

Project Manual for Twin Falls Training Facility at Twin Falls, Idaho

Issue Date:

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Architect: **Pivot North architecture**

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Seal:

Owner: **City of Twin Falls**

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(208) 735-7231

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Architect's Project No.:

19-029

Set No.:

XXX

100% CONSTRUCTION SET

pivot north
ARCHITECTURE

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SECTION 01 1000 - SUMMARY

PART 1 - GENERAL

1.01 PROJECT

- A. Project Name: Twin Falls Training Facility
- B. Owner's Name: City of Twin Falls.
 - 1. Address: 203 Main Ave. E.
 - 2. Twin Falls, ID 83301
 - 3. Owner's Contact: Les Kenworthy, lkenworthy@tfid.org
- C. Architect's Name: Pivot North Architecture.
 - 1. Address: 116 S. 6th Street
 - 2. Boise, Idaho 83702
 - 3. Architect's Representative: Clint Sievers, clint@pivotnorthdesign.com
- D. Consultant Group:
 - 1. Civil Engineer: The Land Group, Inc; Eric Cronin, eric@thelandgroup.com
 - 2. Structural Engineer: KPFF; Judd Williams, judsen.Williams@kpff.com
 - 3. Mechanical Engineer: Cator Ruma & Associates; Jeff Jesse, JJesse@catorruma.com
 - 4. Electrical Engineer: Cator Ruma & Associates; Kyle Olson, KOlson@catorruma.com
- E. Contractor's Name: Starr Corporation
 - 1. Address: 2995 E 3600 N
 - 2. Twin Falls, ID 83301
 - 3. Contractor's Contact: Michael Arrington, michaela@starrcorporation.com
- F. Additional Project contact information is indicated on the Drawing Title Sheet.
- G. The Project consists of the construction of site work, general trades, plumbing, HVAC, Electrical and Fire Protection utilizing a Pre-engineered Metal Building.
 - 1. Interior program will be constructed in two phases:
 - a. Phase I will have two apparatus bays, mezzanine, kitchenette and office space and supporting utilitarian spaces.
 - b. Phase II program has not yet been designed but is planned as a B occupancy.

1.02 DESCRIPTION OF WORK

- A. Scope of work is as shown on Drawings and as specified in the Project Manual.
- B. Contractor shall request, schedule, and coordinate all utility installation and extensions.
- C. The contractor shall obtain and pay for permits, fees, or bonds required by the City of Twin Falls, County, Districts, or State, except those that are stated to be paid by the Owner.

- D. All City Plan review fees will be paid by the Owner.
- E. The Owner will pay for the plan check fee and building permit fee at the time when the Contractor picks up the building permit.

1.03 OWNER OCCUPANCY

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

1.04 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. Arrange use of site and premises to allow:
 - 1. Owner's right to retain other contractors on portions of the site.
 - 2. Work by Owner and storage, protection and installing Owner-Furnished products.
 - 3. Use of site and premises by each contractor for construction operations during the construction period.
- C. Provide access to and from site as required by law and by Owner:
 - 1. Emergency Building Exits During Construction: Keep all exits required by code open during construction period; provide temporary exit signs if exit routes are temporarily altered.
 - 2. Do not obstruct roadways, sidewalks, or other public ways without permit.
- D. Time Restrictions:
 - 1. Limit conduct of especially noisy exterior work to hours approved by Owner.
- E. Utility Outages and Shutdown:
 - 1. Limit disruption of utility services to hours the adjacent buildings are unoccupied.
 - 2. Do not disrupt or shut down life safety systems, including but not limited to fire sprinklers and fire alarm system, without 7 days notice to Owner and authorities having jurisdiction.
 - 3. Prevent accidental disruption of utility services to other facilities.
- F. Nonsmoking Building: Smoking is not permitted within the new building or within 25 feet of any entrances, operable windows, or outdoor-air intakes.
- G. Controlled Substances: Use of alcohol, and other controlled substances on project site is not permitted.
- H. Firearms: Firearms on project site are not permitted.

- I. Contractors performing work are subject to federal and state laws regarding affirmative action, equal employment opportunity, sexual harassment, and sexual offenders.

1.05 WORK SEQUENCE

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

1.06 DEFERRED SUBMITTALS

- A. Deferred submittals are portions of the design that are not submitted at the time of the (permit) application and that are to be submitted to the building official at another date. These include the following:
 - 1. Fire Protection System.
 - 2. Pre-Engineered Building System.

PART 2 - PRODUCTS - NOT USED

PART 3 - EXECUTION - NOT USED

END OF SECTION 01 1000

SECTION 01 2000 - PRICE AND PAYMENT PROCEDURES

PART 1 - GENERAL

1.01 SECTION INCLUDES

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

1.02 RELATED REQUIREMENTS

- A. Agreement Between Owner and Construction Manager/General Contractor: Contract Sum, retainages, percentage allowances for overhead and profit, and payment period.
- B. General Conditions and Supplementary Conditions: Additional requirements for progress payments, final payment, changes in the Work.
- C. Section 01 6000 - Product Requirements: Administrative procedures for handling requests for substitutions made before and after the Contract award.

1.03 SCHEDULE OF VALUES

- A. Coordinate preparation of schedule of values with preparation of Contractor's construction schedule.
 - 1. Coordinate line items in the schedule of values with other required administrative forms and schedules, including the following:
 - a. Application for Payment forms with Continuation Sheets.
 - b. Submittal Schedule.
 - c. Contractor's Construction Schedule.
 - 2. Submit the Schedule of Values to the Architect and Construction Manager at earliest possible date, but no later than 2 days before the first submittal of Application for Payment.
 - 3. When the Schedule of Values is approved by the Architect and Construction Manager it will be the basis for future Contractor Applications for Payments. The Contractor will not be entitled to payment until receipt and acceptance of the Schedule of Values.
- B. Format and Content: The Schedule of Values to be submitted on the form acceptable to Owner and Architect. Include project, Architect and Contractor identification.

1. Use Project Manual Table of Contents as a guide to establish line items. Provide at least one line item for each Specification Section.
2. Provide a breakdown of the Contract Sum in enough detail to facilitate continued evaluation of Applications for Payment and progress reports. Provide multiple line items for principal subcontract amounts in excess of five percent of the Contract Sum.
 - a. Include separate line items under Contractor and principal subcontractors for Project closeout requirements in an amount totaling five percent of the Contract sum and subcontract amount.
3. Round amounts to nearest whole dollar; total shall equal the Contract Sum.
4. Provide a separate line item in the schedule of values for each part of the Work where Applications for Payment may include materials or equipment purchased or fabricated and stored, but not yet installed.
 - a. Differentiate between items stored on-site and items stored off-site. If required include evidence of insurance.
5. Provide separate line items in the schedule of values for initial cost of materials, for each subsequent stage of completion, and for total installed value of that part of the Work.
6. Purchase Contracts: Provide a separate line item in the schedule of values for each purchase contract. Show line-item value of purchase contract. Indicated Owner payments or deposits, if any, and balance to be paid by Contractor.
7. Each item in the schedule of values and Applications for Payment to be complete. Include total cost and proportionate share of general overhead and profit for each item.
 - a. Temporary facilities and other major cost items that are not direct cost of actual work-in-place may be shown either as separate line items in the schedule of values or distributed as general overhead expense, at Contractor's option.
8. Schedule Updating: Update and resubmit the Schedule of Values before the next Applications for Payment when Change Orders or Construction Change Directives result in a change in the Contract Sum.

1.04 APPLICATIONS FOR PROGRESS PAYMENTS

- A. Payment Period: The date for each progress payment is indicated in the Agreement Between Owner and CM/GC. The period of construction work covered by each Application for Payment is the period indicated in the Agreement.
- B. Forms to be used: Use AIA Documents G702 and G703 as for for application of payment.
- C. Application Preparation: Complete every entry on form. Notarize and execute by a person authorized to sign legal documents on behalf of Contractor. Architect will return incomplete applications without notice.
 1. Entries to match data on the approved Schedule of Values and Contractor's Construction Schedule. Use updated schedules if revisions were made.
 2. Include amounts of work completed following previous Application for Payment, whether or not payment has been received. Include only amounts for work completed at time of Application for Payment.
 3. Include amounts of Change Orders and Construction Change Directives issued before last day of construction period covered by application.

4. Indicated separate amounts for work being carried out under Owner-request project acceleration.
- D. Stored Materials: Include in Application for Payment amounts applied for materials or equipment purchased or fabricated and stored, but not yet installed. Differentiate between items stored on-site and items stored off-site.
1. Provide certificate of insurance, evidence of transfer of title to Owner, and consent of surety to payment, for stored materials.
 2. Provide supporting documentation that verifies amount requested, such as paid invoices. Match amount requested with amounts indicated on documentation; do not include overhead and profit on stored materials.
 3. Provide summary documentation for stored materials indicating the following:
 - a. Value of materials previously stored and remaining stored as of date of previous Applications for Payment.
 - b. Value of previously stored materials put in place after date of previous Application for Payment and on or before date of current Application for Payment.
 - c. Value of materials stored since date of previous Application for Payment and remaining stored as of date of current Application for Payment.
- E. Submit number as required by City of Twin Falls, signed and notarized original copies of each Application for Payment to the Architect. One copy shall include waivers of lien and similar attachments as required.
1. Include the following with the application:
 - a. Transmittal letter as specified for Submittals in Section 01 3000.
 - b. Construction progress schedule, revised and current as specified in Section 01 3216.
 - c. Current construction photographs specified in Section 01 3000.
 - d. Partial release of liens from major Subcontractors and vendors.
 - e. Subcontractor payment waivers.
 - f. Project record documents as specified in Section 01 7800, for review by Owner which will be returned to the Contractor.
 - g. Affidavits attesting to off-site stored products.
- F. Construction Progress Schedules: Provide schedule with each Application for Payment. Applications for Payment without schedule will not be processed. The Contractor will deliver this application and schedule to the Architect who will verify accuracy and amount completed. The Architect will then transmit application and schedule to the Owner for approval and payment.
- G. Initial Application for Payment: Administrative actions and submittals that must precede or coincide with submittal of first Application for Payment include the following:
1. List of subcontractors and Contractors staff assignments for project.
 2. Schedule of values.
 3. Contractor's construction schedule (preliminary if not final).
 4. Submittal schedule (preliminary if not final).
 5. Report of preconstruction conference.

6. Copies of building permits, authorizations and licenses from authorities having jurisdiction for performance of the Work.
7. Certificates of Insurance.
8. Performance and payment bonds.

H. Application for Payment at Substantial Completion: After Architect issues the Certificate of Substantial Completion, submit an Application for Payment showing 100 percent completion for portion of the Work claimed as substantially complete.

1. Include documentation supporting claim that the Work is substantially complete and a statement showing an accounting of changes to the Contract Sum.
2. This application shall reflect Certificate(s) of Substantial Completion issued previously for Owner occupancy of designated portions of the Work.

1.05 MINOR CHANGES IN THE WORK

A. Minor Changes in the Work: Architect will issue supplemental instructions authorizing minor changes in the Work, not involving adjustment to the Contract Sum or Contract Time, on Architect's Supplemental Instructions form.

1.06 MODIFICATION PROCEDURES

A. Construction Change Directive: For other required changes, Architect will issue a document signed by Owner instructing Contractor to proceed with the change, for subsequent inclusion in a Change Order.

1. The document will describe the required changes and will designate method of determining any change in Contract Sum or Contract Time.
2. Promptly execute the change.
3. Maintain detailed records on a time and material basis of work required. After completion of change, submit an itemized account and supporting data necessary to substantiate cost and time adjustments to the Contract.
4. Form: AIA G714 Construction Change Directive.

B. Owner-Initiated Proposal Requests: For changes for which advance pricing is desired, Architect will issue a document that includes a detailed description of a proposed change with supplementary or revised drawings and specifications, a change in Contract Time for executing the change. Contractor shall prepare and submit an estimated price quotation within 20 days.

1. Include a list of quantities of products required or eliminated and unit costs, with total amount of purchases and credits to be made. If requested, furnish survey data to substantiate quantities.
2. Indicate applicable taxes, delivery charges, equipment rental, and amounts of trade discounts.
3. Include costs of labor and supervision directly attributable to the change.
4. Include an updated Contractor's construction schedule or information that indicates the effect of the change, including, but not limited to, changes in activity duration, start and finish times, and activity relationship. Use available total float before requesting an extension of the Contract Time.
5. Form: Architects Work Changes Proposal Request.

- C. Contractor-Initiated Proposals: Contractor may propose a change by submitting a request for change to Architect, describing the proposed change and its full effect on the Work, with a statement describing the reason for the change, and the effect on the Contract Sum and Contract Time with full documentation and a statement describing the effect on Work by separate or other contractors. Document any requested substitutions in accordance with Section 01 6000.
 - 1. Include a list of quantities of products required or eliminated and unit costs, with total amount of purchases and credits to be made. If requested, furnish survey data to substantiate quantities.
 - 2. Indicate applicable taxes, delivery charges, equipment rental, and amounts of trade discounts.
 - 3. Include costs of labor and supervision directly attributable to the change.
 - 4. Include an updated Contractor's construction schedule that indicated the effect of the change, including, but not limited to, changes in activity duration, start and finish times, and activity relationship. Use available total float before requesting an extension of the Contract Time.
 - D. Computation of Change in Contract Amount: As specified in the Agreement and Conditions of the Contract.
 - E. Execution of Change Orders: On Owner's approval of a work change proposal request, Architect will issue Change Orders for signatures of parties as provided in the Conditions of the Contract, on AIA G701 Change Order or form acceptable to the Owner and Architect.
 - 1. Form: AIA G701 Change Order or use form acceptable to the Owner and Architect.
 - F. After execution of Change Order, promptly revise Schedule of Values and Application for Payment forms to record each authorized Change Order as a separate line item and adjust the Contract Sum.
 - G. Promptly revise progress schedules to reflect any change in Contract Time, revise sub-schedules to adjust times for other items of work affected by the change, and resubmit.
 - H. Promptly enter changes in Project Record Documents.
- 1.07 APPLICATION FOR FINAL PAYMENT
- A. Prepare Application for Final Payment after completing project closeout requirements and as specified for progress payments, identifying total adjusted Contract Sum, previous payments, and sum remaining due.
 - B. Application for Final Payment will not be considered until the following have been accomplished:
 - 1. All closeout procedures specified in Section 01 7000.
 - 2. Requirements from General Conditions have been met.
 - 3. Evidence has been provided that all claims have been settled.

4. Including but not limited to, AIA Document C706 – Contractor’s Affidavit of Payment of Debts and Claims, AIA G706A – Contractor’s Affidavit of Release of Liens, and AIA G707 – Consent of Surety to Final Payment.
5. Provide evidence that claims have been settled.
6. Final meter readings for utilities and similar data as of date of Substantial completion or when Owner took possession of and assumed responsibility for corresponding utilities or elements of work.
7. Final liquidated damages settlement statement.
8. Insurance and warranty certificates for products have been provided where required and proof of taxes, fees, and similar obligations have been paid.

PART 2 - PRODUCTS

NOT USED

PART 3 - EXECUTION

NOT USED

END OF SECTION 01 2000

SECTION 01 2500 – SUBSTITUTION PROCEDURES

PART 1 - GENERAL

1.01 SECTION INCLUDES

- A. Procedural requirements for proposed substitutions.

1.02 RELATED REQUIREMENTS

- A. Section 01 3000 – Administrative Requirements: Submittal procedures, coordination.
- B. Section 01 6000 – Product Requirements: Fundamental product requirements, product options, delivery, storage, and handling.

PART 2 - PRODUCTS

2.01 NOT USED

PART 3 - EXECUTION

3.01 GENERAL REQUIREMENTS

- A. Substitution Request for products, assemblies, materials, and equipment constitutes a representation that the submitter:
 - 1. Has investigated proposed product and determined that it meets or exceeds the quality level of the specified product, equipment, assembly, or system.
 - 2. Agrees to provide the same warranty for the substitution as for the specified product.
 - 3. Agrees to provide same or equivalent maintenance service and source of replacement parts, as applicable.
 - 4. Agrees to coordinate installation and make changes to other work that may be required for the work to be complete, with no additional cost to Owner.
 - 5. Waives claims for additional costs or time extension that may subsequently become apparent.
- B. Substitution Request for specified installer constitutes a representation that the submitter:
 - 1. Has acted in good faith to obtain services of specified installer, but was unable to come to commercial, or other terms.
- C. Document each request with complete data substantiating compliance of proposed substitution with Contract Documents. Burden of proof is on proposer.
 - 1. Note explicitly any non-compliant characteristics.

- D. Content: Include information necessary for tracking the status of each Substitution Request, and information necessary to provide an actionable response.
 - 1. Forms indicated in the Project Manual are adequate for this purpose, and must be used.
- E. Limit each request to a single proposed substitution item.
 - 1. Submit and electronic document, combining the request form with supporting data into single document.

3.02 SUBSTITUTION PROCEDURES DURING PROCUREMENT

- A. Instructions to Bidders specified time restrictions for submitting requests for substitutions during the bidding period, but no later than 15 days prior to bid date for adequate preparation and review of related submittal and the documents required.
- B. Submittal Form (before award of contract):
 - 1. Submit substitution requests by completing CSI/CSC Form 1.5C – Substitution Request (During the Bidding/Negotiating Stage). See this form for additional information and instructions. Use only this form; other forms of submission are unacceptable.

3.03 SUBSTITUTION PROCEDURES DURING CONSTRUCTION

- A. Submittal Form (after award of contract):
 - 1. Submit substitution requests by completing CSI/CSC Form 13.1A – Substitution Request. See this form for additional information and instructions. Use only this form; other forms of submission are unacceptable.
- B. Submit requests for Substitution for Cause within 14 days of discovery of need for substitution, but not later than 14 days prior to time required for review and approval by Architect, in order to stay on approved project schedule.
- C. Submit request for Substitution for Convenience immediately upon discovery of its potential advantage to the project, but not later than 14 days prior to time required for review and approval by Architect, in order to stay on approved project schedule.
 - 1. In addition to meeting general documentation requirements, document how the requested substitution benefits the Owner through cost savings, time savings, greater energy conservation, or in other specific ways.
 - 2. Document means of coordinating of substitution item with other portions of the work, including work by affected subcontractors.
 - 3. Bear the costs engendered by proposed substitution of:
 - a. Owner's compensation to the Architect for any required redesign, time spent processing and evaluating the request.
- D. Substitutions will not be considered under one or more of the following circumstances:
 - 1. When they are indicated or implied on shop drawing or product data submittals, without having received prior approval.
 - 2. Without a separate written request.

3.04 RESOLUTION

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

3.05 ACCEPTANCE

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

3.06 CLOSEOUT ACTIVITIES

- A. See Section 01 7800 – Closeout Submittals, for closeout submittals.
- B. Include completed Substitution Request Forms as part of the Project record.

END OF SECTION 01 2500



SUBSTITUTION REQUEST (After the Bidding Phase)

Project: _____ Substitution Request Number: _____

 From: _____
 To: _____ Date: _____
 Re: _____ A/E Project Number: _____
 Contract For: _____

Specification Title: _____ Description: _____
 Section: _____ Page: _____ Article/Paragraph: _____

Proposed Substitution: _____
 Manufacturer Address: _____ Phone: _____
 Trade Name: _____ Model No.: _____
 Installer: _____ Address: _____ Phone _____
 History: New product 2-5 years old 5-10 years old More than 10 years old
 Differences between proposed substitution and specified product: _____

X Point-by-point comparative data attached

Reason for not providing specified item: _____

Similar Installation:
 Project: _____ Architect: _____
 Address: _____ Owner: _____
 Date Installed: _____

Proposed substitution affects other parts of Work: X No Yes; explain _____

Savings to Owner for accepting substitution: _____ (\$ _____).

Proposed substitution changes Contract Time: No Yes [Add] [Deduct] _____ days.

Supporting Data Attached: Drawings Product Data Samples Tests Reports _____

SUBSTITUTION REQUEST (Continued)

The Undersigned certifies:

- Proposed substitution has been fully investigated and determined to be equal or superior in all respects to specified product.
- Same warranty will be furnished for proposed substitution as for specified product.
- Same maintenance service and source of replacement parts, as applicable, is available.
- Proposed substitution will have no adverse effect on other trades and will not affect or delay progress schedule.
- Cost data as stated above is complete. Claims for additional costs related to accepted substitution which may subsequently become apparent are to be waived.
- Proposed substitution does not affect dimensions and functional clearances.
- Payment will be made for changes to building design, including A/E design, detailing, and construction costs caused by the substitution.
- Coordination, installation, and changes in the Work as necessary for accepted substitution will be complete in all respects.

Submitted by: _____

Signed by: _____

Firm: _____

Address: _____

Telephone: _____

Attachments: _____

A/E's REVIEW AND ACTION

- Substitution approved - Make submittals in accordance with Specification Section 01330.
- Substitution approved as noted - Make submittals in accordance with Specification Section 01330.
- Substitution rejected - Use specified materials.
- Substitution Request received too late - Use specified materials.

Signed by:

Date:

Additional Comments: Contractor Subcontractor Supplier Manufacturer A/E _____



SUBSTITUTION REQUEST (During the Bidding Phase)

Project: _____ Substitution Request Number: _____

 From: _____
 To: _____ Date: _____

 Re: _____ A/E Project Number: _____
 _____ Contract For: _____

Specification Title: _____ Description: _____
 Section: _____ Page: _____ Article/Paragraph: _____

Proposed Substitution: _____
 Manufacturer: _____ Address: _____ Phone: _____
 Trade Name: _____ Model No.: _____

Attached data includes product description, specifications, drawings, photographs, and performance and test data adequate for evaluation of the request; applicable portions of the data are clearly identified.

Attached data also includes a description of changes to the Contract Documents that the proposed substitution will require for its proper installation.

The Undersigned certifies:

- Proposed substitution has been fully investigated and determined to be equal or superior in all respects to specified product.
- Same warranty will be furnished for proposed substitution as for specified product.
- Same maintenance service and source of replacement parts, as applicable, is available.
- Proposed substitution will have no adverse effect on other trades and will not affect or delay progress schedule.
- Proposed substitution does not affect dimensions and functional clearances.
- Payment will be made for changes to building design, including A/E design, detailing, and construction costs caused by the substitution.

Submitted by: _____
 Signed by: _____
 Firm: _____
 Address: _____
 Telephone: _____

A/E's REVIEW AND ACTION

- Substitution approved - Make submittals in accordance with Specification Section 01330.
- Substitution approved as noted - Make submittals in accordance with Specification Section 01330.
- Substitution rejected - Use specified materials.
- Substitution Request received too late - Use specified materials.

Signed by: _____ Date: _____

Supporting Data Attached: Drawings Product Data Samples Tests Reports _____

SECTION 01 3000 - ADMINISTRATIVE REQUIREMENTS

PART 1 - GENERAL

1.01 SECTION INCLUDES

- A. General coordination procedures.
- B. Electronic document submittals.
- C. Preconstruction meeting.
- D. Preinstallation meetings.
- E. Progress meetings.
- F. Project closeout meeting.
- G. Progress photographs.
- H. Coordination drawings.
- I. Requests for Information (RFIs).
- J. Submittals for review, information, and project closeout.
 - 1. General information only, refer to sections below for detailed submittal requirements.
 - a. Section 01 4000 - Quality Requirements.
 - b. Section 01 6000 - Product Requirements.
 - c. Section 01 7800 - Closeout Submittals.
 - d. Individual Project Sections.
- K. Number of copies of submittals.
- L. Submittal procedures.

1.02 RELATED REQUIREMENTS

- A. General Conditions and Supplementary Conditions: Dates for applications for payment and duties of the Construction Manager/General Contractor.
- B. Section 01 3216 - Construction Progress Schedule: Form, content, and administration of schedules.
- C. Section 01 7000 - Execution and Closeout Requirements: Additional coordination requirements.
- D. Section 01 7800 - Closeout Submittals: Project record documents.

1.03 GENERAL COORDINATION PROCEDURES

- A. Coordination: Coordinate construction operations included in different Sections of the Project Manual to ensure efficient and orderly installation of each part of the Work. Coordinate construction operations, with each contractor, included in different Sections that depend on each other for proper installation, connection, and operation.
 - 1. Schedule construction operations in sequence required to obtain the best results where installation of one part of the Work depends on installation of other components, before or after its own installation.
 - 2. Coordinate installation of different components to ensure maximum performance and accessibility for required maintenance, service, and repair.
 - 3. Make adequate provisions to accommodate items scheduled for later installation.

- B. Prepare memoranda for distribution to each party involved, outlining special procedures required for coordination. Include such items as required notices, reports, and list of attendees at meetings.
 - 1. Prepare similar memoranda for Owner and separate contractors if coordination of their Work is required.

- C. Administrative Procedures: Coordinate scheduling and timing of required administrative procedures with other construction activities to avoid conflicts and to ensure orderly progress of the Work. Such administrative activities include, but are not limited to, the following:
 - 1. Preparation of Contractor's construction schedule.
 - 2. Preparation of the schedule of values.
 - 3. Installation and removal of temporary facilities and controls.
 - 4. Delivery and processing of submittals.
 - 5. Progress meetings.
 - 6. Preinstallation conferences.
 - 7. Project closeout activities.
 - 8. Startup and adjustment of systems.

- D. General Contractor:
 - 1. Cooperate with the General Contractor in allocation of mobilization areas of site; for field offices and sheds, for traffic access, traffic, and parking facilities.
 - 2. During construction, coordinate use of site and facilities through the General Contractor.
 - 3. Comply with General Contractor's procedures for intra-project communications; submittals, reports and records, schedules, coordination drawings, and recommendations; and resolution of ambiguities and conflicts.
 - 4. Comply with instructions of the General Contractor for use of temporary utilities and construction facilities.
 - 5. Coordinate field engineering and layout work under instructions of the General Contractor.
 - 6. Make the following types of submittals to Architect through the General Contractor:
 - a. Requests for interpretation.
 - b. Requests for substitution.
 - c. Shop drawings, product data, and samples.

- d. Test and inspection reports.
 - e. Design data.
 - f. Manufacturer's instructions and field reports.
 - g. Applications for payment and change order requests.
 - h. Progress schedules.
 - i. Coordination drawings.
 - j. Correction Punch List and Final Correction Punch List for Substantial Completion.
 - k. Closeout submittals.
- E. Conservation: Coordinate construction activities to ensure that operations are carried out with consideration given to conservation of energy, water, and materials. Coordinate use of temporary utilities to minimize waste.

PART 2 - PRODUCTS

NOT USED

PART 3 - EXECUTION

3.01 ELECTRONIC DOCUMENT SUBMITTALS

- A. All documents transmitted for purposes of administration of the contract are to be in electronic (PDF) format and posted General Contractor provided Submittal Exchange, Procore, or Sharefile Site specifically established for Project.
- 1. Besides submittals for review, information, and closeout, this procedure applies to requests for information (RFIs), progress documentation, contract modification documents (e.g. supplementary instructions, change proposals, change orders), applications for payment, field reports and meeting minutes, Contractor's correction punchlist, and any other document any participant wishes to make part of the project record.
 - 2. It is Contractor's responsibility to submit documents in PDF format.
 - 3. Subcontractors, suppliers, and Architect and Architect's consultants will be permitted to use the service at no extra charge.
 - 4. Users need an email address, Internet access, and PDF review software that includes ability to mark up and apply electronic stamps (such as Adobe Acrobat, www.adobe.com, or Bluebeam PDF Revu, www.bluebeam.com).
 - 5. Paper document transmittals will not be reviewed.
 - 6. All other specified submittal and document transmission procedures apply, except that electronic document requirements do not apply to samples or color selection charts.

