APWA standards.

1.05 DELIVERY, STORAGE, AND HANDLING

A. Section 01 60 00 - Product Requirements: Requirements for transporting, handling, storing, and protecting products.

B. Unload, store, and handle precast manholes and structures according to manufacturer instructions.

C. Storage:

1. Store precast concrete manholes and structures as to prevent damage to Owner's property or other public or private property.
2. Repair property damaged from materials storage.

1.06 AMBIENT CONDITIONS

A. Section 01 50 00 - Temporary Facilities and Controls: Requirements for ambient condition control facilities for product storage and installation.

1.07 P2 PRODUCTS

1.08 PERFORMANCE AND DESIGN CRITERIA

A. Equivalent strength: Based on structural design of reinforced concrete as outlined in ACI 318.

B. Design of Lifting Devices for Precast Components: According to ASTM C913.

C. Design of Joints for Precast Components:
1. According to ASTM C913.
2. Maximum Leakage: 0.025 gal. per hour per foot of joint at 3 feet of head.

D. Shaft Construction: Concentric with eccentric cone top section; lipped male/female dry joints; sleeved to receive pipe sections.

E. Shape: Cylindrical.

F. Clear Inside Dimensions: 48-inch diameter.

G. Design Depth: As indicated on Drawings.

H. Clear Cover Opening:
1. 26 inches diameter.
2. As indicated on Drawings.

I. Pipe and Conduit Entry: Furnish openings as indicated on Drawings.

1.09 MANHOLES AND STRUCTURES

A. Manhole and Structure Sections:
1. Reinforced precast concrete according to ASTM C478.
2. Gaskets: According to ASTM C923.

B. Mortar and Grout:
1. As specified in Section 04 05 14 - Masonry Mortaring and Grouting.
2. Type S.

C. Reinforcement:
1. Formed steel wire.
2. Thickness: per manufacturers design.
3. Finish: Unfinished.

1.10 FRAMES AND COVERS

A. Description:
   1. Construction: ASTM A48.
   2. Surface: Machined flat bearing.
   3. Lid: Removable.
   4. Cover Design: Closed.
   5. Live Load Rating: H20

1.11 MATERIALS

A. Bedding and Cover:
   1. Bedding: Fill Type A1.
   2. Cover: Fill Type A1.
   3. Soil Backfill from Above Pipe to Finish Grade:
      a. Soil Type S1.
      b. Subsoil: No rocks over 6 inches in diameter, frozen earth, or foreign matter.

1.12 FINISHES

A. Steel:
   1. Galvanizing:
      a. ASTM A123.
      b. Hot dip galvanize after fabrication.

1.13 ACCESSORIES

A. Manhole and Structure Steps:
   1. Formed galvanized steel rungs.
   2. Formed integral with manhole and structure sections.
   3. Diameter: ¾ inch.
   4. Width:
      a. 12 inches.
   5. Spacing:
      a. 16 inches o.c. vertically, set into manhole and structure wall.

B. Manhole and Structure Steps: As required by code.

C. Base Pad:
   1. Leveled top surface.
   2. Cast-in-place concrete of type as specified in Section 03 30 00 - Cast-in-Place Concrete.

1.14 P3 EXECUTION

1.15 EXAMINATION

A. Section 01 70 00 - Execution and Closeout Requirements: Requirements for installation examination.

B. Verify that 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 Work.

D. Verify correct size of manhole and structure excavation.

1.16 PREPARATION

A. Section 01 70 00 - Execution and Closeout Requirements: Requirements for installation preparation.

B. Mark each precast structure by indentation or waterproof paint showing date of manufacture, manufactur er, and identifying symbols and numbers as indicated on Drawings to indicate its intended use.

C. Coordinate placement of inlet and outlet pipe or duct sleeves required by otherSections.

D. Do not install structures where Site conditions induce loads exceeding structural capacity of structures.

E. Inspect precast concrete structures immediately prior to placement in excavation to verify structures are internally clean and free from damage; remove and replace damaged units.

1.17 INSTALLATION

A. Excavation and Backfill:

1. Excavate manholes and structures as specified in Section 31 23 16 - Excavation in location and to indicated depth.
2. Provide clearance around sidewalls of structure for construction operations.
3. When groundwater is encountered, prevent accumulation of water in excavations; place manholes and structures in dry trench.
4. Where possibility exists of watertight structure becoming buoyant in flooded excavation, anchor structure to avoid flotation as approved by Architect/Engineer.

B. Base Pad:

1. Place base pad.
2. Trowel top surface level.

C. Place manhole and structure sections plumb and level, trim to correct elevations, and anchor to base pad.

D. Backfill excavations for manholes and structures as specified in Section 31 23 16 -Excavation.

E. Form and place manhole and structures cylinder plumb and level and to correct dimensions and elevations.

F. As Work progresses, build fabricated metal items.

G. Cut and fit for pipe.

H. Grout base of shaft sections to achieve slope to exit piping, trowel smooth, and contour to form continuous drainage channel.

I. Set cover frames and covers level without tipping and to correct elevations.

J. Coordinate with other Sections of Work to provide correct size, shape, and location.

K. Precast Concrete Manholes and Structures

1. Lift precast components at lifting points designated by manufacturer.
2. When lowering manholes and structures into excavations and joining pipe to units, take precautions to ensure that interior of pipeline and structure remains clean.
3. Set precast structures bearing firmly and fully on crushed stone bedding, compacted as specified in Section 31 23 16 - Excavation and 31 23 23 - Fill or on other support system as indicated on Drawings.
4. Assemble multi-section structures by lowering each section into excavation; set level and firmly position base section before placing additional sections.
5. Remove foreign materials from joint surfaces and verify sealing materials are placed properly.
6. Maintain alignment between sections by using guide devices affixed to lowersection.
7. Joint sealing materials may be installed on Site or at manufacturer's plant.
8. Verify that installed manholes and structures meet required alignment and grade.
9. Remove knockouts or cut structure to receive piping without creating openings larger than required to receive pipe; fill annular spaces with mortar.
10. Cut pipe flush with interior of structure.
11. Shape inverts through manhole and structures as indicated on Drawings.