3.02 PRECONSTRUCTION MEETING

- A. General Contractor will schedule a meeting before starting construction, at a time convenient to Owner and Architect, but no later than 15 days after Notice to Proceed.

- B. Attendees:
 - 1. Authorized representatives of the Owner.
 - 2. Architect and their consultants.
 - 3. Construction Manager.
 - 4. General Contractor and it's superintendent.
 - 5. Major subcontractors and suppliers.
 - 6. Other concerned parties.
 - 7. Participants at the meeting to be familiar with Project and authorized to conclude matters relating to the Work.

- C. Agenda: Discuss items of significance that could affect progress, including the following:
 - 1. Tentative construction schedule.
 - 2. Phasing.
 - 3. Critical work sequencing and long-lead items.
 - 4. Designation of key personnel and their duties.
 - 5. Lines of communications.
 - 6. Procedures for processing field decisions and Change Orders.
 - 7. Procedures for RFIs.
 - 8. Procedures for testing and inspecting.
 - 9. Procedures for processing Applications for Payment.
 - 10. Distribution of the Contract Documents.
 - 11. Submittal procedures
 - 12. Preparation of record documents.
 - 13. Use of the premises and construction parking.
 - 14. Work restrictions.
 - 15. Working hours.
 - 16. Responsibility for temporary facilities and controls.
 - 17. Construction waste management and recycling.
 - 18. Office, work, and storage areas.
 - 19. First aid.
 - 20. Security.
 - 21. Progress cleaning

- D. Record minutes and distribute copies with three days after meeting to Architect, Owner, Construction Manager, participants, and those affected by decisions made.

3.03 PREINSTALLATION MEETINGS

- A. Conduct a preinstallation meeting at Project Site before each construction activity that requires coordination with other construction.
 - 1. Attendees:
 - a. Authorized representatives of the Owner.
 - b. Architect.
 - c. Special Consultants.
 - d. Construction Manager.
 - e. General Contractor's Superintendent.
 - f. Installers.

- g. Manufacturers and/or fabricators.
 - h. Others involved in or affected by the installation and its coordination or integration with other materials that preceded or will follow.
 - 2. Agenda: Review progress of other construction activities and preparations for the particular activity under consideration, including requirements for the following:
 - a. Contract Documents.
 - b. Options.
 - c. Related RFIs.
 - d. Related Change Orders.
 - e. Submittals.
 - f. Review of mockups.
 - g. Possible conflicts.
 - h. Compatibility requirements.
 - i. Time schedules.
 - j. Weather limitations.
 - k. Manufacturer's written instructions.
 - l. Warranty requirements.
 - m. Compatibility of materials.
 - n. Acceptability of substrates.
 - o. Temporary facilities and controls.
 - p. Space and access limitations.
 - q. Regulations of authorities having jurisdiction.
 - r. Testing and inspecting requirements.
 - s. Installation procedures.
 - t. Coordination with other work.
 - u. Required performance results.
 - v. Protection of adjacent work.
 - w. Protection of construction and personnel.
 - B. Record minutes and distribute copies with three days after meeting to Architect, Owner, Construction Manager, participants, and those affected by decisions made.
 - 1. Record significant conference discussions, agreements, and disagreements, including required corrective measures and actions.
 - 2. Do not proceed with installation if the meeting cannot be successfully concluded. Initiate whatever actions are necessary to resolve impediments to performance of the Work and reconvene the conference at earliest feasible date.
- 3.04 PROGRESS MEETINGS
- A. Schedule and administer meetings throughout progress of the Work at maximum weekly intervals. Coordinate dates of meetings with preparation of payment requests.
 - 1. General Contractor will make arrangements for meetings, prepare agenda with copies for participants, preside at meetings.
 - a. Distribute copies of the agenda and minutes to the Architect and Owner prior to each meeting.
 - B. Attendees:

1. Authorized representatives of the Owner.
2. Architect.
3. Special Consultants.
4. Construction Manager.
5. Contractor's Superintendent.
6. Installers.
7. Manufacturers and/or fabricators.
8. Entities concerned with current progress or involved in planning, coordination, or performance of future activities.
9. Participants at the meeting to be familiar with Project and authorized to conclude matters relating to the Work.

C. Agenda:

1. Review and correct or approve minutes of previous meetings.
2. Review of Work progress since last meeting. Determine whether each activity is on time, ahead of schedule, or behind schedule, in relation to Contractor's construction schedule. Determine how construction behind schedule will be expedited; secure commitments from parties involved to do so. Discuss whether schedule revisions are required to ensure that current and subsequent activities will be completed within the Contract Time.
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 and proposal requests.
7. Review of off-site fabrication and delivery schedules.
8. Maintenance of progress schedule.
9. Corrective measures to regain projected schedules.
10. Planned progress during succeeding work period.
11. Coordination of projected progress.
12. Maintenance of quality and work standards.
13. Effect of proposed changes on progress schedule and coordination.
14. Other business relating to Work.

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

1. Schedule Updating: Revise Contractor's construction schedule after each progress meeting where revisions to the schedule have been made or recognized. Issue revised schedule concurrently with the report of each meeting.

3.05 PROJECT CLOSEOUT MEETING

A. Schedule and conduct a project closeout meeting, at a time convenient to Owner and Architect, but no later than 90 days prior to the scheduled date of Substantial Completion.

1. Conduct the conference to review requirements and responsibilities related to Project closeout.

B. Attendees:

1. Authorized representatives of the Owner.
 2. Architect and their consultants.
 3. Construction Manager.
 4. General Contractor and it's superintendent.
 5. Major subcontractors and suppliers.
 6. Other concerned parties.
 7. Participants at the meeting to be familiar with Project and authorized to conclude matters relating to the Work.
- C. Agenda: Discuss items of significance that could affect or delay Project closeout, including the following:
1. Preparation of record documents.
 2. Procedures required prior to inspection for Substantial Completion and for final inspection for acceptance.
 3. Submittal of written warranties.
 4. Requirements for completing sustainable design documentation.
 5. Requirements for preparing operations and maintenance data.
 6. Requirements for delivery of material samples, attic stock, and spare parts.
 7. Requirements for demonstration and training.
 8. Preparation of Contractor's punch list.
 9. Procedures for processing Applications for Payment at Substantial Completion and for final payment.
 10. Submittal procedures.
 11. Owner's partial occupancy requirements.
 12. Installation of Owner's furniture, fixtures, and equipment.
 13. Responsibility for removing temporary facilities and controls.
- D. Record minutes and distribute copies with two days after meeting to Architect, Owner, Construction Manager, participants, and those affected by decisions made.
- 3.06 CONSTRUCTION PROGRESS SCHEDULE – SEE SECTION 01 3216.
- 3.07 PROGRESS PHOTOGRAPHS
- A. Submit photographs with each application for payment, taken not more than 3 days prior to submission of application for payment.
- B. Photography Type: Digital; electronic files.
- C. Provide photographs of site and construction throughout progress of Work produced by an experienced photographer, acceptable to Architect.
- D. In addition to periodic, recurring views, take photographs of each of the following events:
1. Completion of site clearing.
 2. Excavations in progress.
 3. Foundations in progress and upon completion.
 4. Structural framing in progress and upon completion.

5. Enclosure of building, upon completion.
6. Final completion, minimum of ten (10) photos.

E. Views:

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

F. Digital Photographs: 24 bit color, minimum resolution of 1024 by 768, in JPG format; provide files unaltered by photo editing software.

1. Delivery Medium: Via email.
2. File Naming: Include project identification, date and time of view, and view identification.
3. Point of View Sketch: Include digital copy of point of view sketch with each electronic submittal; include point of view identification in each photo file name.
4. PDF File: Assemble all photos into printable pages in PDF format, with 2 to 3 photos per page, each photo labeled with file name; one PDF file per submittal.

3.08 REPORTS

A. Daily Construction Reports: Prepare a daily construction report recording the following information concerning events at Project site:

1. List of subcontractors at Project site.
2. List of separate contractors at Project site.
3. Approximate count of personnel at Project site.
4. Equipment at Project site.
5. Material deliveries.
6. High and low temperatures and general weather conditions, including presence of rain or snow.
7. Accidents.
8. Meetings and significant decisions.
9. Unusual events (see special reports).
10. Stoppages, delays, shortages, and losses.
11. Meter readings and similar recordings.
12. Emergency procedures.
13. Orders and requests of authorities having jurisdiction.
14. Change Orders received and implemented.
15. Services connected and disconnected.
16. Equipment or system tests and startups.
17. Partial completions and occupancies.
18. Substantial Completions authorized.

3.09 COORDINATION DRAWINGS

- A. Coordination Drawings, General: Prepare coordination drawings according to requirements in individual Sections, and additionally where installation is not completely shown on Shop Drawings, where limited space availability necessitates coordination, or if coordination is required to facilitate integration of products and materials fabricated or installed by more than one entity.
1. Content: Project-specific information, drawn accurately to a scale large enough to indicate and resolve conflicts. Do not base coordination drawings on standard printed data. Include the following information, as applicable.
 - a. Use applicable Drawings as a basis for preparation of coordination drawings. Prepare sections, elevations, and details as needed to describe relationship of various systems and components.
 - b. Coordinate the addition of trade-specific information to the coordination drawings by multiple contractors in a sequence that best provides for coordination of the information and resolution of conflicts between installed components before submitting for review.
 - c. Indicate functional and spatial relationships of components of architectural, structural, civil, mechanical, and electrical systems.
 - d. Indicate space requirements for routine maintenance and for anticipated replacement of components during the life of the installation.
 - e. Show location and size of access doors required for access to concealed dampers, valves, and other controls.
 - f. Indicate required installation sequences.
 - g. Indicate dimensions shown on the Drawings. Specifically note dimensions that appear to be in conflict with submitted equipment and minimum clearance requirements. Provide alternate sketches to Architect indicating proposed resolution of such conflicts. Minor dimension changes and difficult installations will not be considered changes to the Contract.
- B. Coordination Drawing Organization: Organize coordination drawings as follows:
1. Floor Plans and Reflected Ceiling Plans: Show architectural and structural elements, and mechanical, plumbing, fire-protection, fire-alarm, and electrical Work. Show locations of visible ceiling-mounted devices relative to acoustical ceiling grid. Supplement plan drawings with section drawings where required to adequately represent the Work.
 2. Plenum Space: Indicate subframing for support of ceiling and wall systems, mechanical and electrical equipment, and related Work. Locate components within ceiling plenum to accommodate layout of light fixtures indicated on Drawings. Indicate areas of conflict between light fixtures and other components.
 3. Mechanical Rooms: Provide coordination drawings for mechanical rooms showing plans and elevations of mechanical, plumbing, fire-protection, fire-alarm, and electrical equipment.
 4. Structural Penetrations: Indicate penetrations and openings required for all disciplines.
 5. Slab Edge and Embedded Items: Indicate slab edge locations and sizes and locations of embedded items for metal fabrications, sleeves, anchor bolts, bearing plates, angles, door floor closers, slab depressions for floor finishes, curbs and housekeeping pads, and similar items.

6. Mechanical and Plumbing Work: Show the following:
 - a. Sizes and bottom elevations of ductwork, piping, and conduit runs, including insulation, bracing, flanges, and support systems.
 - b. Dimensions of major components, such as dampers, valves, diffusers, access doors, cleanouts and electrical distribution equipment.
 - c. Fire-rated enclosures around ductwork.
 7. Electrical Work: Show the following:
 - a. Runs of vertical and horizontal conduit 1-1/4 inches (32 mm) in diameter and larger.
 - b. Light fixture, exit light, emergency battery pack, smoke detector, and other fire-alarm locations.
 - c. Panel board, switch board, switchgear, transformer, busway, generator, and motor control center locations.
 - d. Location of pull boxes and junction boxes, dimensioned from column center lines.
 8. Fire-Protection System: Show the following:
 - a. Locations of standpipes, mains piping, branch lines, pipe drops, and sprinkler heads.
 9. Review: Architect will review coordination drawings to confirm that the Work is being coordinated, but not for the details of the coordination, which are Contractor's responsibility. If Architect determines that coordination drawings are not being prepared in sufficient scope or detail, or are otherwise deficient, Architect will inform Contractor, who shall make changes as directed and resubmit.
- C. Coordination Digital Data Files: Prepare coordination digital data files according to the following requirements:
1. File Preparation Format: Same digital data software program, version, and operating system as original Drawings.
 2. File Submittal Format: Submit or post coordination drawing files using Portable Data File (PDF) format.
 3. Architect will furnish contractor one set of digital data files of Drawings for use in preparing coordination digital data files.
 - a. Architect makes no representations as to the accuracy or completeness of digital data files as they relate to Drawings.
 - b. Contractor will execute a data licensing agreement in the form of AIA G201 or form provided by Architect.

3.10 REQUESTS FOR INFORMATION

- A. General: Immediately on discovery of the need for additional information or interpretation of the Contract Documents, Contractor shall prepare and submit an RFI in the form specified.
 1. Architect will return RFIs submitted to Architect by other entities controlled by Contractor with no response.
 2. Coordinate and submit RFIs in a prompt manner so as to avoid delays in Contractor's work or work of subcontractors.
- B. Content of the RFI: Include a detailed, legible description of item needing information or interpretation and the following:

1. RFI number, numbered sequentially.
 2. RFI subject.
 3. Specification Section number and title and related paragraphs, as appropriate.
 4. Drawing number and detail references, as appropriate.
 5. Field dimensions and conditions, as appropriate.
 6. Contractor's suggested resolution. If Contractor's suggested resolution impacts the Contract Time or the Contract Sum, Contractor shall state impact in the RFI.
 7. Attachments: Include sketches, descriptions, measurements, photos, Product Data, Shop Drawings, coordination drawings, and other information necessary to fully describe items needing interpretation.
- C. RFI Form: Form approved by Architect in PDF format.
- D. Architect's Action: Architect will review each RFI, determine action required, and respond. Allow seven working days for Architect's response for each RFI. RFIs received by Architect after 1:00 p.m. will be considered as received the following working day.
1. The following Contractor-generated RFIs will be returned without action:
 - a. Requests for approval of submittals.
 - b. Requests for approval of substitutions.
 - c. Requests for approval of Contractor's means and methods.
 - d. Requests for coordination information already indicated in the Contract Documents.
 - e. Requests for adjustments in the Contract Time or the Contract Sum.
 - f. Requests for interpretation of Architect's actions on submittals.
 - g. Incomplete RFIs or inaccurately prepared RFIs.
 2. Architect's action may include a request for additional information, in which case Architect's time for response will date from time of receipt of additional information.
 3. Architect's action on RFIs that may result in a change to the Contract Time or the Contract Sum may be eligible for Contractor to submit Change Proposal according to Section 01 2000 - Price and Payment Procedures.
 - a. If Contractor believes the RFI response warrants change in the Contract Time or the Contract Sum, notify Architect in writing within 10 days of receipt of RFI response.
- E. RFI Log: Prepare, maintain, and submit a tabular log of RFIs organized by the RFI number. Submit log weekly.
1. Form: Use CSI RFI Log Form 13.2B or form approved by Architect.
- F. On receipt of Architect's action, update the RFI log and immediately distribute the RFI response to affected parties. Review response and notify Architect with 7 days if Contractor disagrees with response.
1. Identification of related Minor Change in the Work, Construction Change Directive, and Proposal Request, as appropriate.

3.11 GENERAL INFORMATIONAL SUBMITTALS

- A. Subcontract List: Prepare a written summary identifying individuals or firms proposed for each portion of the Work, including those who are to furnish products or equipment fabricated to a special design.
 - 1. Form: Use CSI Subcontractors and Major Material Suppliers Form 1.5A or form approved by Architect.
- B. Key Personnel Names: Within 15 days of starting construction operations, submit a list of key personnel assignments, including superintendent and other personnel in attendance at Project site. Identify individuals and their duties and responsibilities; list addresses and telephone numbers, including home, office, and cellular telephone numbers and e-mail addresses. Provide names, addresses, and telephone numbers of individuals assigned as alternates in the absence of individuals assigned to Project.
 - 1. Post copies of list in project meeting room, in temporary field office, and by each temporary telephone. Keep list current at all times.

3.12 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. Contactor to review each submittal and check for coordination with other Work of the Contract and for compliance with the Contract Documents. Note corrections and field dimensions. **Mark with approval stamp before submitting to Architect.**
- C. Submit to Architect for review for the limited purpose of checking for general conformance with the design concept and the information given in the Construction Documents. Corrections or comments made on the submittal during this review do not relieve the Contractor from compliance with the requirements of the drawings and specifications. Review of a specific item shall not include review of an assembly of which the item is a component. The Contractor is responsible for quantities; dimensions to be confirmed and correlated at the jobsite; information that pertains solely to the fabrication processes or to the means, methods, techniques, sequences and procedures of construction; coordination of the Work with that of all other trades and performing all Work in a safe and satisfactory manner. Architect will stamp each submittal with an action stamp and will mark stamp appropriately to indicated action.
- D. Samples will be reviewed only for aesthetic, color, or finish selection.
- E. 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.

3.13 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. Contactor to review each submittal and check for coordination with other Work of the Contract and for compliance with the Contract Documents. Note corrections and field dimensions. **Mark with approval stamp before submitting to Architect.**
- C. Submit for Architect's knowledge as contract administrator or for Owner. No action will be taken.

3.14 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:
 - 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.

3.15 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.
 - 1. Post PDF files directly to Architect's FTP site specifically established for Project.
 - 2. Assemble complete submittal package into a single indexed file incorporating submittal requirements of a single Specification Section and transmittal form with links enabling navigation to each item.
 - 3. File name to use project identifier and Specification Section number followed by a decimal point and then a sequential number (e.g., LNHS-061000.01). Resubmittals shall include an alphabetic suffix after another decimal point (e.g., LNHS-061000.01.A).
- B. Samples: Submit the number specified in individual specification sections; one of which will be retained by Architect.

1. Transmit samples that contain multiple, related components such as accessories together in one submittal package.
2. Provide corresponding electronic submittal of Sample transmittal, digital image file illustrating Sample characteristics, and identification information for record.
3. Retained samples will not be returned to Contractor unless specifically so stated.

3.16 SUBMITTAL PROCEDURES

- A. Submittal Schedule: Submit a schedule of submittals, arranged in chronological order by dates required by construction schedule. Include time required for review, ordering, manufacturing, fabrication, and delivery when establishing dates. Include additional time required for making corrections or revisions to submittals noted by Architect and additional time for handling and reviewing submittals required by those corrections.
1. Coordinate submittal schedule with list of subcontracts, the schedule of values, and Contractor's construction schedule.
 2. Initial Submittal: Submit concurrently with startup construction schedule. Include submittals required during the first 60 days of construction. List those submittals required to maintain orderly progress of the Work and those required early because of long lead time for manufacture or fabrication.
 3. Final Submittal: Submit concurrently with the first complete submittal of Contractor's construction schedule.
 - a. Submit revised submittal schedule to reflect changes in current status and timing for submittals.
- B. Schedule submittals to expedite the Project, and coordinate submission of related items. Coordinate with Owner for items to be reviewed concurrently by Owner's Facility Team.
- C. Shop Drawing Procedures:
1. Prepare accurate, drawn-to-scale, original shop drawing documentation by interpreting the Contract Documents and coordinating related Work.
 2. Do not reproduce the Contract Documents to create shop drawings.
 3. Generic, non-project specific information submitted as shop drawings do not meet the requirements for shop drawings.
 4. Architect will furnish Contractor one set of digital data drawing files of the Contract Drawings for use in preparing shop drawings.
 - a. Architect makes no representations as to the accuracy or completeness of digital data files as they relate to Drawings.
 - b. Contractor will execute a data licensing agreement in the form of AIA G201 or form provided by Architect.
- D. Transmittals:
1. Transmittal Form: Form provided or approved by Architect.
 2. Transmit each submittal with a copy of approved submittal form.
 3. Sequentially number the transmittal form. Revise submittals with original number and a sequential alphabetic suffix.
 4. Identify Project, Contractor, Subcontractor or supplier; pertinent drawing and detail number, and specification section number, as appropriate on each copy.

5. 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.
- E. Review Time: Allow time for submittal review, including time for resubmittals, as follows. No extension of the Contract Time will be authorized because of failure to transmit submittals enough in advance of the Work to permit processing, including resubmittals.
1. Initial Review: allow 15 working days excluding delivery time to and from the Contractor. Allow additional time if coordination with subsequent submittals is required. Architect will advise Contractor when a submittal being processed must be delayed for coordination.
 2. Intermediate Review: If intermediate submittal is necessary, process in same manner as initial submittal.
 3. Resubmittal Review: Allow 15 working days for review of each resubmittal.
 4. Concurrent Consultant and Owner Review: Where the Contract Documents indicate that submittals may be transmitted simultaneously to Architect, Architect's consultants, and Owner's Representatives, allow 21 working days for review of each submittal. Submittal will be returned to Architect before being returned to Contractor.

3.17 DELEGATED-DESIGN SERVICES

- A. Performance and Design Criteria: Where professional design services or certification by a design professional are specifically required of Contractor by the Contract Documents, provide products and systems complying with specific performance and design criteria indicated.
1. If criteria indicated are not sufficient to perform services or certification required, submit a written request for additional information to Architect.
 2. Delegated-Design Services Certification: In addition to Shop Drawings, Product Data, and other required submittals, submit digitally signed PDF electronic file copies of certificate, signed and sealed by the responsible design professional, for each product and system specifically assigned to Contractor to be designed or certified by a design professional.
 3. Indicate that products and systems comply with performance and design criteria in the Contract Documents. Include list of codes, loads, and other factors used in performing these services.

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, with network analysis diagram and reports.

1.02 RELATED SECTIONS

- A. Section 01 1000 - Summary: Work sequence, occupancy, and owner-furnished items.

1.03 SUBMITTALS

- A. Within 10 days after date established in Notice to Proceed, submit preliminary schedule defining planned operations for the first 90 days of Work, with a general outline for remainder of Work.
- B. If preliminary schedule requires revision after review, submit revised schedule within 10 days.
- C. Within 20 days after review of preliminary schedule, submit draft of proposed complete schedule for review.
 - 1. Include written certification that major contractors have reviewed and accepted proposed schedule.
 - 2. Include written letter clearly indicating the dates that the Owner is to furnish any materials, equipment, or the like, to be incorporated into the Work by the Contractor.
- D. Within 10 days after joint review, submit complete schedule.
- E. Submit updated schedule with each Application for Payment to Architect. Applications for Payment without schedule will not be processed.
- F. Submit under transmittal letter form specified in Section 01 3000 - Administrative Requirements.
- G. Format for Submittals:
 - 1. PDF electronic file and one paper copy.

1.04 QUALITY ASSURANCE

- A. Scheduler: Contractor's personnel or specialist Consultant specializing in CPM scheduling with two 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 (560 x 432 mm) or width required.
- C. Scale and Spacing: To allow for notations and revisions.

PART 2 - PRODUCTS

2.01 NOT USED

PART 3 - EXECUTION

3.01 PRELIMINARY SCHEDULE

- A. Prepare preliminary schedule in the form of a preliminary network diagram.

3.02 CONTENT

- A. The schedule shall include contractually specified interim completion dates and milestones.
- B. Show complete sequence of construction by activity, with dates for beginning and completion of each element of construction.
- C. Identify each item by specification section number.
- D. Identify work of separate stages and other logically grouped activities.
- E. Provide sub-schedules for each phase of Work identified in Section 01 1000.
- F. Provide sub-schedules to define critical portions of the entire schedule.
- G. Include conferences and meetings in schedule.
- H. Show accumulated percentage of completion of each item, and total percentage of Work completed, as of the first day of each month.
- I. Provide separate schedule of submittal dates for shop drawings, product data, and samples, owner-furnished products, and dates reviewed submittals will be required from Architect. Indicate decision dates for selection of finishes.
- J. Indicate delivery dates for owner-furnished products.
- K. Coordinate content with schedule of values specified in Section 01 2000 - Price and Payment Procedures.

- L. Provide legend for symbols and abbreviations used.

3.03 NETWORK ANALYSIS

- A. Prepare network analysis diagrams and supporting mathematical analyses using the Critical Path Method. The CPM schedule shall be developed using Primavera, MS Project, or Suretrack unless otherwise authorized by the Owner.
- B. Illustrate order and interdependence of activities and sequence of work; how start of a given activity depends on completion of preceding activities, and how completion of the activity may restrain start of subsequent activities.
- C. Mathematical Analysis: Tabulate each activity of detailed network diagrams, using calendar dates, and identify for each activity:
 - 1. Preceding and following event numbers.
 - 2. Activity description.
 - 3. Estimated duration of activity, in maximum 14 day intervals.
 - 4. Earliest start date.
 - 5. Earliest finish date.
 - 6. Actual start date.
 - 7. Actual finish date.
 - 8. Latest start date.
 - 9. Latest finish date.
 - 10. Total and free float; float time shall accrue to Owner and to Owner's benefit.
 - 11. Monetary value of activity, keyed to Schedule of Values.
 - 12. Percentage of activity completed.
 - 13. Responsibility.
- D. Unless otherwise authorized by the Owner's Representative, no more than 40 percent of all activities may be identified as critical path items. The relationship between non-critical activities and activities on the critical path shall be clearly shown on the network diagram.
- E. Required Reports: List activities in sorts or groups:
 - 1. By preceding work item or event number from lowest to highest.
 - 2. By amount of float, then in order of early start.
 - 3. By responsibility in order of earliest possible start date.
 - 4. In order of latest allowable start dates.
 - 5. In order of latest allowable finish dates.
 - 6. Contractor's periodic payment request sorted by Schedule of Values listings.
 - 7. Listing of basic input data that generates the report.
 - 8. Listing of activities on the critical path.

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. Schedule shall be updated at least once a month and submitted with each pay request.
- B. Maintain schedules to record actual start and finish dates of completed activities.
- C. Indicate progress of each activity to date of revision, with projected completion date of each activity.
- D. Update diagrams to graphically depict current status of Work.
- E. Identify activities modified since previous submittal, major changes in Work, and other identifiable changes.
- F. Indicate changes required to maintain Date of Substantial Completion.
- G. Submit reports required to support recommended changes.
- H. Provide narrative report to define problem areas, anticipated delays, and impact on the schedule. Report corrective action taken or proposed and its effect including the effects of changes on schedules of separate contractors.

3.06 SCHEDULE RECOVERY

- A. If the Work represented by the critical path falls behind more than 7 days, the project schedule shall be redone within 14 days showing how the Contractor shall recover the time. A narrative that addresses the changes in the schedule from the previously submitted schedule shall be submitted along with the schedule in both hard copy and electronic copy. The Contractor shall comply with the most recent schedules.

3.07 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 shown in schedules.

END OF SECTION 01 3216

SECTION 01 4000 - QUALITY REQUIREMENTS

PART 1 - GENERAL

1.01 SECTION INCLUDES

- A. Submittals.
- B. Delegated Design.
- C. Quality assurance.
- D. References and standards.
- E. Testing and inspection agencies and services.
- F. Control of installation.
- G. Mock-ups.
- H. Tolerances.
- I. Manufacturers' field services.
- J. Defect Assessment.

1.02 RELATED REQUIREMENTS

- A. Section 02 3200 - Geotechnical Investigation: Soil investigation report.
- B. General Conditions and Supplementary Conditions: Inspections and approvals required by public authorities.
- C. Section 01 3000 - Administrative Requirements: Submittal procedures.
- D. Section 01 6000 - Product Requirements: Requirements for material and product quality.

1.03 SUBMITTALS

- A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
- B. Designer's Qualification Statement: Submit for Architect's knowledge as contract administrator, or for Owner's information.
 - 1. Include information for each individual professional responsible for producing, or supervising production of, design-related professional services provided by Contractor.
 - a. Full name.
 - b. Professional licensure information.

- c. Statement addressing extent and depth of experience specifically relevant to design of items assigned to Contractor.
 - C. Design Data: Submit for Architect's knowledge as contract administrator for the limited purpose of assessing conformance with information given and the design concept expressed in the contract documents, or for Owner's information.
 1. Include calculations that have been used to demonstrate compliance to performance and regulatory criteria provided, or for Owner's information.
 2. Include required product data and shop drawings.
 3. Include a statement or certification attesting that design data complies with criteria indicated, such as building codes, loads, functional, and similar engineering requirements.
 4. Include signature and seal of design professional responsible for allocated design services on calculations and drawings.
 - D. Test Reports: After each test/inspection, promptly submit two copies of report to Architect, Contractor, and Construction Manager.
 1. Include:
 - a. Date issued.
 - b. Project title and number.
 - c. Name of inspector.
 - d. Date and time of sampling or inspection.
 - e. Identification of product and specifications section.
 - f. Location in the Project.
 - g. Type of test/inspection.
 - h. Date of test/inspection.
 - i. Results of test/inspection.
 - j. Conformance with Contract Documents.
 - k. When requested by Architect, provide interpretation of results.
 2. Test report submittals are for Architect's knowledge as contract administrator for the limited purpose of assessing conformance with information given and the design concept expressed in the contract documents, or for Owner's information.
 - E. Certificates: When specified in individual specification sections, submit certification by the manufacturer and Contractor or installation/application subcontractor to Architect, in quantities specified for Product Data.
 1. Indicate material or product conforms to or exceeds specified requirements. Submit supporting reference data, affidavits, and certifications as appropriate.
 2. Certificates may be recent or previous test results on material or product, but must be acceptable to Architect.
 - F. Manufacturer's Instructions: When specified in individual specification sections, submit printed instructions for delivery, storage, assembly, installation, start-up, adjusting, and finishing, for the Owner's information. Indicate special procedures, perimeter conditions requiring special attention, and special environmental criteria required for application or installation.

- G. Manufacturer's Field Reports: Submit reports for Architect's benefit as contract administrator or for Owner.
 - 1. Submit report in duplicate within 30 days of observation to Architect for information.
 - 2. Submit for information for the limited purpose of assessing conformance with information given and the design concept expressed in the contract documents.

- H. Erection Drawings: Submit drawings for Architect's benefit as contract administrator or for Owner.
 - 1. Submit for information for the limited purpose of assessing conformance with information given and the design concept expressed in the contract documents.
 - 2. Data indicating inappropriate or unacceptable Work may be subject to action by Architect or Owner.

1.04 DELEGATED-DESIGN SERVICES

- A. Performance and Design Criteria: Where professional design services or certifications by a design professional are specifically required of Contractor by the Contract Documents, provide products and systems complying with specific performance and design criteria indicated.
 - 1. If criteria indicated are not sufficient to perform services or certification required, submit a written request for additional information to Architect.

- B. Delegated-Design Services Certification: In addition to Shop Drawings, Product Data, and other required submittals, submit digitally signed PDF electronic file copies of certificate, signed and sealed by the responsible design professional, for each product and system specifically assigned to Contractor to be designed or certified by a design professional.
 - 1. Indicate that products and systems comply with performance and design criteria in the Contract Documents. Include list of codes, loads, and other factors used in performing these services.

1.05 QUALITY ASSURANCE

- A. Testing Agency Qualifications:
 - 1. Prior to start of Work, submit agency name, address, and telephone number, and names of full time registered Engineer and responsible officer.
 - 2. Submit copy of report of laboratory facilities inspection made by NIST Construction Materials Reference Laboratory during most recent inspection, with memorandum of remedies of any deficiencies reported by the inspection.
 - 3. Qualification Statement: Provide documentation showing testing laboratory is accredited under IAS AC89.

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

1.06 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.

1.07 TESTING AND INSPECTION AGENCIES AND SERVICES

- A. Owner will employ and pay for services of an independent testing agency to perform specified testing and inspection.
- B. Employment of agency in no way relieves Contractor of obligation to perform Work in accordance with requirements of Contract Documents.

PART 2 - PRODUCTS

2.01 NOT USED

PART 3 - EXECUTION

3.01 CONTROL OF INSTALLATION

- A. Monitor quality control over suppliers, manufacturers, products, services, site conditions, and workmanship, to produce Work of specified quality.
- B. Comply with manufacturers' instructions, including each step in sequence.
- C. Should manufacturers' instructions conflict with Contract Documents, request clarification from Architect before proceeding.

- D. Comply with specified standards as minimum quality for the Work except where more stringent tolerances, codes, or specified requirements indicate higher standards or more precise workmanship.
- E. Have Work performed by persons qualified to produce required and specified quality.
- F. Verify that field measurements are as indicated on shop drawings or as instructed by the manufacturer.
- G. Secure products in place with positive anchorage devices designed and sized to withstand stresses, vibration, physical distortion, and disfigurement.

3.02 MOCK-UPS

- A. Before installing portions of the Work where mock-ups are required, construct mock-ups in location and size indicated for each form of construction and finish required to comply with the following requirements, using materials indicated for the completed Work. The purpose of mock-up is to demonstrate the proposed range of aesthetic effects and workmanship.
- B. Accepted mock-ups establish the standard of quality the Architect will use to judge the Work.
- C. Notify Owner, Architect and Construction Manager fifteen (15) working days in advance of dates and times when mock-ups will be constructed.
- D. Provide supervisory personnel who will oversee mock-up construction. Provide workers that will be employed during the construction at Project.
- E. Tests shall be performed under provisions identified in this section and identified in the respective product specification sections.
- F. Assemble and erect specified items with specified attachment and anchorage devices, flashings, seals, and finishes.
- G. Obtain Architect's approval of mock-ups before starting work, fabrication, or construction.
 - 1. Architect will issue written comments within seven (7) working days of initial review and each subsequent follow up review of each mock-up.
 - 2. Make corrections as necessary until Architect's approval is issued.
- H. Accepted mock-ups shall be a comparison standard for the remaining Work.
- I. Where mock-up has been accepted by Architect and is specified in product specification sections to be removed, protect mock-up throughout construction, remove mock-up and clear area when directed to do so by Architect.
- J. Where possible salvage and recycle the demolished mock-up materials.

3.03 TOLERANCES

- A. Monitor fabrication and installation tolerance control of products to produce acceptable Work. Do not permit tolerances to accumulate.
- B. Comply with manufacturers' tolerances. Should manufacturers' tolerances conflict with Contract Documents, request clarification from Architect before proceeding.
- C. Adjust products to appropriate dimensions; position before securing products in place.

3.04 TESTING AND INSPECTION

- A. See individual specification sections for testing and inspection required.
- B. Test and Inspection Log: Prepare a record of tests and inspections. Include the following:
 - 1. Date test or inspection was conducted.
 - 2. Description of Work tested or inspected.
 - 3. Date tests or inspection results were transmitted to Architect.
 - 4. Identification of testing agency or special inspector conducting test or inspection.
 - 5. Maintain log at Project Site. Post changes and revisions as they occur. Provide access to test and inspection log for Architect's and Commissioning Authority's, reference during normal working hours.
- C. Testing Agency Duties:
 - 1. Provide qualified personnel at site. Cooperate with Architect, Contractor, and Construction Manager 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, Contractor, Construction Manager of observed irregularities or non-conformance of Work or products.
 - 5. Perform additional tests and inspections required by Architect.
 - 6. Attend preconstruction meetings and progress meetings if required by Owner.
 - 7. Submit reports of all tests/inspections specified.
- D. 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.
- E. 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, Construction Manager 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.
- F. Re-testing required because of non-conformance to specified requirements shall be performed by the same agency on instructions by Architect.
- G. Re-testing required because of non-conformance to specified requirements shall be paid for by Contractor.
- H. Repair and Protection: On completion of testing, inspecting, sample taking, and similar services, repair damaged construction and restore substrates and finishes.
1. Provide materials and comply with installation requirements specified in other Specification Sections or matching existing substrates and finishes. Restore patched areas and extend restoration into adjoining areas with durable seams that are as invisible as possible. Comply with the Contract Document requirements for cutting and patching in Section 01 7000 - Execution and Closeout Requirements.
 2. Protect construction exposed by or for quality-control service activities.
 3. Repair and protection are Contractor's responsibility, regardless of the assignment of responsibility for quality-control services.
- 3.05 MANUFACTURERS' FIELD SERVICES
- A. When specified in individual specification sections, require material or product suppliers or manufacturers to provide qualified staff personnel to observe site conditions, conditions of surfaces and installation, quality of workmanship, start-up of equipment, test, adjust and balance of equipment as applicable, and to initiate instructions when necessary.
 - B. Submit qualifications of observer to Architect 30 days in advance of required observations.
 1. Observer subject to approval of Architect and Owner.
 - C. Report observations and site decisions or instructions given to applicators or installers that are supplemental or contrary to manufacturers' written instructions.
- 3.06 DEFECT ASSESSMENT
- A. Replace Work or portions of the Work not conforming to specified requirements.

Pivot North Architecture
100% Construction Set
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TWIN FALLS TRAINING FACILITY
SECTION 01 4000
QUALITY REQUIREMENTS

- B. If, in the opinion of Architect and Owner, 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 5000 - TEMPORARY FACILITIES AND CONTROLS

PART 1 - GENERAL

1.01 SECTION INCLUDES

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

1.02 RELATED REQUIREMENTS

- A. Section 01 5100 - Temporary Utilities.

1.03 REFERENCE STANDARDS

- A. ASTM E84 – Standard Test Method for Surface Burning Characteristics of Building Materials; 2021a.

1.04 DEWATERING

- A. Provide temporary means and methods for dewatering all temporary facilities, project site, excavations and controls. Comply with requirements of authorities having jurisdiction for rainwater control. Dewatering, and drains.
- B. Maintain temporary facilities in operable condition.

1.05 TEMPORARY UTILITIES

- A. See Section 01 5100 – Temporary Utilities.

1.06 TELECOMMUNICATIONS SERVICES

- A. Provide, maintain, and pay for telecommunications services to field office at time of project mobilization.
- B. Telecommunications services shall include:
 - 1. Windows-based personal computer dedicated to project telecommunications, with necessary software and laser printer.
 - 2. Telephone Service: Provide temporary telephone service in common-use facilities for use by all construction personnel. Provide cellular service for project manager and site superintendents.
 - 3. Internet Connections: Minimum of one; DSL modem or faster.
 - 4. Email: Account/address reserved for project use.
 - 5. Facsimile Service: Fax-to-email software on personal computer.

1.07 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.
- C. At end of construction, return site to same or better condition as originally found.

1.08 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 .
- B. Provide barricades and covered walkways required by governing authorities for public rights-of-way .
- C. When pedestrians are routed around construction areas additional barricades will be required to prevent damage to adjacent landscaped areas. Barricades shall be placed to route pedestrians around affected areas using existing paved surfaces when possible.
- D. Provide protection for plants designated to remain. Replace damaged plants.
- E. Protect non-owned vehicular traffic, stored materials, site, and structures from damage.

1.09 FENCING

- A. Construction: Commercial grade chain link fence.
- B. Provide 6 foot high fence around construction building area and material storage area on site; equip with vehicular and pedestrian gates with locks. Coordinate location with Architect and Owner.

1.10 EXTERIOR ENCLOSURES

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

1.11 INTERIOR ENCLOSURES

- A. Provide temporary partitions and ceilings as indicated or required to separate work areas from Owner-occupied areas, to prevent penetration of dust and moisture into Owner-occupied areas, and to prevent damage to existing materials and equipment.
- B. Construction: Framing and plywood sheet materials with closed joints and sealed edges at intersections with existing surfaces:
 - 1. Maximum flame spread rating of 75 in accordance with ASTM E84.
- C. Paint surfaces exposed to view from Owner-occupied areas.
- D. Provide temporary lighting with local switching that provides adequate illumination for construction operations, observations, inspections, testing and construction traffic conditions.

1.12 SECURITY

- A. Provide security and facilities to protect Work, and Owner's operations from unauthorized entry, vandalism, or theft. Install and operate temporary lighting that fulfills security requirements without operating entire system.
- B. Coordinate with Owner's security program.

1.13 VEHICULAR ACCESS AND PARKING

- A. Comply with regulations relating to use of streets and sidewalks, access to emergency facilities, and access for emergency vehicles.
- B. Coordinate access and haul routes with governing authorities and Owner.
- C. Provide and maintain access to fire hydrants, free of obstructions.
- D. Provide means of removing mud from vehicle wheels before entering streets.
- E. Designated existing on-site roads may be used for construction traffic.
- F. Provide temporary parking areas to accommodate construction personnel. When site space is not adequate, provide additional off-site parking.

1.14 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 weekly.
- 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.
- E. No on-site burning allowed.

1.15 PROJECT IDENTIFICATION

- A. Provide project identification sign of design and construction approved by Architect.
- B. Sign Materials:
 - 1. Structure and Framing: New, wood or metal, structurally adequate.
 - 2. Sign Surfaces: Exterior grade plywood with medium density overlay, minimum 3/4 inch (19 mm) thick, standard large sizes to minimize joints, painted white.
 - 3. Rough Hardware: Galvanized.
 - 4. Lettering: Exterior quality paint, contrasting colors.
- C. Project Identification Sign:
 - 1. One printed sign, size shall be 72 inches x 48 inches maximum.
 - 2. Content:
 - a. Project title, logo and name of Owner as indicated on Contract Documents.
 - b. Names and titles of Architect and Consultants.
 - c. Name of Prime Contractor and Major Subcontractors.
 - d. Color project rendering.
 - 3. Graphic design, colors, style of lettering: Designated by Contractor for layout and design and coordinated with Architect.
- D. Installation:
 - 1. Install project identification sign within 30 days after date fixed by Notice to Proceed.
 - 2. Erect at location of high public visibility, adjacent to main entrance to site.
 - 3. Erect supports and framing on secure foundation, rigidly braced and framed to resist wind loadings.
 - 4. Install sign surface plumb and level, with butt joints. Anchor securely.
- E. No other signs are allowed without Owner permission except those required by law.

1.16 FIELD OFFICES

- A. Construction office for the use of the Owner, Architect, and Architect's Consultants shall be provided by Contractor. Construction office shall include a table with 12 chairs, a plan rack, a plan table, and a two-drawer file. This office shall be maintained by the Contractor and shall have data, heat and air conditioning. It shall be maintained in clean condition.
- B. Office: Weathertight, with lighting, electrical outlets, heating, cooling equipment, and equipped with sturdy furniture, drawing rack and drawing display table.
- C. Provide space for Project meetings, with table and chairs to accommodate 12 persons minimum.
- D. Locate offices a minimum distance of 30 feet (10 m) from existing and new structures.

1.17 TEMPORARY FIRE PROTECTION

- A. Until fire protection needs are supplied by permanent facilities, install and maintain temporary fire protection facilities of the types needed to protect against reasonably predictable and controllable fire losses. Comply with IFC 906, "Code for Portable Fire Extinguishers", and IBC Chapter 33 and IFC Chapter 14 "Fire Safety During Construction".
 - 1. Locate fire extinguishers where convenient and effective for their intended purpose, but not less than one extinguisher on each floor.
 - 2. Store combustible materials in containers in fire-safe locations.
 - 3. Maintain unobstructed access to fire extinguishers, fire hydrants, temporary fire protection facilities. Prohibit smoking in hazardous fire exposure areas.
 - 4. Provide supervision of welding operations, combustion type temporary heating units, and similar sources of fire ignition.
 - 5. Develop and supervise an overall fire-prevention and protection program for personnel and facilities at Project site. Review needs with local fire department and establish procedures to be followed.

1.18 REMOVAL OF UTILITIES, FACILITIES, AND CONTROLS

- A. Remove temporary utilities, equipment, facilities, materials, roadways and construction parking areas prior to Date of Substantial Completion inspection. Maintain temporary security measures until permanent security provisions are in place.
- B. Remove underground installations to a minimum depth of 2 feet (600 mm). Grade site as indicated.
- C. Clean and repair damage caused by installation or use of temporary work.
- D. Restore new permanent facilities used during construction to specified condition.

1.19 MOISTURE AND MOLD CONTROL

- A. Contractor's Moisture-Protection Plan: Avoid trapping water in finished work. Document signs of mold that may appear during construction.
- B. Exposed Construction Phase: Before installation of weather barriers, when materials are subject to wetting and exposure and to airborne mold spores, protect as follows:
 - 1. Protect porous materials from water damage.
 - 2. Protect stored and installed materials from flowing or standing water.
 - 3. Keep porous and organic materials from coming into prolonged contact with concrete.
 - 4. Remove standing water from decks.
 - 5. Keep deck openings covered or dammed.
- C. Partially Enclosed Construction Phase: After installation of weather barriers but before full enclosure and conditioning of building, when installed materials are still subject to infiltration of moisture and ambient mold spores, protect as follows:
 - 1. Do not load or install drywall or other porous materials or components, or items with high organic content, into partially enclosed building.
 - 2. Keep interior spaces reasonably clean and protected from water damage.
 - 3. Periodically collect and remove waste containing cellulose or other organic matter.
 - 4. Discard or replace water-damaged material.
 - 5. Do not install material that is wet.
 - 6. Discard, replace, or clean stored or installed material that begins to grow mold.

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: 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 TEMPORARY ELECTRICITY

- A. Cost: By Contractor to pay electric-power-service use charges for electricity used by all entities for project construction operations.
 - 1. Temporary power required beyond services capacity to be supplied and paid by Contractor.
- B. Power Service Characteristics: 208 volt, three phase, four wire / 120 volt, single phase.
- C. Provide power outlets for construction operations, with branch wiring and distribution boxes located at each floor. Provide flexible power cords as required.
- D. Provide main service disconnect and over-current protection at convenient location and meter.
- E. Provide adequate distribution equipment, wiring, and outlets to provide single phase branch circuits for power and lighting.
 - 1. Provide 20 ampere, duplex outlets, single phase circuits for power tools.
 - 2. Provide 20 ampere, single phase branch circuits for lighting.

1.04 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 (10.8 watt/sq m) lighting to exterior staging and storage areas after dark for security purposes.
- C. Provide and maintain 0.25 watt/sq ft (2.7 watt/sq m) 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.

1.05 TEMPORARY HEATING

- A. Cost of Energy: By Contractor.
- B. Provide heating devices and heat as needed to maintain specified conditions for construction operations. Provide source that will not add unnecessary moisture to the interior of the building or harmful to completed installations.
- C. Maintain minimum ambient temperature of 50 degrees F (10 degrees C) 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 replacement of filters and worn or consumed parts.

1.06 TEMPORARY 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 (26 degrees C) 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.

1.07 TEMPORARY VENTILATION

- A. Ventilation and Humidity Control: Provide temporary ventilation required by construction activities for curing or drying of completed installations or for protecting installed construction from adverse effects of high humidity. Select equipment that will not have a harmful effect on completed installations or elements being installed. Coordinate ventilation requirements to produce ambient condition required and minimize energy consumption.

1.08 TEMPORARY WATER SERVICE

- A. Cost of Water Used: By Contractor to pay water-service use charges for water used by all entities for construction operations.
 - 1. Large volume water sources to be supplied and paid by Contractor.
- B. Provide and maintain suitable quality water service for construction operations at time of project mobilization.
- C. Extend branch piping with outlets located so water is available by hoses with threaded connections. Provide temporary pipe insulation to prevent freezing.

1.09 TEMPORARY SEWER SERVICE

- A. Sewer Service: Pay sewer-service use charges for sewer usage by all entities for construction operations.

PART 2 - PRODUCTS

NOT USED

PART 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 and procedures.
- 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 procurement and/or construction phases.
- B. Section 01 4000 - Quality Requirements: Product quality monitoring.

1.03 SUBMITTALS

- A. Proposed Products List: Submit list of major products proposed for use, with name of manufacturer, trade name, and model number of each product.
 - 1. Submit within 15 days after date of Agreement.
 - 2. For products specified only by reference standards, list applicable reference standards.
- B. 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.
- C. 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.
- D. 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 EXISTING PRODUCTS

- A. Do not use materials and equipment removed from existing premises unless specifically required or permitted by Contract Documents.
- B. Unforeseen historic items encountered remain the property of the Owner, notify Owner promptly upon discovery; protect, remove, handle, and store as directed by Owner.

2.02 NEW PRODUCTS

- A. Provide new products unless specifically required or permitted by the Contract Documents.
- B. See Section 01 4000 – Quality Requirements, for additional source quality control requirements.
- C. Use of products having any of the following characteristics is not permitted:
 - 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.
- D. Where other criteria are met, Contractor shall give preference to products that:
 - 1. Are extracted, harvested, and/or manufactured closer to the location of the project.
 - 2. Have longer documented life span under normal use.
 - 3. Result in less construction waste.

- E. Provide all Finish Material Products used in any individual system from the same manufacturer; no exceptions.

2.03 PRODUCT OPTIONS

- A. Products Specified by Reference Standards or by Description Only: Use any product meeting those standards or description.

1. Basis-of-Design Product Definition: A specification in which a specific manufacturer's product is named accompanied by the words "basis-of-design product," including make or model number or other designation, to establish the significant qualities related to type, function, dimension, in-service performance, physical properties, appearance, and other characteristics for purposes of evaluating comparable products of additional manufacturers named in the specification.

- 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.

1. Manufacturer/Source: Where Specifications name a single manufacturer or source, provide a product by the named manufacturer or source that complies with requirements. Comparable products or substitutions for Contractor's convenience will not be considered.

- C. Products Specified by Naming One or More Manufacturers with a Provision for Substitutions: Submit a request for substitution for any manufacturer not named.
- D. Manufacturer's other than Basis of Design Manufacturers shall provide products or systems that meet or exceed Basis of Design products or systems. No change order shall be issued solely based on bid product or system not meeting Basis of Design and being rejected through submittal process.

2.04 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 economically feasible.

3.03 STORAGE AND PROTECTION

- A. Provide protection of stored materials and products against theft, casualty, or deterioration.
- B. 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.
- C. Store and protect products in accordance with manufacturers' instructions.
- D. Store with seals and labels intact and legible.
- E. Store sensitive products in weather tight, climate controlled, enclosures in an environment favorable to product.
- F. For exterior storage of fabricated products, place on sloped supports above ground.
- G. Provide off-site storage and protection when site does not permit on-site storage or protection.
- H. Protect products from damage or deterioration due to construction operations, weather, precipitation, humidity, temperature, sunlight and ultraviolet light, dirt, dust, and other contaminants.
- I. Comply with manufacturer's warranty conditions, if any.
- J. Do not store products directly on the ground.
- K. Cover products subject to deterioration with impervious sheet covering. Provide ventilation to prevent condensation and degradation of products.
- L. Store loose granular materials on solid flat surfaces in a well-drained area. Prevent mixing with foreign matter.
- M. Prevent contact with material that may cause corrosion, discoloration, or staining.
- N. Provide equipment and personnel to store products by methods to prevent soiling, disfigurement, or damage.
- O. Arrange storage of products to permit access for inspection. Periodically inspect to verify products are undamaged and are maintained in acceptable condition.
- P. 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

Pivot North Architecture
100% Construction Set
March 17, 2023

TWIN FALLS TRAINING FACILITY
SECTION 01 6000
PRODUCT REQUIREMENTS

SECTION 01 7000 - EXECUTION AND CLOSEOUT REQUIREMENTS

PART 1 - GENERAL

1.01 SECTION INCLUDES

- A. Examination, preparation, and general installation procedures.
- B. Requirements for selective demolition, except removal, disposal, and/or remediation of hazardous materials and toxic substances.
- 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 the project site and premises in buildings; continued occupancy; and work sequence.
- B. Section 01 3000 - Administrative Requirements: Submittals procedures.
- C. Section 01 4000 - Quality Requirements: Testing and inspection procedures.
- D. Section 01 5000 - Temporary Facilities and Controls:
 - 1. Temporary exterior enclosures.
 - 2. Temporary Interior partitions.
- E. Section 01 5100 - Temporary Utilities: Temporary heating, cooling, and ventilating facilities.
- F. Section 01 7800 - Closeout Submittals: Project record documents, operation and maintenance data, warranties and bonds.
- G. Section 07 8400 - Firestopping.

- H. Individual Product Specification Sections:
 - 1. Advance notification to other sections of openings required in work of those sections.
 - 2. Limitations on cutting structural members.

1.03 SUBMITTALS

- A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
- B. Survey work: Submit name, address, and telephone number of Surveyor before starting survey work.
 - 1. On request, submit documentation verifying accuracy of survey work.
 - 2. Submit a copy of site drawing signed by the Land Surveyor, that the elevations and locations of the work are in conformance with Contract Documents.
 - 3. Submit surveys and survey logs for the project record.
- C. Cutting and Patching: Submit written request in advance of cutting or alteration that affects:
 - 1. Structural integrity of any element of Project.
 - 2. Integrity of weather exposed or moisture resistant element.
 - 3. Efficiency, maintenance, or safety of any operational element.
 - 4. Visual qualities of sight exposed elements.
 - 5. Work of Owner or separate Contractor.
 - 6. Include in request:
 - a. Identification of Project.
 - b. Location and description of affected work.
 - c. Necessity for cutting or alteration.
 - d. Description of proposed work and products to be used.
 - e. Effect on work of Owner or separate Contractor.
 - f. Written permission of affected separate Contractor.
 - g. Date and time work will be executed.
- D. Project Record Documents: Accurately record actual locations of capped and active utilities.

1.04 QUALIFICATIONS

- A. For demolition work, employ a firm specializing in the type of work required.
 - 1. Minimum of five years of documented experience.
- B. For survey work, employ a land surveyor registered in the State in which the Project is located 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.
- C. For field engineering, employ a professional engineer of the discipline required for specific service on Project, licensed in the State in which the Project is located. Employ only individual(s) trained and experienced in establishing and maintaining horizontal and vertical

control points necessary for laying out construction work on project of similar size, scope and/or complexity.

- D. For design of temporary shoring and bracing, employ a Professional Engineer experienced in design of this type of work and licensed in the State in which the Project is located.

1.05 PROJECT CONDITIONS

- A. Protect site from puddling or running water. Provide water barriers as required to protect site from soil erosion and control sediment.
- B. Perform dewatering activities, as required, for the duration of the project. Maintain excavations free of water.
- 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. Noise Control: Provide methods, means, and facilities to minimize noise produced by construction operations.
- F. Pest and Rodent Control: Provide methods, means, and facilities to prevent pests and insects from damaging the work.
- G. Rodent Control: Provide methods, means, and facilities to prevent rodents from accessing or invading premises.
- 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 shown 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 misfabrication.

- E. Verify that utility services are available, of the correct characteristics, in the correct locations before beginning sitework and other construction affecting the work.
- 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.
- D. Field Measurements: Take field measurements as required to fit the Work properly. Recheck measurements before installing each product. Where portions of the Work are indicated to fit to other construction, verify dimensions of other construction by field measurements before fabrication. Coordinate fabrication schedule with construction progress to avoid delaying the Work.