1.18 FIELD QUALITY CONTROL

A. Section 01 40 00 - Quality Requirements: Requirements for inspecting and testing.

B. Test concrete manhole and structure sections according to ASTM C497.

C. Test cast-in-place concrete as specified in Section 03 30 00 - Cast-in-Place Concrete.

D. Vertical Adjustment of Existing Manholes and Structures:

1. If required, adjust top elevation of existing manholes and structures to finished grades as indicated on Drawings.
2. Reset existing frames, grates, and covers that were carefully removed and cleaned of mortar fragments to required elevation according to requirements specified for installation of castings.
3. When removal of existing concrete wall is required, remove concrete without damaging existing vertical reinforcing bars, clean concrete from vertical bars, and bend into new concrete top slab or splice to required vertical reinforcement as indicated on Drawings.
4. Clean and apply sand-cement bonding compound on existing concrete surfaces to receive cast-in-place concrete as specified in Section 03 30 00 - Cast-in-Place Concrete.

1.19 ATTACHMENTS

A. Storm Sewer Manholes: Precast concrete sections, galvanized steel steps, not less than 48 inches inside dimension, to depth indicated, with bolted lid.

END OF SECTION 33 0513

SECTION 33 1116

SITE WATER UTILITY DISTRIBUTION PIPING

PART - 1 GENERAL

1.01 SUMMARY

A. Section Includes:

1. Pipe and fittings for Site water line, including domestic water line.
2. Tapping sleeves and valves.
3. Valves: Gate, ball, swing check, and butterfly.
4. Hydrants and yard hydrants.
5. Reduced-pressure backflow preventers.
6. Underground pipe markers.
7. Precast concrete vaults.
8. Valve boxes.
9. Bedding and cover materials.

B. Related Requirements:

1. Section 03 30 00 - Cast-in-Place Concrete: Concrete for thrust restraints.
2. Section 09 90 00 - Painting and Coating: Painting requirements for fire hydrants.
3. Section 22 11 00 - Facility Water Distribution: Product and execution requirements for domestic water piping at building.
4. Section 31 05 13 - Soils for Earthwork: Soils for backfill in trenches.
5. Section 31 05 16 - Aggregates for Earthwork: Aggregate for backfill in trenches.
6. Section 31 23 16 - Excavation: Product and execution requirements for excavation and backfill.
7. Section 31 23 17 - Trenching: Execution requirements for trenching.
8. Section 31 23 23 - Fill: Requirements for backfill to be placed by this Section.
9. Section 33 12 33 - Water Utility Metering: Positive displacement meters as required by this Section.
10. Section 33 13 00 - Disinfecting of Water Utility Distribution: Disinfection of Site service utility water piping.

1.02 REFERENCE STANDARDS

A. American Association of State Highway and Transportation Officials:

1. AASHTO T 180 - Standard Method of Test for Moisture-Density Relations of Soils Using a 4.54-kg (10-lb) Rammer and a 457-mm (18-in.) Drop.

B. American Society of Mechanical Engineers:

1. ASME B16.1 - Gray Iron Pipe Flanges and Flanged Fittings: Classes 25, 125, and 250.
2. ASME B16.18 - Cast Copper Alloy Solder-Joint Pressure Fittings.
3. ASME B16.22 - Wrought Copper and Copper Alloy Solder-Joint Pressure Fittings.

C. American Society of Sanitary Engineering:

1. ASSE 1012 - Performance Requirements for Backflow Preventers with an Intermediate Atmospheric Vent.
2. ASSE 1013 - Performance Requirements for Reduced Pressure Principle Backflow Preventers and Reduced Pressure Principle Fire Protection Backflow Preventers.

D. ASTM International:

1. ASTM A48 - Standard Specification for Gray Iron Castings.
2. ASTM B88 - Standard Specification for Seamless Copper Water Tube.
3. ASTM C858 - Standard Specification for Underground Precast Concrete Utility Structures.
4. ASTM D698 - Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Standard Effort (12 400 ft-lbf/ft3 (600 kN-m/m3)).
5. ASTM D1557 - Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbf/ft3 (2,700 kN-m/m3)).
6. ASTM D1785 - Standard Specification for Poly(Vinyl Chloride) (PVC) Plastic Pipe, Schedules 40, 80, and 120.
7. ASTM D2241 - Standard Specification for Poly(Vinyl Chloride) (PVC) Pressure-Rated Pipe (SDR Series).
8. ASTM D2466 - Standard Specification for Poly(Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 40.
9. ASTM D2855 - Standard Practice for Making Solvent-Cemented Joints with Poly(Vinyl Chloride) (PVC) Pipe and Fittings.
10. ASTM D3035 - Standard Specification for Polyethylene (PE) Plastic Pipe (DR-PR) Based on Controlled Outside Diameter.
11. ASTM D3139 - Standard Specification for Joints for Plastic Pressure Pipes Using Flexible Elastomeric Seals.
12. ASTM D6938 - Standard Test Method for In-Place Density and Water Content of Soil and Soil-Aggregate by Nuclear Methods (Shallow Depth).