3.03 PREINSTALLATION MEETINGS

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

3.04 LAYING OUT THE WORK

- A. Verify locations of survey control points prior to starting work.
- B. Promptly notify Architect of any discrepancies discovered.
- C. Contractor shall locate and protect survey control and reference points.
- D. Control datum for survey is that established by Owner provided survey.

- E. Protect survey control points prior to starting site work; preserve permanent reference points during construction.
 - F. Promptly report to Architect the loss or destruction of any reference point or relocation required because of changes in grades or other reasons.
 - G. Replace dislocated survey control points based on original survey control. Make no changes without prior written notice to Architect.
 - H. Utilize recognized engineering survey practices.
 - I. Establish a minimum of two permanent bench marks on site, referenced to established control points. Record locations, with horizontal and vertical data, on project record documents.
 - J. Establish elevations, lines and levels. Locate and lay out by instrumentation and similar appropriate means:
 - 1. Site improvements including pavements; stakes for grading, fill and topsoil placement; utility locations, slopes, and invert elevations.
 - 2. Grid for structures, building foundation, column locations, floor elevations, door and window elevations, etc.
 - 3. Assist subcontractors relative to layout and coordination of their work to successfully complete the project.
 - K. Construction Related Services: The Contractor will provide construction related services including construction staking, site visits, weekly construction meetings, and shop drawings review.
 - 1. Construction staking will include the following:
 - a. Stake rough grade for new excavations.
 - b. Provide sewer stakes. Identify existing location and depth of sewer. Coordinate ten foot separation from sewer line.
 - c. Provide water line and new fire sprinkler line stakes.
 - d. Provide existing power installation stakes.
 - e. Stake finish grades at areas per Civil Engineers requirements.
 - f. Stake property corners, curb and gutter.
 - g. Blue top street and parking lot finished grade.
 - L. Periodically verify layouts by same means.
 - M. Maintain a complete and accurate log of control and survey work as it progresses.
 - N. Certified Survey: On completion of foundation walls, major site improvements, and other work requiring field-engineering services, prepare a certified survey showing dimensions, locations, angles, and elevations of construction and sitework. Provide with Record Documents.
- 3.05 GENERAL INSTALLATION REQUIREMENTS
- A. In addition to compliance with regulatory requirements, conduct construction operations in compliance with NFPA 241, including applicable recommendations in Appendix A.

- B. 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.
- C. Make vertical elements plumb and horizontal elements level, unless otherwise indicated.
- D. Install equipment and fittings plumb and level, neatly aligned with adjacent vertical and horizontal lines, unless otherwise indicated.
- E. Make consistent texture on surfaces, with seamless transitions, unless otherwise indicated.
- F. Make neat transitions between different surfaces, maintaining texture and appearance.

3.06 ALTERATIONS

- A. Drawings showing existing utilities are based on casual field observation and existing record documents only.
 - 1. Verify that construction and utility arrangements are as indicated.
 - 2. Report discrepancies to Architect before disturbing existing installation.
 - 3. Beginning of alterations work constitutes acceptance of existing conditions.
- B. Keep areas in which alterations are being conducted separated from other areas that are still occupied.
 - 1. Provide, erect, and maintain temporary dustproof partitions of construction specified in Section 01 5000.
- C. Maintain weatherproof exterior building enclosure except for interruptions required for replacement or modifications; take care to prevent water and humidity damage.
 - 1. Where openings in exterior enclosure exist, provide construction to make exterior enclosure weatherproof.
 - 2. Insulate existing ducts or pipes that are exposed to outdoor ambient temperatures by alterations work.
- D. Remove existing work as indicated and as required to accomplish new work.
 - 1. Remove rotted wood, corroded metals, and deteriorated masonry and concrete; replace with new construction specified.
 - 2. Remove items indicated on drawings.
 - 3. Relocate items indicated on drawings.
 - 4. Where new surface finishes are to be applied to existing work, perform removals, patch, and prepare existing surfaces as required to receive new finish; remove existing finish if necessary for successful application of new finish.
 - 5. Where new surface finishes are not specified or indicated, patch holes and damaged surfaces to match adjacent finished surfaces as closely as possible.
- E. Services (including but not limited to HVAC, Plumbing, Fire Protection, Electrical, and Telecommunications): Remove, relocate, and extend existing systems to accommodate new construction.

1. Maintain existing active systems that are to remain in operation; maintain access to equipment and operational components; if necessary, modify installation to allow access or provide access panel.
 2. Where existing systems or equipment are not active and Contract Documents require reactivation, put back into operational condition; repair supply, distribution, and equipment as required.
 3. Where existing active systems serve occupied facilities but are to be replaced with new services, maintain existing systems in service until new systems are complete and ready for service.
 - a. Disable existing systems only to make switchovers and connections; minimize duration of outages.
 - b. Provide temporary connections as required to maintain existing systems in service.
 4. Verify that abandoned services serve only abandoned facilities.
 5. Remove abandoned pipe, ducts, conduits, and equipment, including those above accessible ceilings; remove back to source of supply where possible, otherwise cap stub and tag with identification; patch holes left by removal using materials specified for new construction.
- F. Protect existing work to remain.
1. Prevent movement of structure; provide shoring and bracing if necessary.
 2. Perform cutting to accomplish removals neatly and as specified for cutting new work.
 3. Repair adjacent construction and finishes damaged during removal work.
- G. Adapt existing work to fit new work: Make as neat and smooth transition as possible.
1. When existing finished surfaces are cut so that a smooth transition with new work is not possible, terminate existing surface along a straight line at a natural line of division and make a recommendation to Architect.
 2. Where removal of partitions or walls results in adjacent spaces becoming one, rework floors, walls, and ceilings to a smooth plane without breaks, steps, or bulkheads.
 3. Where a change of plane of 1/4 inch or more occurs in existing work, submit recommendation for providing a smooth transition for Architect review and request instructions.
- H. Patching: Where the existing surface is not indicated to be refinished, patch to match the surface finish that existed prior to cutting. Where the surface is indicated to be refinished, patch so that the substrate is ready for the new finish.
- I. Refinish existing surfaces as indicated:
1. Where rooms or spaces are indicated to be refinished, refinish all visible existing surfaces to remain to the specified condition for each material, with a neat transition to adjacent finishes.
 2. If mechanical or electrical work is exposed accidentally during the work, re-cover and refinish to match.
- J. Clean existing systems and equipment. Seal new and existing exterior wall and roof penetrations weathertight.

- K. Remove demolition debris and abandoned items from alterations areas and dispose of off-site; do not burn or bury.
- L. Do not begin new construction in alterations areas before demolition is complete.
- M. Comply with all other applicable requirements of this section.

3.07 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. Employ skilled and experienced installer to perform cutting for weather exposed and moisture resistant elements, and sight exposed surfaces.
- F. Cut rigid materials using masonry saw or core drill. Pneumatic tools not allowed without prior approval.
- G. Restore work with new products in accordance with requirements of Contract Documents.
- H. Fit work air tight to pipes, sleeves, ducts, conduit, and other penetrations through surfaces.
- I. 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.
- J. 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.

3.08 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 weekly and dispose off-site; do not burn or bury.

3.09 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. Protect work from spilled liquids. If work is exposed to spilled liquids, immediately remove protective coverings, dry out work, and replace protective coverings.
- G. Prohibit traffic or storage upon waterproofed or roofed surfaces. If traffic or activity is necessary, obtain recommendations and provide means for protection from waterproofing or roofing material manufacturer.
- H. Prohibit traffic from landscaped areas.
- I. 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. Notify Architect and owner seven days prior to start-up of each item.

- C. 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. Perform the full prefunctional checkout prior to formal functional testing.
- D. Verify tests, meter readings, and specified electrical characteristics agree with those required by the equipment or system manufacturer.
- E. Verify that wiring and support components for equipment are complete and tested. Test and adjust controls and safeties. Replace damaged malfunctioning controls and equipment.
- F. Execute start-up under supervision of applicable Contractor personnel, Owner representatives and manufacturer's representative in accordance with manufacturers' instructions.
- G. 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.
- H. Submit a written report that equipment or system has been properly installed and is functioning correctly.

3.11 DEMONSTRATION AND INSTRUCTION

- A. See Section 01 7900 - Demonstration and Training.

3.12 ADJUSTING

- A. Adjust operating products and equipment to ensure smooth and unhindered operation.
- B. Testing, adjusting, and balancing HVAC systems: Refer to Drawings and applicable specification sections.

3.13 FINAL CLEANING

- A. Execute final cleaning prior to final project assessment.
- 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. Replace filters of operating equipment.
- G. Clean debris from roofs, gutters, downspouts, 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. Accompany Project Coordinator on preliminary inspection to determine items to be listed for completion or correction in the Contractor's Correction Punch List for Contractor's Notice of Substantial Completion.
- C. Notify Architect when work is considered ready for Architect's Substantial Completion inspection.
- D. Submit written certification containing Contractor's Correction Punch List, that Contract Documents have been reviewed, work has been inspected, and that work is complete in accordance with Contract Documents and ready for Architect's Substantial Completion inspection.
- E. Conduct Substantial Completion inspection and create Final Correction Punch List containing Architect's and Contractor's comprehensive list of items identified to be completed or corrected and submit to Architect.
- F. Correct items of work listed in Final Correction Punch List and comply with requirements for access to Owner-occupied areas.
- G. Accompany Project Coordinator on Contractor's preliminary final inspection.
- H. Notify Architect when work is considered finally complete and ready for Architect's Substantial Completion final inspection.
- I. 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 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 01 3000 - Administrative Requirements: Submittals procedures, shop drawings, product data, and samples.
- B. Section 01 7000 - Execution and Closeout Requirements: Contract closeout procedures.
- C. Individual Product Sections: Specific requirements for operation and maintenance data.
- D. Individual Product Sections: Warranties required for specific products or Work.

1.03 SUBMITTALS

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

3. For items of Work for which acceptance is delayed beyond Date of Substantial Completion, submit within 10 days after acceptance, listing the date of acceptance as the beginning of the warranty period.
- D. Digital Submittal Requirements:
1. Provide two copies of Project Record Documents, Operation and Maintenance Manuals, and Warranties and Bonds in PDF Format.
 - a. All CD-ROM's shall be authored with Adobe Acrobat. The authoring shall, but not be limited to include the following:
 - 1) All information on the shall be printable on 8.5 x 11 inch or 11 x 17 inch plain paper.

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. Moisture protection and weather-exposed products: Include product data listing applicable reference standards, chemical composition, and details of installation. Provide recommendations for inspections, maintenance, and repair.
- D. Additional information as specified in individual product specification sections.
- E. Where additional instructions are required, beyond the manufacturer's standard printed instructions, have instructions prepared by personnel experienced in the operation and maintenance of the specific products.

3.04 OPERATION AND MAINTENANCE DATA FOR EQUIPMENT AND SYSTEMS

- A. For Each Item of Equipment and Each System:
 1. Description of unit or system, and component parts.
 2. Identify function, normal operating characteristics, and limiting conditions.
 3. Include performance curves, with engineering data and tests.
 4. Complete nomenclature and model number of replaceable parts.

- B. Where additional instructions are required, beyond the manufacturer's standard printed instructions, have instructions prepared by personnel experienced in the operation and maintenance of the specific products.
 - C. Panelboard Circuit Directories: Provide electrical service characteristics, controls, and communications; typed.
 - D. Include color coded wiring diagrams as installed.
 - E. Operating Procedures: Include start-up, break-in, and routine normal operating instructions and sequences. Include regulation, control, stopping, shut-down, and emergency instructions. Include summer, winter, and any special operating instructions.
 - F. Maintenance Requirements: Include routine procedures and guide for preventative maintenance and trouble shooting; disassembly, repair, and reassembly instructions; and alignment, adjusting, balancing, and checking instructions.
 - G. Provide servicing and lubrication schedule, and list of lubricants required.
 - H. Include manufacturer's printed operation and maintenance instructions.
 - I. Include sequence of operation by controls manufacturer.
 - J. Provide original manufacturer's parts list, illustrations, assembly drawings, and diagrams required for maintenance.
 - K. Provide control diagrams by controls manufacturer as installed.
 - L. Provide Contractor's coordination drawings, with color coded piping diagrams as installed.
 - M. Provide charts of valve tag numbers, with location and function of each valve, keyed to flow and control diagrams.
 - N. Provide list of original manufacturer's spare parts, current prices, and recommended quantities to be maintained in storage.
 - O. Include test and balancing reports.
 - P. Additional Requirements: As specified in individual product specification sections.
- 3.05 ASSEMBLY OF OPERATION AND MAINTENANCE MANUALS
- A. Assemble operation and maintenance data into durable manuals for Owner's personnel use, with data arranged in the same sequence as, and identified by, the specification sections.
 - B. Where systems involve more than one specification section, provide separate tabbed divider for each system.

- C. Binders: Commercial quality, 8-1/2 by 11 inch (216 by 280 mm) three D side ring binders with durable plastic covers; 2 inch (50 mm) maximum ring size. When multiple binders are used, correlate data into related consistent groupings. Provide two paper copies.
 - 1. PDF Electronic file: In addition to paper copies, assemble each manual in composite electronically indexed file. Submit on digital media acceptable to Architect.
 - a. Name each indexed document file in composite electronic index with applicable item name. Include a complete electronically linked operation and maintenance directory.
 - 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.
 - I. Drawings: Provide with reinforced punched binder tab. Bind in with text; fold larger drawings to size of text pages.
 - J. Arrangement of Contents: Organize each volume in parts as follows:
 - 1. Project Directory.
 - 2. Table of Contents, of all volumes, and of this volume.
 - 3. Operation and Maintenance Data: Arranged by system, then by product category.
 - a. Source data.
 - b. Product data, shop drawings, and other submittals.
 - c. Operation and maintenance data.
 - d. Field quality control data.
 - e. Photocopies of warranties and bonds.
 - 4. Design Data: To allow for addition of design data furnished by Architect or others, provide a tab labeled "Design Data" and provide a binder large enough to allow for insertion of at least 20 pages of typed text.
- 3.06 WARRANTIES AND BONDS
- A. Obtain warranties and bonds, executed in duplicate by responsible Subcontractors, suppliers, and manufacturers, within 10 days after completion of the applicable item of work. Except for items put into use with Owner's permission, leave date of beginning of time of warranty until Date of Substantial completion is determined.

- B. Verify that documents are in proper form, contain full information, and are notarized.
- C. Co-execute submittals when required.
- D. Retain warranties and bonds until time specified for submittal.
- E. Manual: Bind in commercial quality 8-1/2 by 11 inch (216 by 279 mm) three D side ring binders with durable plastic covers.
 - 1. PDF Electronic file: In addition to paper copies, assemble each manual in composite electronically indexed file. Submit on digital media acceptable to Architect.
- 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.

3.07 EMERGENCY MANUALS

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

3. Operating instructions for conditions outside normal operating limits.
 4. Required sequences for electric or electronic systems.
 5. Special operating instructions and procedures.
- E. Emergency Manual: Assemble the manual of emergency information indicating the listed procedures for use by emergency personnel and Owner's operating personnel for types of emergencies listed.

END OF SECTION 01 7800

SECTION 01 7900 - DEMONSTRATION AND TRAINING

PART 1 - GENERAL

1.01 SUMMARY

- A. Demonstration of products and systems where indicated in specific specification sections.
- B. Training of Owner personnel in operation and maintenance is required for:
 - 1. All software-operated systems.
 - 2. HVAC systems and equipment.
 - 3. Plumbing equipment.
 - 4. Electrical systems and equipment.
 - 5. Door hardware.
 - 6. Items specified in individual product Sections.
- C. Training of Owner personnel in care, cleaning, maintenance, and repair is required for:
 - 1. Roofing, waterproofing, and other weather-exposed or moisture protection products.
 - 2. Finishes, including flooring, wall finishes, ceiling finishes.
 - 3. Fixtures and fittings.
 - 4. Items specified in individual product Sections.

1.02 RELATED REQUIREMENTS

- A. Section 01 7800 - Closeout Submittals: Operation and maintenance manuals.
- B. Other Specification Sections: Additional requirements for demonstration and training.

1.03 SUBMITTALS

- A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
- B. Training Plan: Owner will designate personnel to be trained; tailor training to needs and skill-level of attendees.
 - 1. Submit to Architect for transmittal to Owner.
 - 2. Submit not less than four weeks prior to start of training.
 - 3. Revise and resubmit until acceptable.
 - 4. Provide an overall schedule showing all training sessions.
 - 5. Include at least the following for each training session:
 - a. Identification, date, time, and duration.
 - b. Description of products and/or systems to be covered.
 - c. Name of firm and person conducting training; include qualifications.
 - d. Intended audience, such as job description.
 - e. Objectives of training and suggested methods of ensuring adequate training.
 - f. Methods to be used, such as classroom lecture, live demonstrations, hands-on, etc.

- g. Media to be used, such a slides, hand-outs, etc.
 - h. Training equipment required, such as projector, projection screen, etc., to be provided by Contractor.
- C. Training Manuals: Provide training outline for each attendee; allow for minimum of two attendees per training session.
 - 1. Provide one extra copy of each training outline to be included with operation and maintenance data.
- D. Training Reports:
 - 1. Identification of each training session, date, time, and duration.
 - 2. Sign-in sheet showing names and job titles of attendees.
 - 3. List of attendee questions and written answers given, including copies of and references to supporting documentation required for clarification; include answers to questions that could not be answered in original training session.

1.04 QUALITY ASSURANCE

- A. Instructor Qualifications: Familiar with design, operation, maintenance and troubleshooting of the relevant products and systems.
 - 1. Provide as instructors the most qualified trainer of those contractors and/or installers who actually supplied and installed the systems and equipment.
 - 2. Where a single person is not familiar with all aspects, provide specialists with necessary qualifications.

PART 2 - PRODUCTS

NOT USED

PART 3 - EXECUTION

3.01 DEMONSTRATION - GENERAL

- A. Demonstrations conducted during system start-up do not qualify as demonstrations for the purposes of this section, unless approved in advance by Owner.
- B. Demonstration may be combined with Owner personnel training if applicable.
- C. Operating Equipment and Systems: Demonstrate operation in all modes, including start-up, shut-down, seasonal changeover, emergency conditions, and troubleshooting, and maintenance procedures, including scheduled and preventive maintenance.
 - 1. Perform demonstrations not less than two weeks prior to Substantial Completion.
 - 2. For equipment or systems requiring seasonal operation, perform demonstration for other season within six months.

- D. Non-Operating Products: Demonstrate cleaning, scheduled and preventive maintenance, and repair procedures.
 - 1. Perform demonstrations not less than two weeks prior to Substantial Completion.

3.02 TRAINING - GENERAL

- A. Conduct training on-site unless otherwise indicated.
- B. Provide training in minimum two hour segments.
- C. Training schedule will be subject to availability of Owner's personnel to be trained; re-schedule training sessions as required by Owner; once schedule has been approved by Owner failure to conduct sessions according to schedule will be cause for Owner to charge Contractor for personnel "show-up" time.
- D. Review of Facility Policy on Operation and Maintenance Data: During training discuss:
 - 1. The location of the O&M manuals and procedures for use and preservation; backup copies.
 - 2. Typical contents and organization of all manuals, including explanatory information, system narratives, and product specific information.
 - 3. Typical uses of the O&M manuals.
- E. Product- and System-Specific Training:
 - 1. Review the applicable O&M manuals and emergency manuals.
 - 2. For systems, provide an overview of system operation, design parameters and constraints, and operational strategies.
 - 3. Review instructions for proper operation in all modes, including start-up, shut-down, seasonal changeover and emergency procedures, and for maintenance, including preventative maintenance.
 - 4. Provide hands-on training on all operational modes possible and preventive maintenance including control sequencing if applicable.
 - 5. Emphasize safe and proper operating requirements; discuss relevant health and safety issues and emergency procedures.
 - 6. Discuss common troubleshooting problems and solutions.
 - 7. Discuss any peculiarities of equipment installation or operation.
 - 8. Discuss warranties and guarantees, including procedures necessary to avoid voiding coverage.
 - 9. Review recommended tools and spare parts inventory suggestions of manufacturers.
 - 10. Review spare parts and tools required to be furnished by Contractor.
 - 11. Review spare parts suppliers and sources and procurement procedures.
- F. Be prepared to answer questions raised by training attendees; if unable to answer during training session, provide written response within three days.

END OF SECTION 01 7900

Pivot North Architecture
100% Construction Set
March 17, 2023

TWIN FALLS TRAINING FACILITY
SECTION 02 3200
GEOTECHNICAL REPORT

INSERT GEOTECHNICAL REPORT HERE

Mr. Clint Sievers
Pivot North Architecture
1101 West Grove Street
Boise, ID 83702
(208) 602-1633

Re: Groundwater Letter
Twin Falls Fire Training Facility
Rose Street and Victory Avenue
Twin Falls, ID

Dear Mr. Sievers:

This letter has been prepared to verify seasonal high groundwater as determined through regular monitoring unavailable at the time of the previously issued MTI Geotechnical Engineering Report (T200068g). Descriptions of general site characteristics and the proposed project are available in the previous report. Unless otherwise noted in this letter, all initial recommendations, limitations, and warranties expressed in the previous report must be adhered to.

The following table represents groundwater data collected for the site. It should be noted that these levels will fluctuate from year to year, and are limited to the data collected.

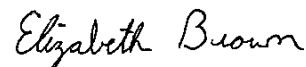
MTI will continue to monitor these wells on a monthly basis. MTI appreciates this opportunity to be of service to you and looks forward to working with you in the future. If you have questions, please call (208) 376-4748.

Respectfully Submitted,

Materials Testing & Inspection



Ethan Salove, PE
Geotechnical Engineer



Reviewed by: Elizabeth Brown, PE
Geotechnical Services Manager

Enclosures:

Groundwater Data

Groundwater Depth (Feet bgs)

Date Monitored	TP-3	TP-5	TP-7
7/15/2020	3.30 A	3.80 A	1.30 A
8/19/2020	2.50	3.10	0.80
9/16/2020	2.30	3.00	0.50
10/21/2020	2.10	3.30	0.20
11/18/2020	2.00 B	2.10 B	0.05 B
12/16/2020	2.40	2.80	0.30
1/20/2021	3.00	2.90	0.50
2/17/2021	3.00	2.90	0.40
3/17/2021	3.40	3.20	0.70
4/21/2021	3.60	3.20	0.80
5/19/2021	3.40	3.21	0.50

Legend:

- A Initial reading/depth recorded at time of piezometer installation.
- B Groundwater depth appears to be influenced by recent storm activity in the area.

SECTION 03 1000 – CONCRETE FORMING AND ACCESSORIES

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 cast-in-place concrete formwork and accessories, for the following:
 - 1. Footings and grade beams.
 - 2. Foundation walls.
 - 3. Slabs-on-grade.
 - 4. Concrete Toppings.
- B. Related Sections:
 - 1. Section 03 3000 "Cast-In-Place Concrete".
 - 2. Section 03 2000 "Concrete Reinforcement".

1.03 REFERENCES

- A. Abbreviations & Acronyms
 - 1. ACI – American Concrete Institute
- B. Reference Standards
 - 1. ACI 301-10: Specification for Structural Concrete Buildings.
 - 2. ACI 117-10: Specification for Tolerances for Concrete Construction and Materials
 - 3. ACI 347-04: Guide to Formwork for Concrete

1.04 INFORMATIONAL SUBMITTALS

- A. Material Certificates: For each of the following, signed by manufacturers:
 - 1. Form materials and form-release agents.

1.05 QUALITY ASSURANCE

- A. ACI Publications: Comply with the following unless modified by requirements in the Contract Documents:
 - 1. ACI 301-10, "Specifications for Structural Concrete for Buildings"
 - 2. ACI 117-10, "Specification for Tolerances for Concrete Construction and Materials"

PART 2 - PRODUCTS

2.01 FORM-FACING MATERIALS

- A. Smooth-Formed Finished Concrete: Form-facing panels that will provide continuous, true, and smooth concrete surfaces. Furnish in largest practicable sizes to minimize number of joints.
 - 1. Plywood, metal, or other approved panel materials.
 - 2. Exterior-grade plywood panels, suitable for concrete forms, complying with DOC PS 1, and as follows:
 - a. High-density overlay, Class 1 or better.
 - b. Medium-density overlay, Class 1 or better; mill-release agent treated and edge sealed.
 - c. Structural 1, B-B or better; mill oiled and edge sealed.
 - d. B-B (Concrete Form), Class 1 or better; mill oiled and edge sealed.
- B. Rough-Formed Finished Concrete: Plywood, lumber, metal, or another approved material. Provide lumber dressed on at least two edges and one side for tight fit.
- C. Pan-Type Forms: Glass-fiber-reinforced plastic or formed steel, stiffened to resist plastic concrete loads without detrimental deformation.
- D. Void Forms: Biodegradable paper surface, treated for moisture resistance, structurally sufficient to support weight of plastic concrete and other superimposed loads.
- E. Chamfer Strips: Wood, metal, PVC, or rubber strips, 3/4 by 3/4 inch (19 by 19 mm), minimum.
- F. Rustication Strips: Wood, metal, PVC, or rubber strips, kerfed for ease of form removal.
- G. Form-Release Agent: Commercially formulated form-release agent that will not bond with, stain, or adversely affect concrete surfaces and will not impair subsequent treatments of concrete surfaces.
 - 1. Formulate form-release agent with rust inhibitor for steel form-facing materials.
- H. Form Ties: Factory-fabricated, removable or snap-off metal or glass-fiber-reinforced plastic form ties designed to resist lateral pressure of fresh concrete on forms and to prevent spalling of concrete on removal.
 - 1. Furnish units that will leave no corrodible metal closer than 1 inch (25 mm) to the plane of exposed concrete surface.
 - 2. Furnish ties that, when removed, will leave holes no larger than 1 inch (25 mm) in diameter in concrete surface.
 - 3. Furnish ties with integral water-barrier plates to walls indicated to receive dampproofing or waterproofing.

PART 3 - EXECUTION

3.01 FORMWORK

- A. Design, erect, shore, brace, and maintain formwork, according to ACI 301, to support vertical, lateral, static, and dynamic loads, and construction loads that might be applied, until structure can support such loads.
- B. Construct formwork so concrete members and structures are of size, shape, alignment, elevation, and position indicated, within tolerance limits of ACI 117.
- C. Limit concrete surface irregularities, designated by ACI 347 as abrupt or gradual, as follows:
 - 1. Class A, 1/8 inch for smooth-formed finished surfaces.
 - 2. Class C, 1/2 inch for rough-formed finished surfaces.
- D. Construct forms tight enough to prevent loss of concrete mortar.
- E. Fabricate forms for easy removal without hammering or prying against concrete surfaces. Provide crush or wrecking plates where stripping may damage cast concrete surfaces. Provide top forms for inclined surfaces steeper than 1.5 horizontal to 1 vertical.
 - 1. Install keyways, reglets, recesses, and the like, for easy removal.
 - 2. Do not use rust-stained steel form-facing material.
- F. Set edge forms, bulkheads, and intermediate screed strips for slabs to achieve required elevations and slopes in finished concrete surfaces. Provide and secure units to support screed strips; use strike-off templates or compacting-type screeds.
- G. Provide temporary openings for cleanouts and inspection ports where interior area of formwork is inaccessible. Close openings with panels tightly fitted to forms and securely braced to prevent loss of concrete mortar. Locate temporary openings in forms at inconspicuous locations.
- H. Chamfer exterior corners and edges of permanently exposed concrete.
- I. Form openings, chases, offsets, sinkages, keyways, reglets, blocking, screeds, and bulkheads required in the Work. Determine sizes and locations from trades providing such items.
- J. Clean forms and adjacent surfaces to receive concrete. Remove chips, wood, sawdust, dirt, and other debris just before placing concrete.
- K. Retighten forms and bracing before placing concrete, as required, to prevent mortar leaks and maintain proper alignment.
- L. Coat contact surfaces of forms with form-release agent, according to manufacturer's written instructions, before placing reinforcement.