E. American Water Works Association:

1. AWWA C104 - Cement-Mortar Lining for Ductile-Iron Pipe and Fittings.
2. AWWA C105 - Polyethylene Encasement for Ductile-Iron Pipe Systems.
3. AWWA C111 - Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings.
4. AWWA C151 - Ductile-Iron Pipe, Centrifugally Cast.
5. AWWA C500 - Metal-Seated Gate Valves for Water Supply Service.
6. AWWA C502 - Dry-Barrel Fire Hydrants.
7. AWWA C504 - Rubber-Seated Butterfly Valves, 3 In. (75 mm) Through 72 In. (1,800 mm).
8. AWWA C508 - Swing-Check Valves for Waterworks Service, 2-In. Through 24-In. (50-mm Through 600-mm) NPS.
9. AWWA C509 - Resilient-Seated Gate Valves for Water Supply Service.
10. AWWA C600 - Installation of Ductile-Iron Mains and Their Appurtenances.
11. AWWA C606 - Grooved and Shouldered Joints.
12. AWWA C700 - Cold-Water Meters - Displacement Type, Bronze Main Case.
13. AWWA C701 - Cold-Water Meters - Turbine Type, for Customer Service.
14. AWWA C702 - Cold-Water Meters - Compound Type.
15. AWWA C706 - Direct-Reading, Remote-Registration Systems for Cold-Water Meters.
16. AWWA C900 - Polyvinyl Chloride (PVC) Pressure Pipe and Fabricated Fittings, 4 In. Through 12 In. (100 mm Through 300 mm), for Water Transmission and Distribution.
17. AWWA C901 - Polyethylene (PE) Pressure Pipe and Tubing, 1/2 In. (13 mm) Through 3 In. (76 mm) for Water Service.
18. AWWA C906 - Polyethylene (PE) Pressure Pipe and Fittings, 4 In. (100 mm) Through 63 In. (1,600 mm), for Water Distribution and Transmission.
19. AWWA M6 - Water Meters - Selection, Installation, Testing, and Maintenance.

F. American Welding Society:

1. AWS A5.8 - Specification for Filler Metals for Brazing and Braze Welding.

G. Manufacturers Standardization Society of the Valve and Fittings Industry:

1. MSS SP-60 - Connecting Flange Joints between Tapping Sleeves and Tapping Valves.

H. UL:

1. UL 246 - Hydrants for Fire-Protection Service.

1.03 SUBMITTALS

A. Section 01 33 00 - Submittal Procedures: Requirements for submittals.

B. Product Data: Submit data on pipe materials, pipe fittings, valves, and accessories.

C. Manufacturer's Certificate: Certify that products meet or exceed specified requirements.

D. Field Quality-Control Submittals: Indicate results of Contractor-furnished tests and inspections.

1.04 CLOSEOUT SUBMITTALS

A. Section 01 70 00 - Execution and Closeout Requirements: Requirements for submittals.

B. Project Record Documents: Record actual locations of piping mains, valves, connections, thrust restraints, and invert elevations.

C. Identify and describe unexpected variations to subsoil conditions or discovery of uncharted utilities.

1.05 QUALITY ASSURANCE

A. Perform Work according to NM APWA standards.

B. Maintain 1 copy of each standard affecting Work of this Section on Site.

PART - 2 PRODUCTS

2.01 WATER PIPING

A. Copper Tubing:

1. Comply with ASTM B88.
2. Type K, annealed.
3. Fittings: ASME B16.18, cast copper.
4. Joints: Compression connection.

B. PVC Pipe:

1. SDR-21 for 200-psig rating.
2. Fittings: ASTM D2466, PVC.
3. Joints:
   a. Comply with ASTM D2855.
      1) Type: Solvent weld.

C. PVC Pipe:

1. Comply with AWWA C900, Class 165.

2. Fittings:

a. Material: Cast iron.

1) Comply with AWWA C111.

(a) Joints:

2) Comply with ASTM D3139.

3) Provide compression gasket ring.

2.02 TAPPING SLEEVES AND VALVES

A. Tapping Sleeves:

1. Furnish materials according to NM APWA standards.

B. Description:

1. Material: Ductile or cast iron.

2. Type: Dual compression.

3. Outlet Flange Dimensions and Drilling: Comply with ASME B16.1, Class 125 and MSS SP-60.

C. Tapping Valves:

1. Furnish materials according to NM APWA standards.

D. Description:

1. Comply with AWWA C500.

2. Type: Double disc with non-rising stem.

3. Inlet Flanges: Comply with ASME B16.1, Class 125, and MSS SP-60.

4. Mechanical Joint Outlets: Comply with AWWA C111.

5. Mark manufacturer's name and pressure rating on valve body.

2.03 GATE VALVES

A. Manufacturers: Basis of Design

1. Furnish materials according to NM APWA standards.

B. 2-1/2 Inch and Smaller: Brass or bronze body, non-rising stem, inside screw, single wedge or disc, compression ends, with control rod, post indicator] valve box, and valvekey.

C. 3 Inch and Larger: AWWA C500, iron body, bronze trim, non-rising stem with square nut, single wedge, flanged mechanical joint ends, control rod, valve box, and valve key.

D. Mark manufacturer's name and pressure rating on valve body.

2.04 HYDRANTS

A. Manufacturers: Basis of Design

1. Kennedy.
2. Furnish materials according to NM APWA standards.

B. Hydrants:

1. Comply with AWWA C502 and UL 246.
2. Type: Dry barrel.
3. Minimum Inside Diameter: 7 inches.
4. Minimum Valve Seat Opening Diameter: 5 inches.
5. Minimum Net Barrel Water Area: Not less than 190 percent of valve opening area.
6. Inlet: 6 bell or mechanical joint connection with accessories, gland bolts, and gaskets.