3.02 REMOVING AND REUSING FORMS

- A. General: Formwork for sides of beams, walls, columns, and similar parts of the Work that does not support weight of concrete may be removed after cumulatively curing at not less than 50 deg F (10 deg C) for 24 hours after placing concrete. Concrete has to be hard enough to not be damaged by form-removal operations and curing and protection operations need to be maintained.
 - 1. Leave formwork for beam soffits, joists, slabs, and other structural elements that supports weight of concrete in place until concrete has achieved its 28-day design compressive strength.
 - 2. Remove forms only if shores have been arranged to permit removal of forms without loosening or disturbing shores.
- B. Clean and repair surfaces of forms to be reused in the Work. Split, frayed, delaminated, or otherwise damaged form-facing material will not be acceptable for exposed surfaces. Apply new form-release agent.
- C. When forms are reused, clean surfaces, remove fins and laitance, and tighten to close joints. Align and secure joints to avoid offsets. Do not use patched forms for exposed concrete surfaces unless approved by Architect.

3.03 FINISHING FORMED SURFACES

- A. Rough-Formed Finish: As-cast concrete texture imparted by form-facing material with tie holes and defects repaired and patched. Remove fins and other projections that exceed specified limits on formed-surface irregularities.
 - 1. Apply to concrete surfaces not exposed to public view.
- B. Smooth-Formed Finish: As-cast concrete texture imparted by form-facing material, arranged in an orderly and symmetrical manner with a minimum of seams. Repair and patch tie holes and defects. Remove fins and other projections that exceed specified limits on formed-surface irregularities.
 - 1. Apply to concrete surfaces exposed to public view or to receive a rubbed finish.
- C. Rubbed Finish: Apply the following to smooth-formed finished as-cast concrete where indicated:
 - 1. Smooth-Rubbed Finish: Not later than one day after form removal, moisten concrete surfaces and rub with carborundum brick or another abrasive until producing a uniform color and texture. Do not apply cement grout other than that created by the rubbing process.
 - 2. Grout-Cleaned Finish: Wet concrete surfaces and apply grout of a consistency of thick paint to coat surfaces and fill small holes. Mix one part portland cement to one and one-half parts fine sand with a 1:1 mixture of bonding admixture and water. Add white portland cement in amounts determined by trial patches so color of dry grout will match adjacent surfaces. Scrub grout into voids and remove excess grout. When grout whitens, rub surface with clean burlap and keep surface damp by fog spray for at least 36 hours.

3. Cork-Floated Finish: Wet concrete surfaces and apply a stiff grout. Mix one part portland cement and one part fine sand with a 1:1 mixture of bonding agent and water. Add white portland cement in amounts determined by trial patches so color of dry grout will match adjacent surfaces. Compress grout into voids by grinding surface. In a swirling motion, finish surface with a cork float.
- D. Related Unformed Surfaces: At tops of walls, horizontal offsets, and similar unformed surfaces adjacent to formed surfaces, strike off smooth and finish with a texture matching adjacent formed surfaces. Continue final surface treatment of formed surfaces uniformly across adjacent unformed surfaces unless otherwise indicated.

3.04 FIELD QUALITY CONTROL

- A. Testing and Inspecting: Owner will engage a special inspector and qualified testing and inspecting agency to perform field tests and inspections and prepare test reports.
- B. All concrete work is subject to special inspection and testing. This section specifies the minimum testing and inspection required. Additional testing and inspection may be required by the Testing Agency, the Owner, or the Engineer/Architect if project conditions warrant.
- C. Special Inspector Qualifications: An independent testing agency, acceptable to authorities having jurisdiction, and qualified according to ASTM C 1077 and ASTM E 329 to conduct the testing indicated, as documented according to ASTM E 548.
- D. Tests and inspections shall be in conformance with Division 1, Section "Quality Requirements".
- E. Independent Testing Agency shall check batch tickets for compliance with required mix design(s).
- F. Continuous Field Inspection: The Independent Testing Agency shall be present at all times during the placing of structural reinforced concrete. Work shall not proceed until all inspections are completed. Prior to placing concrete, the Inspector shall inspect:
 1. Accuracy, configuration, and cleanliness of all formwork
 2. Quantity, cleanliness, and placement of all reinforcing steel.
 3. Testing Agency need not be present during entire reinforcing steel placing operations, provided he has inspected for conformance with the approved placement drawings prior to closing of forms or the delivery of concrete to the job site.
- G. No concrete shall be placed until placement of reinforcement steel has been inspected and approved. Provide 48 hours notice to the Inspector prior to placing concrete.

END OF SECTION 03 1000

SECTION 03 2000 – CONCRETE REINFORCEMENT

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 concrete reinforcement for the following:

1. Footings and grade beams.
2. Foundation walls.
3. Slabs-on-grade.
4. Concrete Toppings.

- B. Related Sections:

1. Section 03 1000 "Concrete Forming and Accessories"
2. Section 03 3000 "Cast-In-Place Concrete"

1.03 REFERENCES

- A. Abbreviations & Acronyms

1. ACI – American Concrete Institute
2. CRSI – Concrete Reinforcing Steel Institute

- B. Reference Standards

1. ACI 301-10: Specification for Structural Concrete Buildings.
2. ACI 117-10: Specification for Tolerances for Concrete Construction and Materials.

1.04 ACTION SUBMITTALS

- A. Submit in accordance with Division 01 Section "Administrative Requirements."

- B. Steel Reinforcement Shop Drawings: Placing drawings that detail fabrication, bending, and placement. Include bar sizes, lengths, material, grade, bar schedules, stirrup spacing, bent bar diagrams, bar arrangement, splices and laps, mechanical connections, tie spacing, hoop spacing, and supports for concrete reinforcement.

1. Provide details of fabrication, bending, and placement, prepared according to ACI 315, "Details and Detailing of Concrete Reinforcement." Include special reinforcement required for openings through concrete structures.
2. Shop drawing re-submittals shall clearly identify all revisions to previous submittals.
 - a. Heavy ink clouded outlines (revision clouds) shall be drawn around revised areas of individual sheets.

- b. Architect/Engineer will not review information outside of revision clouds on resubmitted drawings.

1.05 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For welder
- B. Welding certificates.
- C. Material Certificates: For each of the following, signed by manufacturers:
 - 1. Steel reinforcement and accessories.

1.06 QUALITY ASSURANCE

- A. ACI Publications: Comply with the following unless modified by requirements in the Contract Documents:
 - 1. ACI 301-10, "Specifications for Structural Concrete for Buildings"
 - 2. ACI 117-10, "Specification for Tolerances for Concrete Construction and Materials"
- B. CRSI Publications: Comply with the following, unless more stringent provisions are indicated:
 - 1. Manual of Standard Practice
 - 2. Documents 63 and 65.
- C. Qualifications
 - 1. Welding Qualifications: Qualify procedures and personnel according to AWS D1.4/D 1.4M, "Structural Welding Code - Reinforcing Steel."

1.07 DELIVERY, STORAGE, AND HANDLING

- A. Steel Reinforcement: Deliver, store, and handle steel reinforcement to prevent bending and damage.

PART 2 - PRODUCTS

2.01 STEEL REINFORCEMENT

- A. Reinforcing Bars: See Structural Drawings
- B. Plain-Steel Wire: See Structural Drawings
- C. Deformed-Steel Wire: See Structural Drawings

2.02 REINFORCEMENT ACCESSORIES

- A. Tie Wire: Minimum 16 gage, ASTM A 82, or acceptable patented system.

- B. Joint Dowel Bars: ASTM A 615/A 615M, Grade 60, plain-steel bars, cut true to length with ends square and free of burrs.
- C. Zinc Repair Material: ASTM A 780, zinc-based solder, paint containing zinc dust, or sprayed zinc.
- D. Bar Supports: Bolsters, chairs, spacers, and other devices for spacing, supporting, and fastening reinforcing bars and welded wire reinforcement in place. Manufacture bar supports from steel wire, plastic, or precast concrete according to CRSI's "Manual of Standard Practice," of greater compressive strength than concrete and as follows:
 - 1. For concrete surfaces exposed to view where legs of wire bar supports contact forms, use CRSI Class 1 plastic-protected steel wire or CRSI Class 2 stainless-steel bar supports.
 - 2. For epoxy-coated reinforcement, use epoxy-coated or other dielectric-polymer-coated wire bar supports.
 - 3. For zinc-coated reinforcement, use galvanized wire or dielectric-polymer-coated wire bar supports.

2.03 FABRICATING REINFORCEMENT

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

PART 3 - EXECUTION

3.01 STEEL REINFORCEMENT INSTALLATION

- A. General: Comply with CRSI's "Manual of Standard Practice" for placing reinforcement.
 - 1. Do not cut or puncture vapor retarder. Repair damage and reseal vapor retarder before placing concrete.
- B. Clean reinforcement of loose rust and mill scale, earth, ice, and other foreign materials that would reduce bond to concrete.
- C. Accurately position, support, and secure reinforcement against displacement. Locate and support reinforcement with bar supports to maintain minimum concrete cover. Do not tack weld crossing reinforcing bars.
 - 1. Weld reinforcing bars according to AWS D1.4/D 1.4M, where indicated.
- D. Set wire ties with ends directed into concrete, not toward exposed concrete surfaces.
- E. Defective Work: The following reinforcing steel work will be considered defective, and shall be removed and replaced by the Contractor at no additional cost to the Owner:
 - 1. Bars with kinks or bends not shown on the drawings.
 - 2. Bars damaged due to bending or straightening.
 - 3. Bars heated for bending.
 - 4. Reinforcement not placed in accordance with the drawings.

3.02 FIELD QUALITY CONTROL

- A. Testing and Inspecting: Owner will engage a special inspector and qualified testing and inspecting agency to perform field tests and inspections and prepare test reports.
- B. All concrete work is subject to special inspection and testing. This section specifies the minimum testing and inspection required. Additional testing and inspection may be required by the Testing Agency, the Owner, or the Engineer/Architect if project conditions warrant.
- C. Special Inspector Qualifications: An independent testing agency, acceptable to authorities having jurisdiction, and qualified according to ASTM C 1077 and ASTM E 329 to conduct the testing indicated, as documented according to ASTM E 548.
- D. Tests and inspections shall be in conformance with Division 1, Section "Quality Requirements".
- E. Independent Testing Agency shall check batch tickets for compliance with required mix design(s).
- F. Inspections:
 - 1. Steel reinforcement placement.
 - 2. Steel reinforcement welding.
- G. Reinforcing Steel Testing: Independent Testing Agency will perform the following:
 - 1. All steel bars that can be positively identified as to heat number and mill analysis shall have one tensile test bending test for each 10 tons, or fraction thereof, for all #5 bars and larger.
 - 2. All steel bars that cannot be identified shall have one tensile and one bend test made for each 2 1/2 tons, or fraction thereof, of each size and kind of reinforcing steel.
 - 3. Testing procedure shall conform to ASTM A 615.
- H. Reinforcement Welding: All shop and field welds of reinforcing steel will be inspected. The Special Welding Inspector will check the materials and equipment, the qualifications and ability of the welder, and details of construction and procedure, as well as the welds themselves. The Inspector may use gamma ray, magneflux, trepanning, ultrasonics, or any other aid to visual inspection which the Inspector may deem necessary to determine the adequacy of the welding.
- I. No concrete shall be placed until placement of reinforcement steel has been inspected and approved. Provide 48 hours notice to the Inspector prior to placing concrete.

END OF SECTION 03 2000

SECTION 03 3000 – CAST-IN-PLACE CONCRETE

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 cast-in-place concrete, including, concrete materials, mixture design, placement procedures, and finishes, for the following:
 - 1. Footings and grade beams.
 - 2. Foundation walls.
 - 3. Slabs-on-grade.
 - 4. Concrete Toppings.
- B. Related Sections:
 - 1. Section 03 1000 “Concrete Forming and Accessories”
 - 2. Section 03 2000 “Concrete Reinforcing”
 - 3. Section 07 2616 “Underslab Vapor Barrier”

1.03 REFERENCES

- A. Abbreviations & Acronyms
 - 1. ACI – American Concrete Institute
 - 2. NRMCA – National Ready Mixed Concrete Association
- B. Definitions
 - 1. Cementitious Materials: Portland cement alone or in combination with one or more of the following: blended hydraulic cement, fly ash and other pozzolans, ground granulated blast-furnace slag, and silica fume; subject to compliance with requirements.
 - 2. W/C Ratio: The ratio by weight of water to cementitious materials.
- C. Reference Standards
 - 1. ACI 301-10: Specification for Structural Concrete Buildings.
 - 2. ACI 117-10: Specification for Tolerances for Concrete Construction and Materials

1.04 ADMINISTRATIVE REQUIREMENTS:

- A. Preinstallation Conference: Conduct conference at project site
 - 1. Before submitting design mixtures, review concrete design mixture and examine procedures for ensuring quality of concrete materials. Require representatives of each entity directly concerned with cast-in-place concrete to attend, including the following:
 - a. Contractor's superintendent

- b. Independent testing agency responsible for concrete design mixtures
 - c. Ready-mix concrete manufacturer
 - d. Concrete subcontractor
 - e. Special concrete finish subcontractor
2. Review special inspection and testing and inspecting agency procedures for field quality control, concrete finishes and finishing, cold- and hot-weather concreting procedures, curing procedures, construction contraction and isolation joints, forms and form removal limitations, shoring and re-shoring procedures, vapor-retarder installation, anchor rod and anchorage device installation tolerances, steel reinforcement installation, floor and slab flatness and levelness measurement, concrete repair procedures, and concrete protection.

1.05 ACTION SUBMITTALS

- A. Submit in accordance with Division 01 Section "Administrative Requirements."
- B. Design Mixtures: For each concrete mixture. Submit alternate design mixtures when characteristics of materials, Project conditions, weather, test results, or other circumstances warrant adjustments.
1. Submit proposed mix designs at least 15 days in advance of placing operations for each concrete mixture. The submitted mix design shall include the following:
 - a. Supporting strength test data not more than 12 months old. At the Engineer's request, reports from the independent testing agencies may be required to document the test data. Reports from the independent testing agencies will be required if fly ash is used in the design mix.
 - b. Statistical analysis in compliance with ACI 301.
 - c. Gradation of fine and coarse aggregates not more than 90 days old (ASTM C 33). No substitution of aggregate type or size from those submitted will be permitted.
 - d. Proportions of all ingredients, including all admixtures added either at time of batching or at job site. Aggregate weights shall be based upon saturated surface dry conditions.
 - e. Water/cement ratio.
 - f. Slump (ASTM C 143): When high range water-reducing admixtures are used, slump before and after addition of admixture are required.
 - g. Air content of freshly mixed concrete (ASTM C 231).
 - h. Material Certificates for the following:
 - 1) Cementitious Materials
 - 2) Admixtures
 - i. Certification that all ingredients in each mix design are compatible
 - j. Locations or intended use of each mix design.
 - k. Source of all materials.
 - l. Indicate amounts of mixing water to be withheld for later addition at Project site.
- C. Embedded Item Placement Drawings: Drawings indicating the location and type of plates, anchorages, or other items to be embedded in the finished concrete surfaces. Include wall elevations, slab plans, and details required to locate and install embeds.

- D. Samples: For waterstops.
- E. Saw Cut Joints: Indicate proposed locations for all saw cut joints not shown on the drawings.
 - 1. Location of saw cut joints is subject to approval of the Architect.
- F. Construction Joint Layout: Indicate proposed construction joints required to construct the structure.
 - 1. Location of construction joints is subject to approval of the Architect.

1.06 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For Installer, manufacturer, and testing agency.
- B. Welding certificates.
- C. Material Certificates: For each of the following, signed by manufacturers:
 - 1. Form materials and form-release agents.
 - 2. Steel reinforcement and accessories.
 - 3. Waterstops.
 - 4. Curing compounds.
 - 5. Floor and slab treatments.
 - 6. Bonding agents.
 - 7. Adhesives.
 - 8. Semirigid joint filler.
 - 9. Joint-filler strips.
 - 10. Repair materials.
- D. Material Test Reports: For the following, from a qualified testing agency, indicating compliance with requirements:
 - 1. Aggregates. Include service record data indicating absence of deleterious expansion of concrete due to alkali aggregate reactivity.
- E. Written curing procedure, including curing procedures for hot- and cold-weather placement.
- F. Floor surface flatness and levelness measurements indicating compliance with specified tolerances.
- G. Field quality-control reports.
- H. Minutes of preinstallation conference.

1.07 QUALITY ASSURANCE

- A. ACI Publications: Comply with the following unless modified by requirements in the Contract Documents:
 - 1. ACI 301-10, "Specifications for Structural Concrete for Buildings"
 - 2. ACI 117-10, "Specification for Tolerances for Concrete Construction and Materials"

- B. CRSI Publications: Comply with the following, unless more stringent provisions are indicated:
 - 1. Manual of Standard Practice
 - 2. Documents 63 and 65.

- C. Qualifications
 - 1. Installer Qualifications: A qualified installer who employs on Project personnel qualified as ACI-certified Flatwork Technician and Finisher and a supervisor who is an ACI-certified Concrete Flatwork Technician.
 - 2. Manufacturer Qualifications: A firm experienced in manufacturing ready-mixed concrete products and that complies with ASTM C 94/C 94M requirements for production facilities and equipment.
 - a. Manufacturer certified according to NRMCA's "Certification of Ready Mixed Concrete Production Facilities."
 - 3. Testing Agency Qualifications: An independent agency, acceptable to authorities having jurisdiction, qualified according to ASTM C 1077 and ASTM E 329 for testing indicated.
 - a. Personnel conducting field tests shall be qualified as ACI Concrete Field Testing Technician, Grade 1, according to ACI CP-1 or an equivalent certification program.
 - b. Personnel performing laboratory tests shall be ACI-certified Concrete Strength Testing Technician and Concrete Laboratory Testing Technician - Grade I. Testing Agency laboratory supervisor shall be an ACI-certified Concrete Laboratory Testing Technician - Grade II.

- D. Source Limitations: Obtain each type or class of cementitious material of the same brand from the same manufacturer's plant, obtain aggregate from single source, and obtain admixtures from single source from single manufacturer.

- E. Coordinate chemical and adhesion compatibility of curing compounds used for curing concrete with coatings, stains, paints, liquid flashings, sealers, waterproofing membranes, joint sealants and other materials that penetrate, adhere to or otherwise come into contact with concrete surfaces that are specified in other sections.

- F. Batch Tickets: Provide batch tickets for review by inspector for each truckload of concrete used in the work, indicating project identification name and number, date, mix type, mix time, quantity, and amount of cement and water introduced.

- G. Concrete Finishing and Curing:
 - 1. Obtain each type, composition, and variety of liquid membrane-forming curing compound used for the Project from the same manufacturer.
 - 2. Products from more than one approved manufacturer may be used for different applications, however all products for like applications shall be by the same manufacturer.
 - 3. Liquid membrane curing compound manufacturer qualifications: Obtain materials only from a manufacturer that will send an experienced technical field representative to the Project site before the start of work to verify existing conditions, and during the execution of work to perform manufacturer's field services.

1.08 DELIVERY, STORAGE, AND HANDLING

- A. Store materials in accordance with ACI 301. Admixtures which have been in storage at the project site for longer than six months or which have been subjected to freezing shall not be used, unless retested and proven to meet the specified requirements.
- B. Waterstops: Store waterstops under cover to protect from moisture, sunlight, dirt, oil, and other contaminants.

1.09 FIELD CONDITIONS

- A. Cold-Weather Placement: Comply with ACI 306.1 and as follows. Protect concrete work from physical damage or reduced strength that could be caused by frost, freezing actions, or low temperatures.
 - 1. When average high and low temperature is expected to fall below 40 deg F for three successive days, maintain delivered concrete mixture temperature within the temperature range required by ACI 301.
 - 2. Do not use frozen materials or materials containing ice or snow. Do not place concrete on frozen subgrade or on subgrade containing frozen materials.
 - 3. Do not use calcium chloride, salt, or other materials containing antifreeze agents or chemical accelerators unless otherwise specified and approved in mixture designs.
- B. Hot-Weather Placement: Comply with ACI 301 and as follows:
 - 1. Maintain concrete temperature below 90 deg F at time of placement. Chilled mixing water or chopped ice may be used to control temperature, provided water equivalent of ice is calculated to total amount of mixing water. Using liquid nitrogen to cool concrete is Contractor's option.
 - 2. Fog-spray forms, steel reinforcement, and subgrade just before placing concrete. Keep subgrade uniformly moist without standing water, soft spots, or dry areas.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

- A. In other Part 2 articles where titles below introduce lists, the following requirements apply to product selection:
 - 1. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, products specified.
 - 2. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, manufacturers specified.

2.02 CONCRETE MATERIALS

- A. Cementitious Material: Use the following cementitious materials, of the same type, brand, and source, throughout Project:
 - 1. Portland Cement: ASTM C 150, Type II Supplement with the following:

- a. Fly Ash: ASTM C 618, Class C.
 - b. Ground Granulated Blast-Furnace Slag: ASTM C 989, Grade 100 or 120.
 - c. Silica Fume: ASTM C 1240, amorphous silica.
- B. Normal-Weight Aggregates: ASTM C 33, coarse aggregate, graded. Provide aggregates from a single source.
1. Unless maximum aggregate size is listed specifically under "Project Mix Requirements," the maximum aggregate size shall not exceed:
 - a. Three-fourths of the minimum clear spacing between reinforcing bars.
 - b. One-fifth of the narrowest dimension between the sides of the forms.
 - c. One-third of the thickness of the slabs or toppings.
 2. Fine Aggregate: Free of materials with deleterious reactivity to alkali in cement.
- C. Water: ASTM C 94/C 94M and potable.

2.03 ADMIXTURES

- A. General
1. Admixtures certified by manufacturer to contain not more than 0.05 percent water-soluble chloride ions by mass of cementitious material. Do not use admixtures containing calcium chloride or thiocyanate.
 2. Where more than one admixture is used in the mix, furnish manufacturer's certification to the Architect that the admixtures to be used are compatible in combination with the cement and aggregates.
 3. Accelerating admixtures shall not be used.
- B. Air-Entraining Admixture: ASTM C 260.
- C. Chemical Admixtures: Provide admixtures certified by manufacturer to be compatible with other admixtures and that will not contribute water-soluble chloride ions exceeding those permitted in hardened concrete. Do not use calcium chloride or admixtures containing calcium chloride.
1. Water-Reducing Admixture: ASTM C 494/C 494M, Type A.
 2. Retarding Admixture: ASTM C 494/C 494M, Type B.
 3. Water-Reducing and Retarding Admixture: ASTM C 494/C 494M, Type D.
 4. High-Range, Water-Reducing Admixture: ASTM C 494/C 494M, Type F.
 5. High-Range, Water-Reducing and Retarding Admixture: ASTM C 494/C 494M, Type G.
 6. Plasticizing and Retarding Admixture: ASTM C 1017/C 1017M, Type II.
- A. Set-Accelerating Corrosion-Inhibiting Admixture: Commercially formulated, anodic inhibitor or mixed cathodic and anodic inhibitor; capable of forming a protective barrier and minimizing chloride reactions with steel reinforcement in concrete and complying with ASTM C494/C494M, Type C.
1. Products:
 - a. Axim Italcementi Group, Inc.; CATEXOL CN-CI.
 - b. BASF Construction Chemicals – Building Systems; Rheocrete CNI.
 - c. Euclid Chemical Company (The); Eucon, CIA.

- d. Grace Construction Products, W.R. Grace & Co.; DCI.
 - e. Sika Corporation; Sika CNI.
- A. Non-Set-Accelerating Corrosion-Inhibiting Admixture: Commercially formulated, non-set-accelerating, anodic inhibitor or mixed cathodic and anodic inhibitor; capable of forming a protective barrier and minimizing chloride reactions with steel reinforcement in concrete.
- 1. Products:
 - a. BASF Construction Chemicals – Building Systems; Rheocrete 222+.
 - b. Cortec Corporation; MCI 2000.
 - c. Grace Construction Products, W.R. Grace & Co.; DCI-S.
 - d. Sika Corporation; FerroGard-901.
- 2.04 VAPOR RETARDERS
- A. Sheet Vapor Retarder, Class A: As specified in Section 07 2616 – Underslab Vapor Barrier.
- 2.05 WATERSTOPS
- A. Flexible Rubber Waterstops: CE CRD-C 513 for embedding in concrete to prevent passage of fluids through joints. Factory fabricate corners, intersections, and directional changes.
- 1. Profile: As indicated.
 - 2. Dimensions: 6 inches by 3/8 inch thick; nontapered.
- B. Self-Expanding Rubber Strip Waterstops: Manufactured rectangular or trapezoidal strip, bentonite-free hydrophilic polymer modified chloroprene rubber, for adhesive bonding to concrete, 3/8 by 3/4 inch.
- 2.06 LIQUID FLOOR TREATMENTS
- A. Penetrating Liquid Floor Treatment: Clear, chemically reactive, waterborne solution of inorganic silicate or silicate materials and proprietary components; odorless; that penetrates, hardens, and densifies concrete surfaces.
- 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. ChemMasters; Chemisil Plus.
 - b. ChemTec Int'l; ChemTec One.
 - c. Conspec by Dayton Superior; Intraseal.
 - d. Curecrete Distribution Inc.; Ashford Formula.
 - e. Dayton Superior Corporation; Day-Chem Sure Hard (J-17).
 - f. Edoco by Dayton Superior; Titan Hard.
 - g. Euclid Chemical Company (The), an RPM company; Euco Diamond Hard.
 - h. Kaufman Products, Inc.; SureHard.
 - i. L&M Construction Chemicals, Inc.; Seal Hard.
 - j. Meadows, W. R., Inc.; LIQUI-HARD.
 - k. Metalcrete Industries; Floorsaver.
 - l. Nox-Crete Products Group; Duro-Nox.
 - m. Symons by Dayton Superior; Buff Hard.
 - n. US SPEC, Division of US Mix Products Company; US SPEC Industraseal.

- o. Vexcon Chemicals, Inc.; Vexcon StarSeal PS Clear.

2.07 CURING MATERIALS

- A. Evaporation Retarder: Waterborne, monomolecular film forming, manufactured for application to fresh concrete.
 - 1. Products:
 - a. Dayton Superior Corporation; Sure Film.
 - b. Euclid Chemical Company (The); Eucobar.
 - c. Sika Corporation, Inc.; SikaFilm.
- B. Absorptive Cover: AASHTO M 182, Class 2, burlap cloth made from jute or kenaf, weighing approximately 9 oz./sq. yd. (305 g/sq. m) when dry.
- C. Moisture-Retaining Cover: ASTM C 171, polyethylene film or white burlap-polyethylene sheet.
- D. Water: Potable.
- E. Clear, Waterborne, Membrane-Forming Curing Compound: ASTM C 309, Type 1, Class B, dissipating.

2.08 RELATED MATERIALS

- A. Expansion- and Isolation-Joint-Filler Strips: ASTM D 1751, asphalt-saturated cellulosic fiber
- B. Semirigid Joint Filler: Two-component, semirigid, 100 percent solids, epoxy resin with a Type A shore durometer hardness of 80 per ASTM D 2240.
- C. Bonding Agent: ASTM C 1059/C 1059M, Type II, non-redispersible, acrylic emulsion or styrene butadiene.
- D. Epoxy Bonding Adhesive: ASTM C 881, two-component epoxy resin, capable of humid curing and bonding to damp surfaces, of class suitable for application temperature and of grade to suit requirements, and as follows:
 - 1. Types IV and V, load bearing, for bonding hardened or freshly mixed concrete to hardened concrete.

2.09 REPAIR MATERIALS

- A. Repair Underlayment: Cement-based, polymer-modified, self-leveling product that can be applied in thicknesses from 1/8 inch (3.2 mm) and that can be feathered at edges to match adjacent floor elevations.
 - 1. Cement Binder: ASTM C 150, portland cement or hydraulic or blended hydraulic cement as defined in ASTM C 219.
 - 2. Primer: Product of underlayment manufacturer recommended for substrate, conditions, and application.

3. Aggregate: Well-graded, washed gravel, 1/8 to 1/4 inch (3.2 to 6 mm) or coarse sand as recommended by underlayment manufacturer.
 4. Compressive Strength: Not less than 4100 psi at 28 days when tested according to ASTM C 109/C 109M.
- B. Repair Overlayment: Cement-based, polymer-modified, self-leveling product that can be applied in thicknesses from 1/4 inch (6.4 mm) and that can be filled in over a scarified surface to match adjacent floor elevations.
1. Cement Binder: ASTM C 150, portland cement or hydraulic or blended hydraulic cement as defined in ASTM C 219.
 2. Primer: Product of topping manufacturer recommended for substrate, conditions, and application.
 3. Aggregate: Well-graded, washed gravel, 1/8 to 1/4 inch (3.2 to 6 mm) or coarse sand as recommended by topping manufacturer.
 4. Compressive Strength: Not less than 5000 psi (34.5 MPa) at 28 days when tested according to ASTM C 109/C 109M.

2.10 CONCRETE MIXTURES, GENERAL

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

2. Use water-reducing and retarding admixture when required by high temperatures, low humidity, or other adverse placement conditions.
3. Use water-reducing admixture in pumped concrete, concrete for heavy-use industrial slabs and parking structure slabs, concrete required to be watertight, and concrete with a water-cementitious materials ratio below 0.50.
4. Use corrosion-inhibiting admixture in concrete mixtures where indicated.

2.11 CONCRETE MIXTURES FOR BUILDING ELEMENTS

- A. Concrete mix design shall comply with the requirements of the structural drawings.

2.12 CONCRETE MIXING

- A. Ready-Mixed Concrete: Measure, batch, mix, and deliver concrete according to ASTM C 94/C 94M and furnish batch ticket information.
 1. When air temperature is between 85 and 90 deg F (30 and 32 deg C), reduce mixing and delivery time from 1-1/2 hours to 75 minutes; when air temperature is above 90 deg F (32 deg C), reduce mixing and delivery time to 60 minutes.

PART 3 - EXECUTION

3.01 EMBEDDED ITEMS

- A. Place and secure anchorage devices and other embedded items required for adjoining work that is attached to or supported by cast-in-place concrete. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
 1. Install anchor rods, accurately located, to elevations required and complying with tolerances in Section 7.5 of AISC 303, "Code of Standard Practice for Steel Buildings and Bridges."
 2. Install connection plates, angles, or other embedded items flush with concrete surface and at accurate locations per the approved embedded item placement drawings required by Part 1, "Submittals," section.

3.02 INSTALLATION OF VAPOR RETARDER

- A. Sheet Vapor Retarders: See Section 07 2616 – Underslab Vapor Barrier for installation.

3.03 JOINTS

- A. General: Construct joints true to line with faces perpendicular to surface plane of concrete.
- B. Construction Joints: Install so strength and appearance of concrete are not impaired, at locations indicated or as approved by Architect.
 1. Place joints perpendicular to main reinforcement. Continue reinforcement across construction joints unless otherwise indicated. Do not continue reinforcement through sides of strip placements of floors and slabs.
 2. Form keyed joints as indicated. Embed keys at least 1-1/2 inches (38 mm) into concrete.

3. Locate joints for beams, slabs, joists, and girders in the middle third of spans. Offset joints in girders a minimum distance of twice the beam width from a beam-girder intersection.
 4. Locate horizontal joints in walls and columns at underside of floors, slabs, beams, and girders and at the top of footings or floor slabs.
 5. Space vertical joints in walls at maximum of 30-foot spacing. Locate joints beside piers integral with walls, near corners, and in concealed locations where possible.
 6. Use a bonding agent at locations where fresh concrete is placed against hardened or partially hardened concrete surfaces.
 7. Use epoxy-bonding adhesive at locations where fresh concrete is placed against hardened or partially hardened concrete surfaces.
 8. Provide roughened surfaces at joints where shown on the drawings. Roughen to a full amplitude of approximately 1/4-inch.
- C. Contraction Joints in Slabs-on-Grade: Form weakened-plane contraction joints, sectioning concrete into areas as indicated. Construct contraction joints for a depth equal to at least one-fourth of concrete thickness as follows:
1. Grooved Joints: Form contraction joints after initial floating by grooving and finishing each edge of joint to a radius of 1/8 inch (3.2 mm). Repeat grooving of contraction joints after applying surface finishes. Eliminate groover tool marks on concrete surfaces.
 2. Sawed Joints: Form contraction joints with power saws equipped with shatterproof abrasive or diamond-rimmed blades. Cut 1/8-inch- (3.2-mm-) wide joints into concrete when cutting action will not tear, abrade, or otherwise damage surface and before concrete develops random contraction cracks.
- D. Isolation Joints in Slabs-on-Grade: After removing formwork, install joint-filler strips at slab junctions with vertical surfaces, such as column pedestals, foundation walls, grade beams, and other locations, as indicated.
1. Extend joint-filler strips full width and depth of joint, terminating flush with finished concrete surface unless otherwise indicated.
 2. Terminate full-width joint-filler strips not less than 1/2 inch (13 mm) or more than 1 inch (25 mm) below finished concrete surface where joint sealants, specified in Section 07 9200 "Joint Sealants," are indicated.
 3. Install joint-filler strips in lengths as long as practicable. Where more than one length is required, lace or clip sections together.
- E. Doweled Joints: Install dowel bars and support assemblies at joints where indicated. Lubricate or asphalt coat one-half of dowel length to prevent concrete bonding to one side of joint.
- 3.04 WATERSTOP INSTALLATION
- A. Flexible Waterstops: Install in construction joints and at other joints indicated to form a continuous diaphragm. Install in longest lengths practicable. Support and protect exposed waterstops during progress of the Work. Field fabricate joints in waterstops according to manufacturer's written instructions.

3.05 CONCRETE PLACEMENT

- A. Before placing concrete, verify that installation of formwork, reinforcement, and embedded items is complete and that required inspections have been performed.
- B. Do not add water to concrete during delivery, at Project site, or during placement unless approved by Architect.
- C. Before test sampling and placing concrete, water may be added at Project site, subject to limitations of ACI 301.
 - 1. Do not add water to concrete after adding high-range water-reducing admixtures to mixture.
- D. Deposit concrete continuously in one layer or in horizontal layers of such thickness that no new concrete will be placed on concrete that has hardened enough to cause seams or planes of weakness. If a section cannot be placed continuously, provide construction joints as indicated. Deposit concrete to avoid segregation.
 - 1. Deposit concrete in horizontal layers of depth to not exceed formwork design pressures and in a manner to avoid inclined construction joints.
 - 2. Consolidate placed concrete with mechanical vibrating equipment according to ACI 301.
 - 3. Do not use vibrators to transport concrete inside forms. Insert and withdraw vibrators vertically at uniformly spaced locations to rapidly penetrate placed layer and at least 6 inches (150 mm) into preceding layer. Do not insert vibrators into lower layers of concrete that have begun to lose plasticity. At each insertion, limit duration of vibration to time necessary to consolidate concrete and complete embedment of reinforcement and other embedded items without causing mixture constituents to segregate.
- E. Deposit and consolidate concrete for floors and slabs in a continuous operation, within limits of construction joints, until placement of a panel or section is complete.
 - 1. Consolidate concrete during placement operations so concrete is thoroughly worked around reinforcement and other embedded items and into corners.
 - 2. Maintain reinforcement in position on chairs during concrete placement.
 - 3. Screed slab surfaces with a straightedge and strike off to correct elevations.
 - 4. Slope surfaces uniformly to drains where required.
 - 5. Begin initial floating using bull floats or darbies to form a uniform and open-textured surface plane, before excess bleedwater appears on the surface. Do not further disturb slab surfaces before starting finishing operations.

3.06 FINISHING FORMED SURFACES

- A. Rough-Formed Finish: As-cast concrete texture imparted by form-facing material with tie holes and defects repaired and patched. Remove fins and other projections that exceed specified limits on formed-surface irregularities.
 - 1. Apply to concrete surfaces not exposed to public view.
- B. Smooth-Formed Finish: As-cast concrete texture imparted by form-facing material, arranged in an orderly and symmetrical manner with a minimum of seams. Repair and patch tie holes

and defects. Remove fins and other projections that exceed specified limits on formed-surface irregularities.

1. Apply to concrete surfaces exposed to public view or to receive a rubbed finish.

C. Rubbed Finish: Apply the following to smooth-formed finished as-cast concrete where indicated:

1. Smooth-Rubbed Finish: Not later than one day after form removal, moisten concrete surfaces and rub with carborundum brick or another abrasive until producing a uniform color and texture. Do not apply cement grout other than that created by the rubbing process.
2. Grout-Cleaned Finish: Wet concrete surfaces and apply grout of a consistency of thick paint to coat surfaces and fill small holes. Mix one part portland cement to one and one-half parts fine sand with a 1:1 mixture of bonding admixture and water. Add white portland cement in amounts determined by trial patches so color of dry grout will match adjacent surfaces. Scrub grout into voids and remove excess grout. When grout whitens, rub surface with clean burlap and keep surface damp by fog spray for at least 36 hours.
3. Cork-Floated Finish: Wet concrete surfaces and apply a stiff grout. Mix one part portland cement and one part fine sand with a 1:1 mixture of bonding agent and water. Add white portland cement in amounts determined by trial patches so color of dry grout will match adjacent surfaces. Compress grout into voids by grinding surface. In a swirling motion, finish surface with a cork float.

D. Related Unformed Surfaces: At tops of walls, horizontal offsets, and similar unformed surfaces adjacent to formed surfaces, strike off smooth and finish with a texture matching adjacent formed surfaces. Continue final surface treatment of formed surfaces uniformly across adjacent unformed surfaces unless otherwise indicated.

3.07 FINISHING FLOORS AND SLABS

A. General: Comply with ACI 302.1R recommendations for screeding, restraightening, and finishing operations for concrete surfaces. Do not wet concrete surfaces.

B. Scratch Finish: While still plastic, texture concrete surface that has been screeded and bull-floated or darbied. Use stiff brushes, brooms, or rakes to produce a profile amplitude of 1/4 inch (6 mm) in one direction.

1. Apply scratch finish to receive mortar setting beds for bonded cementitious floor finishes.

C. Float Finish: Consolidate surface with power-driven floats or by hand floating if area is small or inaccessible to power driven floats. Restraighten, cut down high spots, and fill low spots. Repeat float passes and restraightening until surface is left with a uniform, smooth, granular texture.

1. Apply float finish to surfaces to receive trowel finish.

D. Trowel Finish: After applying float finish, apply first troweling and consolidate concrete by hand or power-driven trowel. Continue troweling passes and restraighten until surface is free

of trowel marks and uniform in texture and appearance. Grind smooth any surface defects that would telegraph through applied coatings or floor coverings.

1. Apply a trowel finish to surfaces indicated to be covered with resilient flooring, carpet, ceramic or quarry tile set over a cleavage membrane, paint, or another thin-film-finish coating system.

- E. Broom Finish: Apply a broom finish to exterior concrete, steps, ramps, and elsewhere as indicated.

1. Immediately after float finishing, slightly roughen trafficked surface by brooming with fiber-bristle broom perpendicular to main traffic rout. Coordinate required final finish with Architect before application.

3.08 MISCELLANEOUS CONCRETE ITEMS

- A. Filling In: Fill in holes and openings left in concrete structures after work of other trades is in place unless otherwise indicated. Mix, place, and cure concrete, as specified, to blend with in-place construction. Provide other miscellaneous concrete filling indicated or required to complete the Work.

- B. Curbs: Provide monolithic finish to interior curbs by stripping forms while concrete is still green and by steel-troweling surfaces to a hard, dense finish with corners, intersections, and terminations slightly rounded.

3.09 CONCRETE PROTECTING AND CURING

- A. General: Protect freshly placed concrete from premature drying and excessive cold or hot temperatures. Comply with ACI 306.1 for cold-weather protection and ACI 301 for hot-weather protection during curing.

- B. Evaporation Retarder: Apply evaporation retarder to unformed concrete surfaces if hot, dry, or windy conditions cause moisture loss approaching 0.2 lb/sq. ft. x h (1 kg/sq. m x h) before and during finishing operations. Apply according to manufacturer's written instructions after placing, screeding, and bull floating or darbying concrete, but before float finishing.

- C. Formed Surfaces: Cure formed concrete surfaces, including underside of beams, supported slabs, and other similar surfaces. If forms remain during curing period, moist cure after loosening forms. If removing forms before end of curing period, continue curing for the remainder of the curing period.

- D. Unformed Surfaces: Begin curing immediately after finishing concrete. Cure unformed surfaces, including floors and slabs, concrete floor toppings, and other surfaces.

- E. Cure concrete according to ACI 308.1, by one or a combination of the following methods:

1. Moisture Curing: Keep surfaces continuously moist for not less than seven days with the following materials:

- a. Water.
- b. Continuous water-fog spray.

- c. Absorptive cover, water saturated, and kept continuously wet. Cover concrete surfaces and edges with 12-inch (300-mm) lap over adjacent absorptive covers.
 2. Moisture-Retaining-Cover Curing: Cover concrete surfaces with moisture-retaining cover for curing concrete, placed in widest practicable width, with sides and ends lapped at least 12 inches (300 mm), and sealed by waterproof tape or adhesive. Cure for not less than seven days. Immediately repair any holes or tears during curing period using cover material and waterproof tape.
 - a. Moisture cure or use moisture-retaining covers to cure concrete surfaces to receive floor coverings.
 - b. Moisture cure or use moisture-retaining covers to cure concrete surfaces to receive penetrating liquid floor treatments.
 - c. Cure concrete surfaces to receive floor coverings with either a moisture-retaining cover or a curing compound that the manufacturer certifies will not interfere with bonding of floor covering used on Project.
 3. Curing Compound: Apply uniformly in continuous operation by power spray or roller according to manufacturer's written instructions. Recoat areas subjected to heavy rainfall within three hours after initial application. Maintain continuity of coating and repair damage during curing period.
 - a. Removal: After curing period has elapsed, remove curing compound without damaging concrete surfaces by method recommended by curing compound manufacturer unless manufacturer certifies curing compound will not interfere with bonding of floor covering used on Project.
 4. Curing and Sealing Compound: Apply uniformly to floors and slabs indicated in a continuous operation by power spray or roller according to manufacturer's written instructions. Recoat areas subjected to heavy rainfall within three hours after initial application. Repeat process 24 hours later and apply a second coat. Maintain continuity of coating and repair damage during curing period.

3.10 JOINT FILLING

- A. Prepare, clean, and install joint filler according to manufacturer's written instructions.
 1. Defer joint filling until concrete has aged at least one month(s). Do not fill joints until construction traffic has permanently ceased.
- B. Remove dirt, debris, saw cuttings, curing compounds, and sealers from joints; leave contact faces of joint clean and dry.
- C. Install semirigid joint filler full depth in saw-cut joints and at least 2 inches (50 mm) deep in formed joints. Overfill joint and trim joint filler flush with top of joint after hardening.

3.11 CONCRETE SURFACE REPAIRS

- A. Defective Concrete: Repair and patch defective areas when approved by Architect. Remove and replace concrete that cannot be repaired and patched to Architect's approval.

- B. Patching Mortar: Mix dry-pack patching mortar, consisting of one part portland cement to two and one-half parts fine aggregate passing a No. 16 (1.18-mm) sieve, using only enough water for handling and placing.

- C. Repairing Formed Surfaces: Surface defects include color and texture irregularities, cracks, spalls, air bubbles, honeycombs, rock pockets, fins and other projections on the surface, and stains and other discolorations that cannot be removed by cleaning.
 - 1. Immediately after form removal, cut out honeycombs, rock pockets, and voids more than 1/2 inch (13 mm) in any dimension to solid concrete. Limit cut depth to 3/4 inch (19 mm). Make edges of cuts perpendicular to concrete surface. Clean, dampen with water, and brush-coat holes and voids with bonding agent. Fill and compact with patching mortar before bonding agent has dried. Fill form-tie voids with patching mortar or cone plugs secured in place with bonding agent.
 - 2. Repair defects on surfaces exposed to view by blending white portland cement and standard portland cement so that, when dry, patching mortar will match surrounding color. Patch a test area at inconspicuous locations to verify mixture and color match before proceeding with patching. Compact mortar in place and strike off slightly higher than surrounding surface.
 - 3. Repair defects on concealed formed surfaces that affect concrete's durability and structural performance as determined by Architect.

- D. Repairing Unformed Surfaces: Test unformed surfaces, such as floors and slabs, for finish and verify surface tolerances specified for each surface. Correct low and high areas. Test surfaces sloped to drain for trueness of slope and smoothness; use a sloped template.
 - 1. Repair finished surfaces containing defects. Surface defects include spalls, popouts, honeycombs, rock pockets, crazing and cracks in excess of 0.01 inch (0.25 mm) wide or that penetrate to reinforcement or completely through unreinforced sections regardless of width, and other objectionable conditions.
 - 2. After concrete has cured at least 14 days, correct high areas by grinding.
 - 3. Correct localized low areas during or immediately after completing surface finishing operations by cutting out low areas and replacing with patching mortar. Finish repaired areas to blend into adjacent concrete.
 - 4. Correct other low areas scheduled to receive floor coverings with a repair underlayment. Prepare, mix, and apply repair underlayment and primer according to manufacturer's written instructions to produce a smooth, uniform, plane, and level surface. Feather edges to match adjacent floor elevations.
 - 5. Correct other low areas scheduled to remain exposed with a repair topping. Cut out low areas to ensure a minimum repair topping depth of 1/4 inch (6 mm) to match adjacent floor elevations. Prepare, mix, and apply repair topping and primer according to manufacturer's written instructions to produce a smooth, uniform, plane, and level surface.
 - 6. Repair defective areas, except random cracks and single holes 1 inch (25 mm) or less in diameter, by cutting out and replacing with fresh concrete. Remove defective areas with clean, square cuts and expose steel reinforcement with at least a 3/4-inch (19-mm) clearance all around. Dampen concrete surfaces in contact with patching concrete and apply bonding agent. Mix patching concrete of same materials and mixture as original

concrete except without coarse aggregate. Place, compact, and finish to blend with adjacent finished concrete. Cure in same manner as adjacent concrete.

7. Repair random cracks and single holes 1 inch (25 mm) or less in diameter with patching mortar. Groove top of cracks and cut out holes to sound concrete and clean off dust, dirt, and loose particles. Dampen cleaned concrete surfaces and apply bonding agent. Place patching mortar before bonding agent has dried. Compact patching mortar and finish to match adjacent concrete. Keep patched area continuously moist for at least 72 hours.

- E. Perform structural repairs of concrete, subject to Architect's approval, using epoxy adhesive and patching mortar.
- F. Repair materials and installation not specified above may be used, subject to Architect's approval.

3.12 FIELD QUALITY CONTROL

- A. Testing and Inspecting: Owner will engage a special inspector and qualified testing and inspecting agency to perform field tests and inspections and prepare test reports.
- B. All concrete work is subject to special inspection and testing. This section specifies the minimum testing and inspection required. Additional testing and inspection may be required by the Testing Agency, the Owner, or the Engineer/Architect if project conditions warrant.
- C. Special Inspector Qualifications: An independent testing agency, acceptable to authorities having jurisdiction, and qualified according to ASTM C 1077 and ASTM E 329 to conduct the testing indicated, as documented according to ASTM E 548.
- D. Tests and inspections shall be in conformance with Division 1, Section "Quality Requirements".
- E. Independent Testing Agency shall check batch tickets for compliance with required mix design(s).
- F. Continuous Field Inspection: The Independent Testing Agency shall be present at all times during the placing of structural reinforced concrete. Work shall not proceed until all inspections are completed. Prior to placing concrete, the Inspector shall inspect:
 1. Accuracy, configuration, and cleanliness of all formwork
 2. Quantity, cleanliness, and placement of all reinforcing steel.
 3. Testing Agency need not be present during entire reinforcing steel placing operations, provided he has inspected for conformance with the approved placement drawings prior to closing of forms or the delivery of concrete to the job site.
- G. Inspections:
 1. Headed bolts and studs.
 2. Verification of use of required design mixture.
 3. Concrete placement, including conveying and depositing.
 4. Curing procedures and maintenance of curing temperature.

- H. No concrete shall be placed until placement of reinforcement steel has been inspected and approved. Provide 48 hours notice to the Inspector prior to placing concrete.

- I. Concrete Sampling: Testing of composite samples of fresh concrete obtained according to ASTM C 172 shall be performed according to the following requirements:
 - 1. Testing Frequency: Obtain at least one composite sample for each 100 cu. yd. or fraction thereof of each concrete mixture placed each day.
 - a. When frequency of testing will provide fewer than five compressive-strength tests for each concrete mixture, testing shall be conducted from at least five randomly selected batches or from each batch if fewer than five are used.
 - 2. Slump: ASTM C 143/C 143M; one test at point of placement for each composite sample, but not less than one test for each day's pour of each concrete mixture. Perform additional tests when concrete consistency appears to change.
 - 3. Air Content: ASTM C 231, pressure method, for normal-weight concrete; one test for each composite sample, but not less than one test for each day's pour of each concrete mixture.
 - 4. Concrete Temperature: ASTM C 1064/C 1064M; one test hourly when air temperature is 40 deg F and below and when 80 deg F and above, and one test for each composite sample.
 - 5. Compression Test Specimens: ASTM C 31/C 31M.
 - a. Cast and laboratory cure two sets of two standard cylinder specimens for each composite sample.
 - b. At the Contractor's expense and direction, cast and field-cure standard cylinder specimens as may be required for construction. Number of specimens and testing age shall be determined by the Contractor based on construction sequence requirements.
 - 6. Compressive-Strength Tests: ASTM C 39/C 39M; test one set of two laboratory-cured specimens at 7 days and one set of two specimens at 28 days.
 - a. Test field-cured specimens at the Contractor's direction.
 - 7. When strength of field-cured cylinders is less than 85 percent of companion laboratory-cured cylinders, Contractor shall evaluate operations and provide corrective procedures for protecting and curing in-place concrete.
 - 8. Strength of each concrete mixture will be satisfactory if every average of any three consecutive compressive-strength tests equals or exceeds specified compressive strength and no compressive-strength test value falls below specified compressive strength by more than 500 psi.
 - 9. Test results shall be reported in writing to Architect, concrete manufacturer, and Contractor within 48 hours of testing. Reports of compressive-strength tests shall contain Project identification name and number, date of concrete placement, name of concrete testing and inspecting agency, location of concrete batch in Work, design compressive strength at 28 days, concrete mixture proportions and materials, compressive breaking strength, and type of break for both 7- and 28-day tests.
 - 10. Linear Shrinkage Tests: Test for linear shrinkage in accordance with ASTM C 157 (air storage method for 28 days. Take a minimum of 3 test samples from each mix, at the Project Representative's direction, of concrete for elevated slabs and beams. Take samples at truck and discharge end of pumped mix. Consistency of the concrete must not be altered after test samples have been taken.

11. Nondestructive Testing: Impact hammer, sonoscope, or other nondestructive device may be permitted by Architect but will not be used as sole basis for approval or rejection of concrete.
 12. Additional Tests: Testing and inspecting agency shall make additional tests of concrete when test results indicate that slump, air entrainment, compressive strengths, or other requirements have not been met, as directed by Architect. Testing and inspecting agency may conduct tests to determine adequacy of concrete by cored cylinders complying with ASTM C 42/C 42M or by other methods as directed by Architect.
 13. Additional testing and inspecting, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.
 14. Correct deficiencies in the Work that test reports and inspections indicate does not comply with the Contract Documents.
- J. Measure floor and slab flatness and levelness according to ASTM E 1155 within 48 hours of finishing.
1. Finish surfaces to the following tolerances, for a randomly trafficked floor surface:
 - a. Specified overall values of flatness, F(F) 35; and of levelness, F(L) 25; with minimum local values of flatness, F(F) 24; and of levelness, F(L) 17; for slabs-on-grade.
 - b. Specified overall values of flatness, F(F) 30; with minimum local values of flatness, F(F) 24; for suspended slabs.
 - c. Specified overall values of flatness, F(F) 40; and of levelness, F(L) 25; with minimum local values of flatness, F(F) 24; and of levelness, F(L) 17; for concrete receiving polished concrete finish.

3.13 PROTECTION OF LIQUID FLOOR TREATMENTS

- A. Protect liquid floor treatment from damage and wear during the remainder of construction period. Use protective methods and materials, including temporary covering, recommended in writing by liquid floor treatments installer.

END OF SECTION 03 3000

SECTION 03 3500 – CONCRETE FINISHES

PART 1 - GENERAL

1.01 SUMMARY

- A. Section Includes:
 - 1. Concrete Sealer.
 - 2. Concrete Sealer / Densifier.
 - 3. Standard concrete finishing.

1.02 REFERENCES

- A. American Concrete Institute (ACI): ACI 302.1R - Guide for Concrete Floor and Slab Construction.
- B. American National Standards Institute (ANSI): Standards B-101.1/2009.
- C. ASTM International (ASTM):
 - 1. ASTM C 309 - Standard Specification for Liquid Membrane-Forming Compounds for Curing Concrete.
 - 2. ASTM C 171 - Standard Specification for Sheet Materials for Curing Concrete.
 - 3. ASTM C 779 - Standard Test Method for Abrasion Resistance of Horizontal Concrete Surfaces.
- D. National Floor Safety Institute (NFSI): NFSI Test Method 101-A - Standard for Evaluating High-Traction Flooring Materials.

1.03 SUBMITTALS

- A. Product Data: Submit product data, including manufacturer's data sheet for specified products.
 - 1. Material Safety Data Sheets (MSDS).
- B. Shop Drawings:
 - 1. Flooring Shop Drawings: Indicate information on shop drawings as follows:
 - a. Plan view of floor and joint pattern layout.
 - b. Hardener, sealer, densifier identified in notes.
 - 2. Formwork Shop Drawings: Prepared by or under the supervision of a qualified professional engineer detailing fabrication, assembly and support of formwork.
 - a. Shoring and Reshoring: Indicate proposed schedule and sequence of stripping formwork, shoring removal and installing and removing reshoring.
 - 3. Joints: Show proposed location of construction joints, expansion/contraction joints and control joints and obtain approval from Architect prior to construction.
- C. Quality Assurance Submittals:

1. Test Reports: Certified test reports showing compliance with specified performance characteristics and physical properties as cited in Performance Requirements.
 2. Certificates:
 - a. Product certificates signed by manufacturer certifying materials comply with specified performance characteristics and criteria and physical requirements.
 3. Manufacturer's Instructions: Manufacturer's installation instructions.
- D. Warranty: Submit warranty documents specified.
- E. Operation and Maintenance Data: Submit operation and maintenance data for installed products.
1. Manufacturer's instructions on maintenance renewal of applied treatments.
 2. Protocols and product specifications for joint filing, crack repair and/or surface repair.