C. Hydrant Extensions: Fabricate in multiples of 6 inches with rod and coupling to increase barrel length.

D. Hose and Streamer Connection:

1. Match sizes and type of thread with requirements of fire department.
2. Provide two hose nozzles and one pumper nozzle.

E. Finish:

1. Primer and two coats of enamel.
2. Color according to architect requirements.

2.05 POSITIVE DISPLACEMENT METERS

A. Manufacturers: Basis of Design

1. Ford.
2. Furnish materials according to NM APWA standards.

B. Description:

1. Comply with AWWA C700.
2. Type: Positive displacement disc.
3. Case Material: Bronze.
4. Bottom Cap:
   a. Material: Cast iron.
   b. Type: Frost-proof, breakaway.
5. Register: Hermetically sealed.
6. Remote Reading: Comply with AWWA C706.

C. Meter:

1. Description: Brass body turbine meter with magnetic drive register.
2. Service: Cold water, 122 degrees F.
3. Nominal Flow Rate: 200 gpm.
4. Pressure Drop at Nominal Flow: 5 psi.
5. Maximum Flow Rate: 300 gpm.
6. Maximum Operating Pressure: psig .
7. Accuracy: 2 percent.
8. Maximum Counter Reading: 10 M gal .
   a. Pipe Size: as indicated on the drawings.

2.06 VALVE BOXES

A. Manufacturers:

1. Furnish materials according to NM APWA standards.

B. Description:

1. Valve boxes and covers, including position indicators and valve extensions
2. Material: Cast iron.
3. Type: Extension, with slide adjustment.
4. Covers marked WATER SERVICE.

2.07 MATERIALS

A. Bedding and Cover:

1. Bedding: Fill Type A1, as specified in Section 31 05 16 - Aggregates for Earthwork
2. Cover: Fill Type A1, as specified in Section .
3. Soil Backfill from Above Pipe to Finish Grade:
   a. Soil Type S1, as specified in Section 31 05 13 - Soils for Earthwork.

2.08 ACCESSORIES

A. Concrete for Thrust Restraints: Concrete type as specified in Section 03 30 00 - Cast-in-Place Concrete.

B. Manhole and Cover: As specified in Section 33 05 13 - Manholes and Structures.

PART - 3 EXECUTION

3.01 EXAMINATION

A. Section 01 70 00 - Execution and Closeout Requirements: Requirements for installation examination.

B. Verify that building service connections and municipal utility water main sizes, locations, and elevations are as indicated on Drawings.

3.02 PREPARATION

A. Section 01 70 00 - Execution and Closeout Requirements: Requirements for installation preparation.

B. Cut pipe ends square, ream pipe and tube ends to full pipe diameter, and remove burrs.

C. Remove scale and dirt on inside and outside before assembly.

D. Prepare pipe connections to equipment with flanges or unions.

E. Protect and support existing distribution piping and appurtenances as Work progresses.

3.03 INSTALLATION

A. Bedding:

1. Excavate pipe trench as specified in Section 31 23 17 - Trenching.
2. Place bedding material at trench bottom.
3. Level fill materials in continuous layers not exceeding 6 inches compacted depth.
4. Compact to 95 percent of maximum density.
5. Backfill around sides and to top of pipe with cover fill, tamp in place, and compact to 95] percent of maximum density.
6. Maintain optimum moisture content of fill material to attain required compaction density.

B. Piping:

1. Maintain separation of water main from sewer] piping as indicated on the drawings.
2. Group piping with other Site piping work whenever practical.
3. Install pipe to elevations indicated on Drawings.
4. Install ductile iron piping and fittings according to AWWA C600.
5. Route pipe in straight line.
6. Install access fittings to permit disinfection of water system performed under Section 33 13 00 - Disinfecting of Water Utility Distribution.
7. Thrust Restraints:
    a. Form and place concrete for pipe thrust restraints at each elbow or change of pipe direction.
        1) Place concrete to permit full access to pipe and pipe accessories.
        2) Provide bearing area as indicated on Drawings.
8. Establish elevations of buried piping with not less than 4 feet of cover.
9. Pipe Markers:
    a. Install plastic ribbon tape continuous buried 6 inches below finish grade, above piping.
    b. Coordinate with trench Work as specified in Section 31 23 23 - Fill and 31 23 17 - Trenching.
10. Backfill trench as specified in Section 31 23 23 - Fill.
11. Installation Standards: Install Work according to NM APWA standards.

C. Valves and Hydrants:

1. Set valves on solid bearing.

2. Valve Box:

a. Center and plumb valve box overvalve.

b. Set box cover flush with finishedgrade.