1.04 QUALITY ASSURANCE

- A. Manufacturer's Qualifications:
1. Manufacturer capable of providing field service representation during construction and approving application method.
 2. Manufacturer shall have a minimum 5 years of experience in manufacturing components similar to or exceeding requirements of project.
- B. Source Limitations: Obtain each type or class of cementitious material of the same brand from the same manufacturer's plant, each aggregate from one source, and each admixture from the same manufacturer.
1. Obtain cement and aggregates from a single source for specialty concrete finishes to provide uniformity in appearance and color.
- C. Mock-Up: Provide in place sample for approval. Approved mock-up may remain.
1. Expansion/contraction joint and control joint: 4 inch long.
 2. When accepted, mock-up will demonstrate minimum standard of quality required for this work.
- D. Pre-installation Meetings: Conduct a pre-installation meeting to verify project requirements, manufacturer's installation instructions and manufacturer's warranty requirements. Review the following:
1. Environmental requirements.
 2. Scheduling and phasing of work.
 3. Coordinating with other work and personnel. Remind all trades that they are working on a surface that is to become a finished surface.
 4. Protection of adjacent surfaces.
 5. Surface preparation.
 6. Repair of defects and defective work prior to installation.
 7. Cleaning.
 8. Protection of finished surfaces after installation.

9. Placing of materials on the concrete surface that may cause staining, etching or scratching.

1.05 DELIVERY, STORAGE, AND HANDLING

- A. Storage and Protection: Store materials at the site off the ground and in a manner to prevent damage to the materials.

1.06 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.

- B. Protect Concrete Slab:

1. Protect from petroleum stains during construction.
2. Diaper hydraulic power equipment.
3. Restrict vehicular parking.
4. Restrict use of pipe cutting machinery.
5. Restrict placement of reinforcing steel on slab.
6. Restrict use of acids or acidic detergents on slab.

- C. Waste Management and Disposal:

1. Separate waste materials for Reuse and Recycling.
2. Remove from site and dispose of packaging materials at appropriate recycling facilities.

1.07 PROJECT AMBIENT CONDITIONS

- A. Installation Location: Comply with manufacturer's written recommendations.

1.08 SEQUENCING

- A. Sequence with Other Work: Comply with manufacturer's written recommendations for sequencing construction operations.

1.09 WARRANTY

- A. 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 does not limit, other rights Owner may have under Contract Documents.

PART 2 - PRODUCTS

2.01 CONCRETE MATERIALS

- A. Refer to Structural Drawings for concrete materials, mixing, curing, joint compound, grout and reinforcement.

- B. (PC-1) Polished and Sealed Concrete:
 - 1. Penetrating Liquid Floor Treatments for Polished Concrete Finish: Clean, waterborne solution of inorganic silicate or silicate materials and proprietary components; odorless; that penetrates, hardens, and is suitable for polished concrete surfaces.
 - a. Basis of Design: Consolideck by PROSOCO, Inc; or approved equal.
 - 2. Penetrating Liquid Floor Sealer: Clear, provides water, oil, and stain repellancy. VOC Content <100 g/L.
 - a. Basis of Design: Consolideck Concrete Protector SB by PROSOCO, Inc; or approved equal.
 - 3. Penetrating Hardener/Densifier:
 - a. Basis of Design: Consolideck LS by PROSOCO, Inc; or approved equal.
 - 4. Style: Salt & Pepper; as shown on Finish Schedule.
 - 5. Finish: Matte.
 - 6. Locations: Typical locations as shown on drawings.

- C. (SC-1) Hard Troweled and Sealed:
 - 1. Basis of Design: RetroPlate Concrete Polishing System by CureCrete Distribution Inc., as provided by Diamond – S Polished Concrete Inc.
 - 2. Finish: Light Broom Finish; as shown on Finish Schedule.
 - 3. Locations: Apparatus bay and support; as shown on Drawings.

2.02 ACCESSORIES

- A. Sealing Compound: ASTM C309, Type I, Class B, dissipating, non-yellowing product.
 - 1. Acceptable Products:
 - a. BASF Construction Chemicals – Building Systems; Kure-N-Seal WB.
 - b. Dayton Superior Corporation; Safe Cure and Seal (J-18).
 - c. Euclid Chemical Company (The), an RPM company; Aqua Cure VOC; Clearseal WB 150.
 - d. L&M Construction Chemicals, Inc.; Dress & Seal WB.
 - e. Symons by Dayton Superior; Cure & Seal 18 Percent E.

- B. Sealing/Densifying Compound: Clear, chemically reactive, waterborne solution of inorganic silicate or silicate materials and proprietary components; odorless; that penetrates, hardens and densifies concrete surfaces.
 - 1. Acceptable Products:
 - a. Curecrete Distribution Inc.; Ashford Formula.
 - b. L&M Construction Chemicals, Inc.; Seal Hard.

PART 3 - EXECUTION

3.01 EXAMINATION

- A. Site Verification of Conditions:
 - 1. Verify that concrete substrate conditions, which have been previously installed under other sections are acceptable for product installation in accordance with manufacturer's instructions prior to installation of concrete finishing materials.
- B. Do not begin installation until substrates have been properly prepared.
- C. If substrate preparation is the responsibility of another installer, notify Architect of unsatisfactory preparation before proceeding.
- D. Verify Concrete Slab Performance requirements:
 - 1. Verify concrete is cured to 28 day duration and 3500 psi strength.
 - 2. Verify overall floor flatness is a minimum of Ff 40.

3.02 PREPARATION

- A. Ensure surfaces are clean and free of dirt and other foreign matter harmful to performance of concrete finishing materials.

3.03 FINISHING FLOORS AND SLABS

- A. General: Comply with ACI 302.1R recommendations for screeding, restraightening, and finishing operations for concrete surfaces. Do not wet concrete surfaces.
 - 1. Exterior Building Exposed to view Surfaces: Class A Finish. Smooth form finish per ACI 5.3.3.3.b. Tie holes, voids and honeycombed areas are to be patched. All fins are to be removed. A smooth rubbed finish per ACI 301-5.3.3.a or grout cleaned finish per ACI 301-5.3.3.4.b is to be provided. Exception: Surfaces specifically called out to receive a coating or architectural finish.
 - a. Exterior walls, planters, stairs, stem and rail walls: Class B Finish. Grind large offsets, fins and other irregularities, patch voids, offsets and irregularities, patch major voids, rock pockets, honeycombs and tie holes. Small bug holes to remain unpatched.
 - 2. Interior formed cast-in-place, Exposed to view Surfaces: Class A Finish. De-fin only, no patching or sacking. Fill all holes larger than 1/4" in diameter.
 - 3. Walls and columns in common core areas: Class B Finish (grind large offsets, fins and other irregularities, patch voids, offsets and irregularities, patch major voids, rock pockets, honeycombs and tie holes. Small bug holes to remain unpatched.
 - 4. Interior Stairwells: Class C Finish. Knock off major fins, offsets and irregularities, patch major voids, rock pockets, honeycombs. Tie holes to remain unpatched.
- B. Float Finish: Consolidate surface with power-driven floats or by hand floating if area is small or inaccessible to power-driven floats. Restraighten, cut down high spots, and fill low spots. Repeat float passes and restraightening until surface is left with a uniform, smooth, granular texture.

1. Apply float finish to surfaces to receive trowel finish and to be covered with fluid-applied or sheet waterproofing, built-up or membrane roofing, or sand-bed terrazzo.
- C. Trowel Finish: After applying float finish, apply first troweling and consolidate concrete by hand or power-driven trowel. Continue troweling passes and restraighten until surface is free of trowel marks and uniform in texture and appearance. Grind smooth any surface defects that would telegraph through applied coatings or floor coverings.
1. Apply a trowel finish to surfaces exposed to view or to be covered with resilient flooring, carpet, ceramic or quarry tile set over a cleavage membrane, paint, or another thin-film-finish coating system.
 2. Finish surfaces to the following tolerances, according to ASTM E 1155, for a randomly trafficked floor surface:
 - a. For surfaces to be covered with carpet: Specified overall values of flatness, F(F) 25; and of levelness, F(L) 20; with minimum local values of flatness, F(F) 17; and of levelness, F(L) 15.
 - b. For all surfaces not otherwise indicated: Specified overall values of flatness, F(F) 35; and of levelness, F(L) 25; with minimum local values of flatness, F(F) 24; and of levelness, F(L) 17; for slabs-on-grade.
 3. Trowel and Fine-Broom Finish: Apply a first trowel finish to surfaces where ceramic or quarry tile is to be installed by either thickset or thinset method. While concrete is still plastic, slightly scarify surface with a fine broom.
 - a. Comply with flatness and levelness tolerances for trowel-finished floor surfaces.
- D. Broom Finish: Apply a broom finish to exterior concrete platforms, steps, ramps, and elsewhere as indicated.
1. Immediately after float finishing, slightly roughen trafficked surface by brooming with fiber-bristle broom perpendicular to main traffic route. Coordinate required final finish with Architect before application.
- E. Sealing Coat: Uniformly apply a continuous sealing coat of curing and sealing compound to hardened concrete by power spray or roller according to manufacturer's written instructions.
1. Apply 2 coats if recommended by manufacturer, allowing first coat to dry before applying second coat.

3.04 MISCELLANEOUS CONCRETE ITEMS

- A. Filling In: Fill in holes and openings left in concrete structures, unless otherwise indicated, after work of other trades is in place. Mix, place, and cure concrete, as specified, to blend with in-place construction. Provide other miscellaneous concrete filling indicated or required to complete Work.

3.05 CONCRETE PROTECTION AND CURING

- A. General: Protect freshly placed concrete from premature drying and excessive cold or hot temperatures. Comply with ACI 306.1 for cold-weather protection and with recommendations in ACI 305R for hot-weather protection during curing.

3.06 JOINT FILLING

- A. Prepare, clean, and install joint filler according to manufacturers written instructions.
 - 1. Defer joint filling until concrete has aged a minimum of 30 days.
- B. Remove dirt, debris, saw cuttings, curing compounds, and sealers from joints; leave contact faces of joint clean and dry.
- C. Install joint filler per manufacturer's recommendations. Overfill joint and trim joint filler flush with top of joint after hardening.

3.07 CONCRETE SURFACE REPAIRS

- A. Defective Concrete: Repair and patch defective areas concealed from view. Do not patch, repair or replace exposed architectural concrete except upon written direction of Architect. Remove and replace concrete that cannot be repaired and patched to Architect's approval.
- B. Patching Mortar: Mix dry-pack patching mortar, consisting of one part portland cement to two and one-half parts fine aggregate passing a No. 16 sieve, using only enough water for handling and placing.
- C. Repairing Formed Surfaces: Surface defects include color and texture irregularities, cracks, spalls, air bubbles, honeycombs, rock pockets, fins and other projections on the surface, and stains and other discolorations that cannot be removed by cleaning.
 - 1. Concealed Locations: Immediately after form removal, cut out honeycombs, rock pockets, and voids more than 1/2 inch in any dimension. Remove defective concrete to a depth of 3/4-inch to 1-inch. Make edges of cuts perpendicular to concrete surface. Clean, dampen with water, and brush-coat holes and voids with bonding agent. Fill and compact with patching mortar before bonding agent has dried. Fill form-tie voids with patching mortar or cone plugs secured in place with bonding agent.
 - 2. Surfaces exposed to view: Repair defects by blending white portland cement and standard portland cement so that, when dry, patching mortar will match surrounding color. Patch a test area at inconspicuous locations to verify mixture and color match before proceeding with patching. Compact mortar in place and strike off slightly higher than surrounding surface.
 - 3. Surfaces that affect concrete's durability and structural performance: Repair defects upon direction of Architect and Structural Engineer.
- D. Repairing Unformed Surfaces: Test unformed surfaces, such as floors and slabs, for finish and verify surface tolerances specified for each surface. Correct low and high areas. Test surfaces sloped to drain for trueness of slope and smoothness; use a sloped template.

1. Repair finished surfaces containing defects. Surface defects include spalls, popouts, honeycombs, rock pockets, crazing and cracks in excess of 0.01 inch wide or that penetrate to reinforcement or completely through unreinforced sections regardless of width, and other objectionable conditions.
2. After concrete has cured at least 14 days, correct high areas by grinding.
3. Correct localized low areas during or immediately after completing surface finishing operations by cutting out low areas and replacing with patching mortar. Finish repaired areas to blend into adjacent concrete.
4. Correct other low areas scheduled to receive floor coverings with a repair underlayment. Prepare, mix, and apply repair underlayment and primer according to manufacturer's written instructions to produce a smooth, uniform, plane, and level surface. Feather edges to match adjacent floor elevations.
5. Correct other low areas scheduled to remain exposed with a repair topping. Cut out low areas to ensure a minimum repair topping depth of 1/4 inch to match adjacent floor elevations. Prepare, mix, and apply repair topping and primer according to manufacturer's written instructions to produce a smooth, uniform, plane, and level surface.
6. Repair defective areas, except random cracks and single holes 1 inch or less in diameter, by cutting out and replacing with fresh concrete. Remove defective areas with clean, square cuts and expose steel reinforcement with at least 3/4 inch clearance all around. Dampen concrete surfaces in contact with patching concrete and apply bonding agent. Mix patching concrete of same materials and mix as original concrete except without coarse aggregate. Place, compact, and finish to blend with adjacent finished concrete. Cure in same manner as adjacent concrete.
7. Repair random cracks and single holes 1 inch or less in diameter with patching mortar. Groove top of cracks and cut out holes to sound concrete and clean off dust, dirt, and loose particles. Dampen cleaned concrete surfaces and apply bonding agent. Place patching mortar before bonding agent has dried. Compact patching mortar and finish to match adjacent concrete. Keep patched area continuously moist for at least 72 hours.

3.08 PROTECTION

- A. Protect finished surfaces from stains or abrasions. Protect surfaces or edges by leaving forms in place or by providing temporary covers. Protect concrete from rain, flowing water or mechanical injury.
- B. Protect floor slabs from the droppings of plaster, paint, dirt, and other marring by covering with polyethylene plastic sheet, well lapped and sealed. Provide a continuous covering of 1/2 inch particle board, joints tightly butted and cut to sizes tight to wall construction, over entire floor area over polyethylene plastic sheet.

3.09 CLEANING

- A. During the course of the Work and on completion of the Work, remove and dispose of excess materials, equipment and debris away from premises.

Pivot North Architecture
100% Construction Set
March 17, 2023

TWIN FALLS TRAINING FACILITY
SECTION 03 3500
CONCRETE FINISHES

END OF SECTION 03 3500

SECTION 05 5000 - METAL FABRICATIONS

PART 1 - GENERAL

1.01 SUMMARY

- A. Section Includes:
 - 1. Miscellaneous steel framing and supports.
 - 2. Miscellaneous steel trim.
 - 3. Other metal fabrications that may be required.
 - 4. Bollards.
- B. Products furnished, but not installed, under this Section:
 - 1. Loose steel lintels.
 - 2. Anchor bolts, steel pipe sleeves, slotted-channel inserts, and wedge-type inserts indicated to be cast into concrete.
 - 3. Steel weld plates and angles for casting into concrete.

1.02 SUBMITTALS

- A. Product Data: Submit manufacturer's printed literature.
- B. Shop Drawings: Submit drawings for the fabrication and erection of items and assemblies not completely shown by the manufacturer's product data sheets.
 - 1. Include plans, elevations, sections, and details of metal fabrications and their connections. Show anchorage and accessory items.
 - 2. For installed products indicated to comply with design loads, include structural analysis data signed and sealed by the qualified professional engineer responsible for their preparation.
- C. Samples: For each type and finish of extruded nosing, and tread.

PART 2 - PRODUCTS

2.01 PERFORMANCE REQUIREMENTS

- A. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes acting on exterior metal fabrications by preventing buckling, opening of joints, overstressing of components, failure of connections, and other detrimental effects.
 - 1. Temperature Change: 120 deg F, ambient; 180 deg F, material surfaces.

2.02 METALS, GENERAL

- A. Comply with the following codes, standards and Specifications:

1. AISC "Specifications for the Design, Fabrication and Erection of Structural Steel for Buildings," including "Commentary of the AISC Specifications."
2. AISC "Specifications for the Design of Cold-Formed Steel Structural Members."
3. AWS "Code for Welding in Building Construction."

B. Metal Surfaces, General: Provide materials with smooth, flat surfaces without blemishes.

2.03 FERROUS METALS

A. Steel Plates, Shapes, and Bars: ASTM A 36.

B. Corrosion-Resisting (Weathering) Structural-Steel Shapes, Plates, and Bars: ASTM A588, 50 ksi.

C. Corrosion-Resisting (Weathering) Steel Sheet: ASTM A606, Type IV.

D. Stainless-Steel Bars and Shapes: ASTM A 276

E. Steel Tubing: ASTM A 500, cold-formed steel tubing.

F. Steel Pipe: ASTM A 53, standard weight (Schedule 40) unless otherwise indicated.

G. Slotted Channel Framing: Cold-formed metal box channels (struts) complying with MFMA-4.

1. As indicated on Contract Documents.

2.04 NONFERROUS METALS

A. Aluminum Extrusions: ASTM B 221, Alloy 6063-T6.

2.05 FASTENERS

A. General: Unless otherwise indicated, provide stainless-steel fasteners for exterior use and zinc-plated fasteners with coating complying with ASTM B 633 or ASTM F 1941, Class Fe/Zn 5, at exterior walls.

1. Provide stainless-steel fasteners for fastening aluminum.
2. Provide stainless-steel fasteners for fastening stainless steel.

B. Cast-in-Place Anchors in Concrete: Either threaded type or wedge type unless otherwise indicated; galvanized ferrous castings, either ASTM A 47 malleable iron or ASTM A 27 cast steel. Provide bolts, washers, and shims as needed, all hot-dip galvanized per ASTM F 2329.

C. Post-Installed Anchors: Torque-controlled expansion anchors or chemical anchors.

1. Material for Interior Locations: Carbon-steel components zinc plated to comply with ASTM B 633 or ASTM F 1941, Class Fe/Zn 5, unless otherwise indicated.
2. Material for Exterior Locations and Where Stainless Steel is Indicated: Alloy Group 1 (A1) stainless-steel bolts, ASTM F 593, and nuts, ASTM F 594.

D. Slotted-Channel Inserts: Cold-formed, hot-dip galvanized-steel box channels (struts) complying with MFMA-4, 1-5/8 by 7/8 inches by length indicated with anchor straps or studs

not less than 3 inches long at not more than 8 inches o.c. Provide with temporary filler and tee-head bolts, complete with washers and nuts, all zinc-plated to comply with ASTM B 633, Class Fe/Zn 5, as needed for fastening to inserts.

2.06 MISCELLANEOUS MATERIALS

- A. Low-Emitting Materials: 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."
- B. Shop Primers: Provide primers that comply with Section 09 9100 – Painting.
- C. Universal Shop Primer: Fast-curing, lead- and chromate-free, universal modified-alkyd primer complying with MPI#79 and compatible with topcoat.
- D. Epoxy Zinc-Rich Primer: Complying with MPI#20 and compatible with topcoat.
- E. See Editing Instruction No. 1 in the Evaluations for cautions about naming manufacturers and products. See Division 01 Section "Product Requirements."
- F. Galvanizing Repair Paint: High-zinc-dust-content paint complying with SSPC-Paint 20 and compatible with paints specified to be used over it.
- G. Bituminous Paint: Cold-applied asphalt emulsion complying with ASTM D 1187.
- H. Nonshrink, Nonmetallic Grout: Factory-packaged, nonstaining, noncorrosive, nongaseous grout complying with ASTM C 1107. Provide grout specifically recommended by manufacturer for interior and exterior applications.
- I. Concrete: Comply with requirements in Division 03 Section "Cast-in-Place Concrete" for normal-weight, air-entrained, concrete with a minimum 28-day compressive strength of 3000 psi.

2.07 FABRICATION, GENERAL

- A. Shop Assembly: Preassemble items in the shop to greatest extent possible. Use connections that maintain structural value of joined pieces.
- B. Cut, drill, and punch metals cleanly and accurately. Remove burrs and ease edges to a radius of approximately 1/32 inch, unless otherwise indicated. Form bent-metal corners to smallest radius possible without causing grain separation or otherwise impairing work. Remove sharp or rough areas on exposed surfaces.
- C. Weld corners and seams continuously to comply with the following:
 - 1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
 - 2. Obtain fusion without undercut or overlap.

3. Remove welding flux immediately.
 4. At exposed connections, finish exposed welds and surfaces smooth and blended.
- D. Provide for anchorage of type indicated; coordinate with supporting structure.
- E. Cut, reinforce, drill, and tap metal fabrications as indicated to receive finish hardware, screws, and similar items.
- F. Fabricate seams and other connections that will be exposed to weather in a manner to exclude water. Provide weep holes where water may accumulate.
- G. Where units are indicated to be cast into concrete or built into masonry, equip with integrally welded steel strap anchors not less than 24 inches o.c.
- H. Exposed Metal:
1. Form exposed work true to line and level with accurate angles and surfaces and straight sharp edges.
 2. Form exposed connections with hairline joints, flush and smooth, using concealed fasteners where possible. Use exposed fasteners of type indicated or, if not indicated, Phillips flat-head (countersunk) screws or bolts. Locate joints where least conspicuous.
 3. Finish exposed welds and surfaces smooth with no visible roughness and with contour of welded surface matching that of adjacent surface.

2.08 MISCELLANEOUS FRAMING AND SUPPORTS

- A. General: Provide steel framing and supports not specified in other Sections as needed to complete the Work.
- B. Fabricate units from steel shapes, plates, and bars of welded construction unless otherwise indicated. Fabricate to sizes, shapes, and profiles indicated and as necessary to receive adjacent construction.
- C. Fabricate steel girders for wood frame construction from continuous steel shapes of sizes indicated.
1. Where wood nailers are attached to girders with bolts or lag screws, drill or punch holes at 24 inches o.c.
- D. Fabricate steel pipe or tube columns for supporting wood frame construction from steel pipe with steel baseplates and top plates as indicated. Drill or punch baseplates and top plates for anchor and connection bolts and weld to pipe with fillet welds all around. Make welds the same size as pipe wall thickness unless otherwise indicated.

2.09 MISCELLANEOUS STEEL TRIM

- A. Unless otherwise indicated, fabricate units from steel shapes, plates, and bars of profiles shown with continuously welded joints and smooth exposed edges. Miter corners and use concealed field splices where possible.

- B. Provide cutouts, fittings, and anchorages as needed to coordinate assembly and installation with other work.
- C. Galvanize miscellaneous steel trim.
- D. Prime miscellaneous steel trim with zinc-rich primer.

2.10 BOLLARDS

- A. Fabricate metal bollards from Schedule 40 steel pipe.
- B. Fabricate bollards with 3/8 inch steel baseplates for bolting to concrete slab. Drill baseplates at all four corners for 3/4 inch anchor bolts.
 - 1. Where bollards are to be anchored to sloping concrete slabs, angle baseplates for plumb alignment of bollards.
- C. Fabricate sleeves for bollard anchorage from steel pipe with 1/4 inch thick steel plate welded to bottom of sleeve. Make sleeves not less than 8 inches deep and 3/4 inch larger than OD of bollard.
- D. Prime bollards with zinc-rich primer to receive field paint finish as specified in Section 09 91 00 – Painting.

2.11 STEEL WELD PLATES AND ANGLES

- A. Provide steel weld plates and angles not specified in other Sections, for items supported from concrete construction as needed to complete the Work. Provide each unit with no fewer than two integrally welded steel strap anchors for embedding in concrete.

2.12 FINISHES, GENERAL

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

2.13 STEEL FINISHES

- A. Galvanizing: Hot-dip galvanize items as indicated to comply with ASTM A 153/A 153M for steel and iron hardware and with ASTM A 123/A 123M for other steel and iron products.
- B. Shop prime iron and steel items not indicated to be galvanized unless they are to be embedded in concrete, sprayed-on fireproofing, or masonry, or unless otherwise indicated.
 - 1. Shop prime with universal shop primer unless zinc-rich primer is indicated.
- C. Preparation for Shop Priming: Clean surfaces to be painted. Remove loose rust and mill scale and spatter, slag, or flux deposits. Prepare surfaces to comply with requirements indicated below:

1. Exterior Items: SSPC-SP 6/NACE No. 3, "Commercial Blast Cleaning."
 2. Items Indicated to Receive Zinc-Rich Primer: SSPC-SP 6/NACE No. 3, "Commercial Blast Cleaning."
 3. Items Indicated to Receive Primers Specified in Division 09 Section "High-Performance Coatings": SSPC-SP 6/NACE No. 3, "Commercial Blast Cleaning."
 4. Other Items: SSPC-SP 3, "Power Tool Cleaning."
- D. Shop Priming: Apply shop primer to comply with SSPC-PA 1, "Paint Application Specification No. 1: Shop, Field, and Maintenance Painting of Steel," for shop painting.

PART 3 - EXECUTION

3.01 INSTALLATION, GENERAL

- A. Cutting, Fitting, and Placement: Perform cutting, drilling, and fitting required for installing metal fabrications. Set metal fabrications accurately in location, alignment, and elevation; with edges and surfaces level, plumb, true, and free of rack; and measured from established lines and levels.
- B. Fit exposed connections accurately together to form hairline joints. Weld connections that are not to be left as exposed joints but cannot be shop welded because of shipping size limitations. Do not weld, cut, or abrade surfaces of exterior units that have been hot-dip galvanized after fabrication and are for bolted or screwed field connections.
- C. Field Welding: Comply with the following requirements:
1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
 2. Obtain fusion without undercut or overlap.
 3. Remove welding flux immediately.
 4. At exposed connections, finish exposed welds and surfaces smooth and blended.
- D. Fastening to In-Place Construction: Provide anchorage devices and fasteners where metal fabrications are required to be fastened to in-place construction.
- E. Provide temporary bracing or anchors in formwork for items that are to be built into concrete, masonry, or similar construction.

3.02 INSTALLING METAL BOLLARDS

- A. Fill metal-capped bollards solidly with concrete and allow concrete to cure seven days before installing.
- B. Anchor bollards in concrete. Fill annular space around bollard solidly with nonshrink, nonmetallic grout.
- C. Fill bollards solidly with concrete, mounting top surface to shed water.

3.03 ADJUSTING AND CLEANING

- A. Touchup Painting: Immediately after erection, clean field welds, bolted connections, and abraded areas. Paint uncoated and abraded areas with the same material as used for shop painting to comply with SSPC-PA 1 for touching up shop-painted surfaces.
- B. Galvanized Surfaces: Clean field welds, bolted connections, and abraded areas and repair galvanizing to comply with ASTM A 780.

END OF SECTION 05 5000

SECTION 05 5200 - METAL RAILINGS

PART 1 - GENERAL

1.01 SUMMARY

- A. Section Includes:
 - 1. Steel pipe and tube railings.
 - 2. Railing Gate.