3. Set hydrants plumb.

4. Locate pumper nozzle perpendicular to and facing roadway.

5. Set hydrants to grade, with nozzles at least 20 inches above ground.

6. Locate control valve 4 inches away from hydrant.

7. Provide drainage pit 36 inches square by 24 inches deep, filled with 2 inches washed gravel.

8. Encase elbow of hydrant in gravel to 6 inches above drain opening.

9. Do not connect drain opening to sewer.

10. Paint hydrants as specified in Section 09 90 00 - Painting and Coating.

11. Installation Standards: Install Work according to NM APWA standards.

D. Meters:

1. Install positive displacement meters according to AWWA M6 with isolating valves on inlet and outlet.

2. Installation Standards: Install Work according to NM APWA standards.

E. Service Connections:

1. Install water meter in vault located on Site as indicated on drawings.

F. Disinfection:

1. Flush and disinfect system as specified in Section 33 13 00 - Disinfecting of Water Utility Distribution.

3.04 TOLERANCES

A. Section 01 40 00 - Quality Requirements: Requirements for tolerances.

B. Install pipe within tolerance of 5/8 inch.

3.05 FIELD QUALITY CONTROL

A. Section 01 40 00 - Quality Requirements: Requirements for inspecting and testing.

B. Perform pressure test on domestic Site water distribution system according to AWWA C600.

C. Compaction Testing for Bedding: Comply with ASTM D1557.

D. When tests indicate Work does not meet specified requirements, remove Work, replace, and retest.

E. Frequency of Compaction Tests: as specified in NM APWA.

END OF SECTION 33 1116

SECTION 33 3300

LOW PRESSURE UTILITY SEWERAGE

PART - 1 GENERAL

1.01 SUMMARY

A. Section Includes:

1. Sanitary sewer low-pressure pipelines.
2. Service connections.
3. Bedding and cover materials.

B. Related Requirements:

1. Section 03 30 00 - Cast-in-Place Concrete: Concrete material requirements.
2. Section 31 05 13 - Soils for Earthwork: Soil backfill from above pipe to finish grade.
3. Section 31 23 17 - Trenching: Excavation, backfilling, compacting, and fill.
4. Section 31 23 23 - Fill: Requirements for fill.

1.02 REFERENCE STANDARDS

A. NM APWA

B. ASTM International:

1. ASTM D698 - Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/ft3 (600 kN-m/m3)).
2. ASTM D1557 - Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbf/ft3 (2,700 kN-m/m3)).
3. ASTM D1785 - Standard Specification for Poly(Vinyl Chloride) (PVC) Plastic Pipe, Schedules 40, 80, and 120.
4. ASTM D2466 - Standard Specification for Poly(Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 40.
5. ASTM D2564 - Standard Specification for Solvent Cements for Poly(Vinyl Chloride) (PVC) Plastic Piping Systems.
6. ASTM D6938 - Standard Test Method for In-Place Density and Water Content of Soil and Soil-Aggregate by Nuclear Methods (Shallow Depth).
7. ASTM F477 - Standard Specification for Elastomeric Seals (Gaskets) for Joining Plastic Pipe.

1.03 COORDINATION

A. Section 01 30 00 - Administrative Requirements: Requirements for coordination.

1.04 PREINSTALLATION MEETINGS

A. Section 01 30 00 - Administrative Requirements: Requirements for preinstallation meeting.

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

1.05 SUBMITTALS

A. Section 01 33 00 - Submittal Procedures: Requirements for submittals.

B. Product Data: Submit manufacturer information indicating pipe material used, and pipe accessories.

C. Manufacturer's Certificate: Certify that products meet or exceed specified requirements.

D. Manufacturer Instructions: Indicate special procedures required to install specified products.

E. Field Quality-Control Submittals: Indicate results of Contractor-furnished tests and inspections.

1.06 CLOSEOUT SUBMITTALS

A. Section 01 70 00 - Execution and Closeout Requirements: Requirements for submittals.

B. Project Record Documents: Record invert elevations and actual locations of pipe runs, connections.

C. Identify and describe unexpected variations to subsoil conditions, or discovery of uncharted utilities.

1.07 QUALITY ASSURANCE

A. Perform Work according to NM APWA standards.

B. Maintain 1 copy of each standard affecting Work of this Section on Site.

1.08 DELIVERY, STORAGE, AND HANDLING

A. Section 01 60 00 - Product Requirements: Requirements for transporting, handling, storing, and protecting products.

B. Inspection: Accept materials on Site in manufacturer's original packaging and inspect for damage.

C. Storage:

1. Store materials according to manufacturer instructions.
2. Do not store materials on private property without written permission of property owner.
3. Do not stack pipe higher than recommended by pipe manufacturer.

D. Protection:

1. Protect materials from moisture and dust by storing in clean, dry location remote from construction operations areas.
2. Provide additional protection according to manufacturer instructions.

PART - 2 PRODUCTS

2.01 LOW-PRESSURE SEWER PIPING

A. Pipe: Comply with ASTM D2241, SDR21.
B. Flexible Elastomeric Seals: Comply with ASTM D3139.
C. Seal Material:
   1. Elastomeric joints.
   2. Comply with ASTM F477.
   3.
D. Fittings:
   1. Type: Socket.
   2. Schedule 40.
   3. Comply with ASTM D2466.
E. Solvent Cement: Comply with ASTM D2564.

2.02 MATERIALS

A. Bedding and Cover:
B. Bedding: Fill Type A1.
C. Cover: Fill Type A1, as specified in Section 31 05 16 - Aggregates for Earthwork.
D. Soil Backfill from above Pipe to Finish Grade:
   1. Soil Type S1, as specified in Section 31 05 13 Soils for Earthwork.
   2. Subsoil: No rocks more than 6 inches in diameter, frozen earth, or foreign matter.
E. Concrete: As specified in Section 03 30 00 - Cast-in-Place Concrete.

PART - 3 EXECUTION

3.01 EXAMINATION

A. Section 01 70 00 - Execution and Closeout Requirements: Requirements for installation examination.
B. Verify that excavation base is ready to receive Work.
C. Verify that excavations, dimensions, and elevations are as indicated on Drawings.

3.02 PREPARATION

A. Section 01 70 00 - Execution and Closeout Requirements: Requirements for installation preparation.
B. Correct over-excavation with fine aggregate.
C. Remove large stones or other hard matter that could damage pipe or impede consistent backfilling or compaction.
D. Protect pipe and aggregate cover from damage or displacement until backfilling operation is in progress.

3.03 INSTALLATION

A. Bedding:

1. Excavate pipe trench as specified in Section 31 23 17 - Trenching.
2. Place bedding material at trench bottom.
3. Level materials in continuous layer not exceeding 6 inches.
4. Maintain optimum moisture content of bedding material to attain required compaction density.

B. Piping:

1. Install pipe, fittings, and accessories according to ASTM D2321, and seal joints watertight.
2. Lay pipe to slope gradients indicated on Drawings.
3. Maximum Variation from Indicated Slope: 1/8 inch in 10 feet.
4. Install bedding at sides and over top of pipe to minimum compacted thickness of 12 inches.
5. Backfilling and Compacting:
   a. As specified in Section 31 23 17 - Trenching.
   b. Do not displace or damage pipe while compacting.
6. Pipe Markers: As specified in Section 33 05 26 - Utility Identification.

3.04 FIELD QUALITY CONTROL

A. Section 01 40 00 - Quality Requirements: Requirements for inspecting and testing.

B. Inspection: Request inspection prior to and immediately after placement of bedding.

C. Testing:

1. If tests indicate that Work does not meet specified requirements, remove Work, replace, and retest.
2. Perform tests on low-pressure sanitary sewerage system according to of NM APWA standards.
3. Piping Testing:
   a. Pressure Test: As specified in Section 33 01 30.13 - Sewer and Manhole Testing.
   b. Infiltration Test: As specified in Section 33 01 30.13 - Sewer and Manhole Testing.
   c. Deflection Test: As specified in Section 33 01 30.13 - Sewer and Manhole Testing.
4. Compaction Testing:
   a. Comply with ASTM D1557.
   b. Testing Frequency: as specified in NM APWA Standard.

END OF SECTION 33 3300

SECTION 33 3613

UTILITY SEPTIC TANK

PART - 1 GENERAL

1.01 SUMMARY

A. Section Includes: Septic tanks and effluent wet wells.

B. Related Requirements:

1. Section 31 05 16 - Aggregates for Earthwork: Bedding materials.
2. Section 31 23 16 - Excavation: Excavation requirements for septic tanks.
3. Section 33 36 16 - Utility Septic Tank Effluent Pumps: Effluent pumps for use in STEP systems.

1.02 REFERENCE STANDARDS

A. American Association of State Highway and Transportation Officials:

1. AASHTO T180 - Standard Method of Test for Moisture-Density Relations of Soils Using a 4.54-kg (10-lb) Rammer and a 457-mm (18-in.) Drop.

B. ASTM International:

1. ASTM A615 - Standard Specification for Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement.
2. ASTM A1064 - Standard Specification for Carbon-Steel Wire and Welded Wire Reinforcement, Plain and Deformed, for Concrete.
3. ASTM C33 - Standard Specification for Concrete Aggregates.
4. ASTM C150 - Standard Specification for Portland Cement.
5. ASTM C260 - Standard Specification for Air-Entraining Admixtures for Concrete.
6. ASTM C890 - Standard Practice for Minimum Structural Design Loading for Monolithic or Sectional Precast Concrete Water and Wastewater Structures.
7. ASTM C913 - Standard Specification for Precast Concrete Water and Wastewater Structures.
8. ASTM C990 - Standard Specification for Joints for Concrete Pipe, Manholes, and Precast Box Sections Using Preformed Flexible Joint Sealants.
9. ASTM D698 - Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Standard Effort 12,400 ft-lbf/ft3 (600 kN-m/m3).
10. ASTM D1557 - Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Modified Effort 56,000 ft-lbf/ft3 (2,700 kN-m/m3).
11. ASTM D6938 - Standard Test Method for In-Place Density and Water Content of Soil and Soil-Aggregate by Nuclear Methods (Shallow Depth).

1.03 PREINSTALLATION MEETINGS

A. Section 01 30 00 - Administrative Requirements: Requirements for preinstallation meeting.

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

1.04 SUBMITTALS

A. Section 01 33 00 - Submittal Procedures: Requirements for submittals.

B. Product Data: Submit manufacturer information on tank.

C. Shop Drawings: Indicate plan, location, and inverts of connecting piping.

D. Manufacturer's Certificate: Certify that products meet or exceed specified requirements.

E. Manufacturer Instructions: Submit special procedures for septic tank and effluent wet well installation.

1.05 CLOSEOUT SUBMITTALS

A. Section 01 70 00 - Execution and Closeout Requirements: Requirements for submittals.

B. Project Record Documents: Record actual locations and inverts of buried pipe, components, and connections.

C. Identify and describe unexpected variations to subsoil conditions or discovery of uncharted utilities.

1.06 QUALITY ASSURANCE

A. Perform Work according to NM APWA standards.

B. Maintain 1 copy of each standard affecting Work of this Section on Site.

1.07 QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing products specified in this Section with minimum three years' documented experience.

1.08 DELIVERY, STORAGE AND HANDLING

A. Section 01 60 00 - Product Requirements: Requirements for transporting, handling, storing, and protecting products.

B. Inspection: Accept materials on Site in manufacturer's original packaging and inspect for damage.

C. Transport and handle precast concrete units with equipment designed to protect units from damage.

D. Store materials according to manufacturer instructions.

E. Protection:

1. Do not place concrete units in position that causes overstress, warp, or twist.

2. Provide additional protection according to manufacturer instructions.

PART - 2 PRODUCTS

2.01 SEPTIC TANKS AND EFFLUENT WET WELLS

A. Performance and Design Criteria:

1. Precast Structures:

a. Material: Reinforced and air-entrained concrete, watertight.

b. Design: Comply with ASTM C890 live loading and installation conditions.

c. Manufacturing: Comply with ASTM C913.

2. Minimum 28-Day Compressive Strength: 5,000 psi.

3. Honeycombed or retempered concrete will not be accepted.

B. Materials:

1. Portland Cement: Comply with ASTM C150, Type II.

2. Coarse Aggregates:

a. Comply with ASTM C33.

b. Grading: 1 inch o No. 4 sieve.

3. Sand:

a. Comply with ASTM C33.

b. Fineness Modulus: 2.35.

4. Water:

a. Potable.

b. Clean and free of injurious amounts of acids, alkalis, salts, organic materials, and substances incompatible with concrete or steel.

5. Air-Entraining Admixtures: Comply with ASTM C260 .

6. Reinforcing Steel:

a. Deformed Bars: Comply with ASTM A615, Grade 40.

b. Welded Wire Fabric: Comply with ASTM A1064.

7. Joint Sealant: Comply with ASTM C990 .

2.02 MATERIALS

A. Bedding:

1. Aggregate Material: Fill Type A1 as specified in Section 31 05 16 - Aggregates for Earthwork.

2.03 FABRICATION

A. Comply with ASTM C913.

B. Fabricate precast reinforced concrete structures to dimensions as indicated on Drawings and to specified design criteria.

PART - 3 EXECUTION

3.01 EXAMINATION

A. Section 01 70 00 - Execution and Closeout Requirements: Requirements for installation examination.

B. Verify that building sanitary sewer connection, size, location, and invert are as indicated on Drawings.

3.02 PREPARATION

A. Section 01 70 00 - Execution and Closeout Requirements: Requirements for installation preparation.

B. Conduct operations as not to interfere with, interrupt, damage, destroy, or endanger integrity of surface or subsurface structures, utilities, and landscape in immediate or adjacentareas.

C. Ream pipe ends and remove burrs.

D. Remove scale and dirt from components before assembly.

E. Establish invert elevations for each component in system.

F. Remove stones, roots, and other obstructions.

3.03 INSTALLATION

A. Tank and Bedding:

1. Excavate as specified in Section 31 23 16 - Excavation.

2. Hand trim excavation for accurate placement of tank to indicated elevations.

3. Place bedding material level and in continuous layers not exceeding 6 inches of compacted depth.

4. Compact to 95 percent maximum density.

5. Backfill around sides of tank, tamp in place and compact to 95 percent maximum density.

6. Maintain optimum moisture content of bedding material to attain required compaction density.

7. Install septic tank, distribution box, and related components on bedding.

B. Interconnecting Piping:

1. Connect inlet and outlet sanitary piping.

3.04 FIELD QUALITY CONTROL

A. Section 01 40 00 - Quality Requirements: Requirements for inspecting and testing.

B. Request inspection by Architect/Engineer prior to placing cover over piping.

C. Compaction Testing:

1. Comply with ASTM D1557.
2. If tests indicate Work does not meet specified requirements, remove Work, replace, and retest.
3. Testing Frequency: as specified in NM APWA.

END OF SECTION 33 3613

SECTION 33 4213.13

PUBLIC PIPE CULVERTS

PART - 1 GENERAL

1.01 SUMMARY

1. Section Includes: Pipe culverts and accessories.
2. Drainage structures.
3. Bedding and cover materials.
4. Pipe supports and anchoring.
5. Pile support systems.
6. Concrete encasement and cradles.
7. Slope protection at pipe end.

B. Related Requirements:

1. Section 03 20 00 - Concrete Reinforcing: Reinforcement of concrete cradles.
2. Section 03 30 00 - Cast-in-Place Concrete: Concrete grout fill to adjacent construction.
3. Section 31 05 16 - Aggregates for Earthwork: Aggregate for backfill in trenches.
4. Section 31 23 16 - Excavation 31 23 17 - Trenching: Excavating for culvert piping.
5. Section 31 23 17 - Trenching 31 23 23 - Fill: Backfilling over piping.
6. Section 31 32 14 - Cement Soil Stabilization: Soil-cement material blend for fill at pipe ends.
7. Section 31 37 00 - Riprap: Fill at pipe ends.
8. Section 33 05 13.16 - Public Manholes and Structures: Material requirements for drainage structures.

1.02 REFERENCE STANDARDS

A. NM APWA

1.03 COORDINATION

A. Section 01 30 00 - Administrative Requirements: Requirements for coordination.

B. Coordinate Work of this Section with termination of storm sewer and trenching.

1.04 PREINSTALLATION MEETINGS

A. Section 01 30 00 - Administrative Requirements: Requirements for preinstallation meeting.

B. Convene minimum one week prior to commencing Work of this section.

1.05 SUBMITTALS

A. Section 01 33 00 - Submittal Procedures: Requirements for submittals.

B. Product Data: Submit manufacturer information regarding pipe, fittings, and accessories.

C. Manufacturer's Certificate: Certify that products meet or exceed specified requirements.

1.06 CLOSEOUT SUBMITTALS

A. Section 01 70 00 - Execution and Closeout Requirements: Requirements for submittals.

B. Identify and describe unexpected variations to subsoil conditions or discovery of uncharted utilities.

1.07 QUALITY ASSURANCE

A. Perform Work according to NM APWA standards.

B. Maintain 1 copy of each standard affecting Work of this Section on Site.

1.08 QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing products specified in this Section with minimum three years' documented experience.

1.09 DELIVERY, STORAGE, AND HANDLING

A. Section 01 60 00 - Product Requirements: Requirements for transporting, handling, storing, and protecting products.

B. Inspection: Accept materials on Site in manufacturer's original packaging and inspect for damage.

C. Storage:

1. Do not place pipe or pipe materials on private property or in areas obstructing pedestrian or vehicle traffic.

2. Do not place pipe flat on ground.

3. Store UV-sensitive materials out of direct sunlight.

D. Protection:

1. Protect materials from moisture and dust by storing in clean, dry location remote from construction operations areas.

2. Block individual and stockpiled pipe lengths to prevent moving.

3. Cradle pipe to prevent point stress.

4. Provide additional protection according to manufacturer instructions.

1.10 EXISTING CONDITIONS

A. Field Measurements:

1. Verify field measurements prior to fabrication.

2. Indicate field measurements on Shop Drawings.

PART - 2 PRODUCTS

2.01 PIPE CULVERT & STORM DRAIN

A. Pipe

1. Furnish materials according to NM APWA standards.
2. Comply with NM APWA, Class I, with Wall Type A.
3. Reinforcement: Mesh.
4. End Joints: Bell and spigot.
5. Shape: Circular with nominal diameter of as indicated on

B. Corrugated HDPE

1. Furnish materials according to NM APWA standards.

2.02 DRAINAGE STRUCTURES

A. Description: As specified in Section 33 05 13.16 - Public Manholes and Structures.

B. Materials: Precast concrete.

C. Manholes:

1. Size: 48 inches in diameter.
2. Eccentric conical top.
3. Covers: Water tight.

D. Inlets:

1. Size: as indicated on drawings.
2. Grating:
   a. Cast iron.

2.03 MATERIALS

A. Bedding and Cover:
1. Bedding: Fill Type A1, as specified in Section 31 05 16 - Aggregates for Earthwork.
2. Cover: Fill Type A1, as specified in Section 31 05 16 - Aggregates for Earthwork.

2.04 FINISHES

A. Steel:
1. Galvanizing:
   a. Comply with ASTM A123 (A123M).
   b. Hot-dip galvanize after fabrication.

2.05 ACCESSORIES

A. Pipe Support Brackets: Galvanized and Unfinished structural steel coated with bituminouspaint.

B. Geotextile Filter Fabric:

1. Comply with AASHTO M288 for subsurface drainage.

2. Class A, non-biodegradable.

3. Woven.

PART - 3 EXECUTION

3.01 EXAMINATION

A. Section 01 70 00 - Execution and Closeout Requirements: Requirements for installation examination.

B. Verify that excavation base is ready to receive Work.

C. Verify that excavations, dimensions, and elevations are as indicated on Drawings.

3.02 PREPARATION

A. Section 01 70 00 - Execution and Closeout Requirements: Requirements for installation preparation.

B. Correct over-excavation with fine aggregate.

C. Remove large stones and other hard matter that could damage piping or impede consistent backfilling or compaction.

3.03 INSTALLATION

A. Excavation and Bedding:

1. Excavate culvert trench to 12 inches below pipe invert, and as specified in Section 31 23 17 - Trenching.

2. Hand trim excavation for accurate placement of piping to indicated elevations.

3. Place bedding material at trench bottom.

4. Level fill materials in continuous layers not exceeding 6 inches in depth, and compact to 95 percent maximum density.

B. Culvert & Storm Drain:

1. Positioning:

a. Lift or roll culvert into position; do not drop or drag culvert over preparedbedding.

b. Shore culvert to required position, and retain in place until after compaction of adjacent fills.

c. Ensure that pipe remains in correct position and to required slope.

d. Cradle bottom 20 percent of pipe diameter to avoid point load.

2. Backfilling and Compaction:

a. As specified in Section 31 23 23 - Fill.

b. Level fill materials in continuous layers not exceeding 6 inches in depth, and compact to 95 percent maximum density.

c. Do not displace or damage pipe while compacting.

d. Install cover at sides and over top of pipe.

e. Install cover to minimum compacted thickness of 12 inches and compact to 95 percent maximum density.

f. Maintain optimum moisture content of bedding material to attain required compaction density.

g. Place geotextile fabric over backfill as indicated on Drawings.

3. Install culvert end gratings.

C. Pipe Ends:

1. Place fill at pipe ends, and at embankment slopes, at concrete aprons.

2. Level fill materials in continuous layers not exceeding 6 inches in depth, and compact to 95 percent maximum density.

3.04 TOLERANCES

A. Section 01 40 00 - Quality Requirements: Requirements for tolerances.

B. Maximum Variation from Indicated Slope:1/8 inch

C. Maximum Variation from Intended Elevation of Invert: ½ inch .

D. Maximum Offset of Pipe from Indicated Alignment: 1 inch .

E. Maximum Variation in Profile of Structure from Intended Position: 1.0 percent.

3.05 FIELD QUALITY CONTROL

A. Section 01 40 00 - Quality Requirements: Requirements for inspecting and testing.

B. Section 01 70 00 - Execution and Closeout Requirements: Requirements for testing, adjusting, and balancing.

C. Request inspection from Architect/Engineer prior to and immediately after placing aggregate cover over pipe.

D. Compaction Testing:

1. Comply with ASTM D1557.

2. If tests indicate that Work does not meet specified requirements, remove Work, replace, and retest.

3. Testing Frequency: as specified in NM APWA.

3.06 PROTECTION

A. Section 01 70 00 - Execution and Closeout Requirements: Requirements for protecting installed construction.

B. Protect pipe and bedding from damage or displacement until backfilling operation is inprogress.

***END OF SECTION 33 4213.13**