1.02 SUBMITTALS

- A. Product Data: Manufacturer's product lines of mechanically connected railings.
- B. Shop Drawings: Include plans, elevations, sections, details, and attachments to other work.
- C. Samples: For each type of exposed finish required.
 - 1. Sections of each distinctly different linear railing member, including handrails, top rails, posts, and balusters, including finish.
 - 2. Fittings and brackets.
 - 3. Assembled Sample of railing system, made from full-size components, including top rail, post, handrail, and infill. Sample need not be full height.
 - a. Show method of connection and finishing members at intersections.
- D. Welding Certificates.
- E. Product Test Reports: For tests on railings performed by a qualified testing agency, in accordance with ASTM E894 and ASTM E935.
- F. Research Reports: For post-installed anchors, from ICC-ES or other qualified testing agency acceptable to authorities having jurisdiction.

1.03 QUALITY ASSURANCE

- A. Welding Qualifications: Qualify procedures and personnel in accordance with the following:
 - 1. AWS D1.1, "Structural Welding Code – Steel."

1.04 DELIVERY, STORAGE AND HANDLING

- A. Protect mechanical finishes on exposed surfaces of railings from damage by applying a strippable, temporary protective covering before shipping.

1.05 FIELD CONDITIONS

- A. Field Measurements: Verify actual locations of walls and other construction contiguous with railings by field measurements before fabrication.

PART 2 - PRODUCTS

2.01 PERFORMANCE REQUIREMENTS

- A. Structural Performance: Railings shall withstand the effects of gravity loads and the following loads and stresses within limits and under conditions indicated:
 - 1. Top Rails of Guards:
 - a. Uniform load of 50 lbf/ ft. applied in any direction.
 - b. Concentrated load of 200 lbf applied in any direction.
 - c. Uniform and concentrated loads need not be assumed to act concurrently.
 - 2. Infill of Guards:
 - a. Concentrated load of 50 lbf applied horizontally on an area of 1 sq. ft.
 - b. Infill load and other loads need not be assumed to act concurrently.
- B. Control of Corrosion: Prevent galvanic action and other forms of corrosion by insulating metals and other materials from direct contact with incompatible materials.

2.02 METALS, GENERAL

- A. Metal Surfaces, General: Provide materials with smooth surfaces, without seam marks, roller marks, rolled trade names, stains, discolorations, or blemishes.
- B. Brackets, Flanges, and Anchors: Cast or formed metal of same type of material and finish as supported rails unless otherwise indicated.

2.03 STEEL RAILINGS

- A. Tubing: ASTM A500 (cold formed) or ASTM A513, Type 5.
- B. Pipe: ASTM A53, Type F or Type S, Grade A, Standard Weight (Schedule 40), unless another grade and weight are required by structural loads.
 - 1. Provide galvanized finish for exterior installations and where indicated.
- C. Plates, Shapes and Bars: ASTM A36.

2.04 MISCELLANEOUS MATERIALS

- A. Fasteners: Provide as indicated on Contract Documents and to meet all industry standards. If retaining first paragraph below, indicate loads on Drawings and verify safety factors with Project's structural engineer.
 - 1. Fasteners for Interconnecting Railing Components:
 - a. Provide concealed fasteners for interconnecting railing components and for attaching them to other work, unless otherwise indicated.
- B. Post-Installed Anchors: Anchors capable of sustaining, without failure, a load equal to six times the load imposed when installed in unit masonry and four times the load imposed when installed in concrete.

- C. Gate Hardware: Provide spring-loaded metal hinges at barrier gate, designed to support gate load. See drawings for additional information.
 - 1. Finish: As selected by Architect.
- D. Welding Rods and Bare Electrodes: Select according to AWS specifications for metal alloy welded.
- E. Low-Emitting Materials: 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."
- F. Etching Cleaner for Galvanized Metal: Complying with MPI#25.
- G. Galvanizing Repair Paint: High-zinc-dust-content paint complying with SSPC-Paint 20 and compatible with paints specified to be used over it.
- H. Shop Primers: Provide primers that comply with Division 09 painting Sections.
- I. Universal Shop Primer: Fast-curing, lead- and chromate-free, universal modified-alkyd primer complying with MPI#79 and compatible with topcoat.
- J. Shop Primer for Galvanized Steel: Cementitious galvanized metal primer complying with MPI#26, Vinyl wash primer complying with MPI#80 or Water based galvanized metal primer complying with MPI#134.
- K. Bituminous Paint: Cold-applied asphalt emulsion complying with ASTM D 1187.
- L. Nonshrink, Nonmetallic Grout: Factory-packaged, nonstaining, noncorrosive, nongaseous grout complying with ASTM C 1107. Provide grout specifically recommended by manufacturer for interior and exterior applications.

2.05 FABRICATION

- A. General: Fabricate railings to comply with requirements indicated for design, dimensions, details, finish and member sizes, including wall thickness of tube, post spacings, and anchorage, but not less than that needed to withstand indicated loads.
- B. Cut, drill, and punch metals cleanly and accurately. Remove burrs and ease edges to a radius of approximately 1/32 inch unless otherwise indicated. Remove sharp or rough areas on exposed surfaces.
- C. Form work true to line and level with accurate angles and surfaces.
- D. Welded Connections: Cope components at connections to provide close fit, or use fittings designed for this purpose. Weld all around at connections, including at fittings.
 - 1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.

2. Obtain fusion without undercut or overlap.
 3. Remove flux immediately.
 4. At exposed connections, finish exposed surfaces smooth and blended so no roughness shows after finishing and welded surface matches contours of adjoining surfaces.
- E. Nonwelded Connections: Connect members with concealed mechanical fasteners and fittings. Fabricate members and fittings to produce flush, smooth, rigid, hairline joints.
- F. Form changes in direction by bending or by inserting prefabricated elbow fittings.
- G. Bend members in jigs to produce uniform curvature without buckling or otherwise deforming exposed surfaces.
- H. Close exposed ends of railing members with prefabricated end fittings.
- I. Provide wall returns at ends of wall-mounted handrails unless otherwise indicated.
- J. Brackets, Flanges, Fittings, and Anchors: Provide wall brackets, flanges, miscellaneous fittings, and anchors to interconnect railing members to other work unless otherwise indicated.
1. At brackets and fittings fastened to plaster or gypsum board partitions, provide crush-resistant fillers to transfer loads through wall finishes.

2.06 STEEL FINISHES

- A. Preparation for Shop Priming: Prepare uncoated ferrous-metal surfaces to comply with requirements indicated below:
- B. Primer Application: Apply shop primer to prepared surfaces of railings unless otherwise indicated. Comply with requirements in SSPC-PA 1, "Paint Application Specification No. 1: Shop, Field, and Maintenance Painting of Steel," for shop painting.
1. Do not apply primer to galvanized surfaces.

PART 3 - EXECUTION

3.01 INSTALLATION

- A. Set railings accurately in location, alignment, and elevation; measured from established lines and levels and free of rack.
1. Do not weld, cut, or abrade surfaces of railing components that have been coated or finished after fabrication and that are intended for field connection by mechanical or other means without further cutting or fitting.
 2. Set posts plumb within a tolerance of 1/16 inch in 3 feet.
 3. Align rails so variations from level for horizontal members and variations from parallel with rake of steps and ramps for sloping members do not exceed 1/4 inch in 12 feet.
- B. Corrosion Protection: Coat concealed surfaces of aluminum that will be in contact with grout, concrete, masonry, wood, or dissimilar metals, with a heavy coat of bituminous paint.

- C. Anchor posts in concrete by inserting as indicated on Contract Documents or into preset metal pipe sleeves or formed or core-drilled holes and grouting annular space.
- D. Anchor posts to metal surfaces with oval flanges.
- E. Anchor railing ends at walls with round flanges anchored to wall construction.
- F. Anchor railing ends to metal surfaces with flanges bolted to metal surfaces.
- G. Attach railings to wall with wall brackets, except where end flanges are used. Use type of bracket with flange tapped for concealed anchorage to threaded hanger bolt or as indicated on Contract Documents.
 - 1. Install welded tabs for swinging gates and to receive pipe hinges. Install cane bolts and pipe sleeves for holding gates in open and closed positions where applicable.
 - 2. Provide and install gate stop and pin system to prevent Mezzanine gate from swinging out over Apparatus Bay area and to latch gate in closed position.
- H. Secure wall brackets and railing end flanges to building construction as follows:
 - 1. For concrete and solid masonry anchorage, use drilled-in expansion shields and hanger or lag bolts.
 - 2. For hollow masonry anchorage, use toggle bolts.
 - 3. For wood stud partitions, use hanger or lag bolts set into studs or wood backing between studs. Coordinate with carpentry work to locate backing members.

3.02 ADJUSTING AND CLEANING

- A. Touchup Painting: Immediately after erection, clean field welds, bolted connections, and abraded areas of shop paint, and paint exposed areas with the same material as used for shop painting to comply with SSPC-PA 1 for touching up shop-painted surfaces.

3.03 PROTECTION

- A. Protect finishes of railings from damage during construction period with temporary protective coverings approved by railing manufacturer. Remove protective coverings at time of Substantial Completion.
- B. Restore finish damaged during installation and construction period so no evidence remains of correction work. Return items that cannot be refinished in the field to the shop; make required alterations and refinish entire unit, or provide new units.

END OF SECTION 05 5200

SECTION 06 1000 – ROUGH CARPENTRY

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. Framing with dimension lumber.
 - 2. Framing with engineered wood products.
 - 3. Wood blocking, and nailers.
 - 4. Plywood backing panels.
- B. Related Requirements:
 - 1. Section 06 1001 "Miscellaneous Rough Carpentry" for sheathing, subflooring, and underlayment.

1.03 DEFINITIONS

- A. Boards or Strips: Lumber of less than 2 inches nominal size in least dimension.
- B. Dimension Lumber: Lumber of 2 inches nominal size or greater but less than 5 inches nominal size in least dimension.
- C. Exposed Framing: Framing not concealed by other construction.
- D. OSB: Oriented strand board.
- E. Timber: Lumber of 5 inches nominal size or greater in least dimension.

1.04 ACTION SUBMITTALS

- A. Product Data: For each type of process and factory-fabricated product. Indicate component materials and dimensions and include construction and application details.
 - 1. Include data for wood-preservative treatment from chemical treatment manufacturer and certification by treating plant that treated materials comply with requirements. Indicate type of preservative used and net amount of preservative retained.
 - 2. Include data for fire-retardant treatment from chemical treatment manufacturer and certification by treating plant that treated materials comply with requirements. Include physical properties of treated materials based on testing by a qualified independent testing agency.

3. For fire-retardant treatments, include physical properties of treated lumber both before and after exposure to elevated temperatures, based on testing by a qualified independent testing agency according to ASTM D 5664.
4. For products receiving a waterborne treatment, include statement that moisture content of treated materials was reduced to levels specified before shipment to Project site.

1.05 INFORMATIONAL SUBMITTALS

- A. Material Certificates: For dimension lumber specified to comply with minimum allowable unit stresses. Indicate species and grade selected for each use and design values approved by the ALSC Board of Review.
- B. Evaluation Reports: For the following, from ICC-ES:
 1. Wood-preservative-treated wood.
 2. Engineered wood products.
 3. Shear panels.
 4. Power-driven fasteners.
 5. Post-installed anchors.

1.06 QUALITY ASSURANCE

- A. Testing Agency Qualifications: For testing agency providing classification marking for fire-retardant treated material, an inspection agency acceptable to authorities having jurisdiction that periodically performs inspections to verify that the material bearing the classification marking is representative of the material tested.

1.07 DELIVERY, STORAGE, AND HANDLING

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

PART 2 - PRODUCTS

2.01 WOOD PRODUCTS, GENERAL

- A. Lumber: DOC PS 20 and applicable rules of grading agencies indicated. If no grading agency is indicated, comply with the applicable rules of any rules-writing agency certified by the ALSC Board of Review. Grade lumber by an agency certified by the ALSC Board of Review to inspect and grade lumber under the rules indicated.
 1. Factory mark each piece of lumber with grade stamp of grading agency.
 2. For exposed lumber indicated to receive a stained or natural finish, omit grade stamp and provide certificates of grade compliance issued by grading agency.
 3. Dress lumber, S4S, unless otherwise indicated.
- B. Maximum Moisture Content of Lumber: 19 percent unless otherwise indicated.

- C. Engineered Wood Products: Acceptable to authorities having jurisdiction and for which current model code research or evaluation reports exist that show compliance with building code in effect for Project.
 - 1. Allowable design stresses, as published by manufacturer, shall meet or exceed those indicated. Manufacturer's published values shall be determined from empirical data or by rational engineering analysis and demonstrated by comprehensive testing performed by a qualified independent testing agency.

2.02 WOOD-PRESERVATIVE-TREATED LUMBER

- A. Preservative Treatment by Pressure Process: AWPA U1; Use Category UC2 for interior construction not in contact with ground, Use Category UC3b for exterior construction not in contact with ground, and Use Category UC4a for items in contact with ground.
 - 1. Preservative Chemicals: Acceptable to authorities having jurisdiction and containing no arsenic or chromium. Do not use inorganic boron (SBX) for sill plates.
 - 2. For exposed items indicated to receive a stained or natural finish, chemical formulations shall not require incising, contain colorants, bleed through, or otherwise adversely affect finishes.
- B. Kiln-dry lumber after treatment to a maximum moisture content of 19 percent. Do not use material that is warped or that does not comply with requirements for untreated material.
- C. Mark lumber with treatment quality mark of an inspection agency approved by the ALSC Board of Review.
- D. Application: Treat items indicated on Drawings, and the following:
 - 1. Wood cants, nailers, curbs, equipment support bases, blocking, stripping, and similar members in connection with roofing, flashing, vapor barriers, and waterproofing.
 - 2. Wood sills, sleepers, blocking, and similar concealed members in contact with masonry or concrete.
 - 3. Wood floor plates that are installed over concrete slabs-on-grade.

2.03 DIMENSION LUMBER FRAMING

- A. Non-Load-Bearing Interior Partitions: Stud grade.
 - 1. Application: Interior partitions not indicated as load bearing.
 - 2. Species: As indicated in on structural drawings
- B. Framing Other Than Non-Load-Bearing Partitions: As indicated in the structural drawings.
 - 1. Application: Framing other than interior partitions not indicated as load bearing.
 - 2. Species: As indicated in the structural drawings.

2.04 ENGINEERED WOOD PRODUCTS

- A. Laminated-Veneer Lumber: As indicated in the structural drawings.
 - 1. Manufacturers: Provide products manufactured by Boise Cascade Corporation.
 - a. Extreme Fiber Stress in Bending, Edgewise: As indicated in the structural drawings.
 - 2. Modulus of Elasticity, Edgewise: As indicated in the structural drawings.

- B. Rim Boards: Product designed to be used as a load-bearing member and to brace wood trusses at bearing ends, complying with research or evaluation report for trusses.
 - 1. Manufacturer: Provide products by same manufacturer as Laminated-Veneer Lumber.
 - 2. Material: All-veneer product.
 - 3. Thickness: As indicated in structural drawings.

2.05 MISCELLANEOUS LUMBER

- A. General: Provide miscellaneous lumber indicated and lumber for support or attachment of other construction, including the following:
 - 1. Blocking.
 - 2. Nailers.
 - 3. Rooftop equipment bases and support curbs.
 - 4. Cants.
 - 5. Furring.
 - 6. Grounds.
 - 7. Utility shelving.
- B. Dimension Lumber Items: As indicated in the structural drawings.
- C. Concealed Boards: 19 percent maximum moisture content and any of the following species and grades:
 - 1. Northern species; No. 2 Common grade; NLGA.
 - 2. Western woods; Construction or No. 2 Common grade; WCLIB or WWPA.
- D. For blocking not used for attachment of other construction, Utility, Stud, or No. 3 grade lumber of any species may be used provided that it is cut and selected to eliminate defects that will interfere with its attachment and purpose.
- E. For blocking and nailers used for attachment of other construction, select and cut lumber to eliminate knots and other defects that will interfere with attachment of other work.
- F. For furring strips for installing plywood or hardboard paneling, select boards with no knots capable of producing bent-over nails and damage to paneling.

2.06 FASTENERS

- A. General: Fasteners shall be of size and type indicated and shall comply with requirements specified in this article for material and manufacture.
 - 1. Where rough carpentry is exposed to weather, in ground contact, pressure-preservative treated, or in area of high relative humidity, provide fasteners with hot-dip zinc coating complying with ASTM A 153/A 153M.
- B. Power-Driven Fasteners: Fastener systems with an evaluation report acceptable to authorities having jurisdiction, based on ICC-ES AC70.
- C. Post-Installed Anchors: Fastener systems with an evaluation report acceptable to authorities having jurisdiction, based on ICC-ES AC01 as appropriate for the substrate.

2.07 METAL FRAMING ANCHORS

- A. Manufacturers: Provide products from one of the following:
 - 1. Cleveland Steel Specialty Co.
 - 2. KC Metals Products, Inc.
 - 3. Phoenix Metal Products, Inc.
 - 4. Simpson Strong-Tie Co., Inc
 - 5. USP Structural Connectors.
- B. Allowable design loads, as published by manufacturer, shall meet or exceed those indicated. Manufacturer's published values shall be determined from empirical data or by rational engineering analysis and demonstrated by comprehensive testing performed by a qualified independent testing agency. Framing anchors shall be punched for fasteners adequate to withstand same loads as framing anchors.
- C. Galvanized-Steel Sheet: Hot-dip, zinc-coated steel sheet complying with ASTM A 653/A 653M, G60 coating designation.
 - 1. Use for interior locations unless otherwise indicated.
- D. Hot-Dip, Heavy-Galvanized Steel Sheet: ASTM A 653/A 653M; structural steel (SS), high-strength low-alloy steel Type A (HSLAS Type A), or high-strength low-alloy steel Type B (HSLAS Type B); G185 coating designation; and not less than 0.036 inch thick.
 - 1. Use for wood-preserved-treated lumber and where indicated.

2.08 MISCELLANEOUS MATERIALS

- A. Sill-Sealer Gaskets: Provide one of the following:
 - 1. Glass-fiber-resilient insulation, fabricated in strip form, for use as a sill sealer; 1-inch nominal thickness, compressible to 1/32 inch; selected from manufacturer's standard widths to suit width of sill members indicated.
 - 2. Closed-cell neoprene foam, 1/4 inch thick, selected from manufacturer's standard widths to suit width of sill members indicated
- B. Flexible Flashing: Composite, self-adhesive, flashing product consisting of a pliable, butyl rubber or rubberized-asphalt compound, bonded to a high-density polyethylene film, aluminum foil, or spunbonded polyolefin to produce an overall thickness of not less than 0.025 inch.
- C. Adhesives for Gluing Furring and Sleepers to Concrete or Masonry: Formulation complying with ASTM D 3498 that is approved for use indicated by adhesive manufacturer.

PART 3 - EXECUTION

3.01 INSTALLATION, GENERAL

- A. Framing Standard: Comply with AF&PA's WCD 1, "Details for Conventional Wood Frame Construction," unless otherwise indicated.

- B. Framing with Engineered Wood Products: Install engineered wood products to comply with manufacturer's written instructions.
- C. Set rough carpentry to required levels and lines, with members plumb, true to line, cut, and fitted. Fit rough carpentry accurately to other construction. Locate furring, nailers, blocking, grounds, and similar supports to comply with requirements for attaching other construction.
- D. Install shear wall panels to comply with manufacturer's written instructions and as indicated on Structural Drawings.
- E. Install metal framing anchors to comply with manufacturer's written instructions. Install fasteners through each fastener hole.
- F. Do not splice structural members between supports unless otherwise indicated.
- G. Comply with AWWA M4 for applying field treatment to cut surfaces of preservative-treated lumber.
- H. Where wood-preservative-treated lumber is installed adjacent to metal decking, install continuous flexible flashing separator between wood and metal decking.
- I. Securely attach rough carpentry work to substrate by anchoring and fastening as indicated, complying with the following:
 - 1. Table 2304.9.1, "Fastening Schedule," in ICC's International Building Code (IBC).
 - 2. ICC-ES evaluation report for fastener.

3.02 PROTECTION

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

END OF SECTION 06 1000

SECTION 06 1001 – MISCELLANEOUS ROUGH CARPENTRY

PART 1 - GENERAL

1.01 SUMMARY

- A. This Section includes the following:
1. Lumber.
 2. Dimensional lumber for stair treads and risers.
 3. Treated wood blocking.
 4. Plywood backing panels.
 5. Miscellaneous lumber for support or attachment to other construction.
 6. Sheathing.
 7. Plywood Subtops.

1.02 DEFINITIONS

- A. Dimension Lumber: Lumber of 2 inches nominal or greater but less than 5 inches nominal in least dimension.
- B. Lumber grading agencies, and the abbreviations used to reference them, include the following:
1. NeLMA: Northeastern Lumber Manufacturers' Association.
 2. NLGA: National Lumber Grades Authority.
 3. RIS: Redwood Inspection Service.
 4. SPIB: The Southern Pine Inspection Bureau.
 5. WCLIB: West Coast Lumber Inspection Bureau.
 6. WWPA: Western Wood Products Association.

1.03 SUBMITTALS

- A. Product Data: For each type of process and factory-fabricated product. Indicate component materials and dimensions and include construction and application details.
1. Include data for wood-preservative treatment from chemical treatment manufacturer and certification by treating plant that treated materials comply with requirements. Indicate type of preservative used and net amount of preservative retained.
 2. Include data for fire-retardant treatment from chemical treatment manufacturer and certification by treating plant that treated materials comply with requirements. Include physical properties of treated materials based on testing by a qualified independent testing agency.
 3. For products receiving a waterborne treatment, include statement that moisture content of treated materials was reduced to levels specified before shipment to Project site.
 4. Include copies of warranties from chemical treatment manufacturers for each type of treatment.

- B. Research/Evaluation Reports: For the following, showing compliance with building code in effect for Project:
 - 1. Wood-preservative-treated wood.
 - 2. Fire-retardant-treated wood.

1.04 DELIVERY, STORAGE, AND HANDLING

- A. Forest Certification: For the following wood products, provide materials produced from wood obtained from forests certified by an FSC-accredited certification body to comply with FSC STD-01-001, "FSC Principles and Criteria for Forest Stewardship":
 - 1. Miscellaneous lumber.
- B. Stack lumber flat with spacers between each bundle to provide air circulation. Provide for air circulation around stacks and under coverings.

PART 2 - PRODUCTS

2.01 WOOD PRODUCTS, GENERAL

- A. Lumber: DOC PS 20 and applicable rules of grading agencies indicated. If no grading agency is indicated, provide lumber that complies with the applicable rules of any rules-writing agency certified by the ALSC Board of Review. Provide lumber graded by an agency certified by the ALSC Board of Review to inspect and grade lumber under the rules indicated.
 - 1. Factory mark each piece of lumber with grade stamp of grading agency.
 - 2. Where nominal sizes are indicated, provide actual sizes required by DOC PS 20 for moisture content specified. Where actual sizes are indicated, they are minimum dressed sizes for dry lumber.
 - 3. Provide dressed lumber, S4S, unless otherwise indicated.

2.02 WOOD-PRESERVATIVE-TREATED LUMBER

- A. Preservative Treatment by Pressure Process: AWPA C2; Use Category UC2 for interior construction not in contact with ground and Use Category EC3b for exterior construction not in contact with ground, treated with waterborne, inorganic boron (SBX) or other Borate-derived products.
 - 1. Preservative Chemicals: Acceptable to authorities having jurisdiction and containing no arsenic or chromium.
 - 2. Wood products treated with Pentachlorophenol are not allowed in interior occupied spaces or in exterior applications where the possibility of human contact exists.
 - 3. Wood products treated with creosotes are not permitted in any interior or exterior application.
 - 4. VOC Certification: Verify product's volatile organic compounds compliance with California Environmental Protection Agency "Test Method 310."
- B. Kiln-dry lumber after treatment to a maximum moisture content of 19 percent. Do not use material that is warped or does not comply with requirements for untreated material.

- C. Mark lumber with treatment quality mark of an inspection agency approved by the ALSC Board of Review.
- D. Application: Treat items indicated on Drawings, and the following:
 - 1. Wood cants, nailers, curbs, equipment support bases, blocking, stripping, and similar members in connection with roofing, flashing, vapor barriers, and waterproofing.
 - 2. Wood sills, sleepers, blocking, and similar concealed members in contact with masonry or concrete.

2.03 MISCELLANEOUS LUMBER

- A. General: Provide miscellaneous lumber indicated and lumber for support or attachment of other construction, including the following:
 - 1. Blocking.
 - 2. Nailers.
 - 3. Rooftop equipment bases and support curbs.
 - 4. Cants.
 - 5. Stair treads and risers.
- B. Grounds and Furring: Construction Grade Douglas Fir or No. 2 White Pine.
- C. For blocking not used for attachment of other construction, Utility, Stud, or No. 3 grade lumber of any species may be used provided that it is cut and selected to eliminate defects that will interfere with its attachment and purpose.
- D. For blocking and nailers used for attachment of other construction, select and cut lumber to eliminate knots and other defects that will interfere with attachment of other work.
- E. For furring strips for installing plywood or hardboard paneling, select boards with no knots capable of producing bent-over nails and damage to paneling.

2.04 PLYWOOD PANELS

- A. Plywood Panels: DOC PS 1-07, Exterior, AC, in thickness indicated or, if not indicated, not less than 3/4-inch nominal thickness.
 - 1. Moisture Content: Maximum 15 percent, kiln-dried.
 - 2. Provide tongue and groove plywood at Mezzanine Flooring.
- B. Each panel of softwood plywood shall be identified with the APA grade-trademark and shall meet the requirements of PS-1-83 for softwood plywood.
 - 1. Softwood Plywood: DOC PS1, Douglas Fir face species, rotary cut, exterior glue, sanded finish.
- C. Provide Plywood Panels for:
 - 1. Electrical Equipment Backing Panels.
 - 2. Handrail Backing Panel.
 - 3. Blocking for upper cabinets and mirror backing.
 - 4. Thickness: 3/4 inch unless otherwise indicated.

5. Backing panels for Apparatus Bay and Mezzanine Storage.

2.05 SHEATHING

- A. Sheathing: DOC PS1 or DOC PS2, unless otherwise indicated. Each panel of softwood plywood shall be identified with the APA grade-trademark and shall meet the requirements of PS-1-83 for softwood plywood.
 1. Shear Walls: Thickness as needed to comply with requirements and as specified on Drawings.

2.06 FASTENERS

- A. General: Provide fasteners of size and type indicated that comply with requirements specified in this Article for material and manufacture.
 1. Where rough carpentry is exposed to weather, in ground contact, pressure-preservative treated, or in area of high relative humidity, provide fasteners with hot-dip zinc coating complying with ASTM A 153/A 153M.
- B. Nails, Brads, and Staples: ASTM F 1667.
- C. Power-Driven Fasteners: NES NER-272.
- D. Wood Screws: ASME B18.6.1.
- E. Lag Bolts: ASME B18.2.1.
- F. Bolts: Steel bolts complying with ASTM A 307, Grade A; with ASTM A 563 hex nuts and, where indicated, flat washers.
- G. Expansion Anchors: Anchor bolt and sleeve assembly of material indicated below with capability to sustain, without failure, a load equal to 6 times the load imposed when installed in unit masonry assemblies and equal to 4 times the load imposed when installed in concrete as determined by testing per ASTM E 488 conducted by a qualified independent testing and inspecting agency.
 1. Material: Carbon-steel components, zinc plated to comply with ASTM B 633, Class Fe/Zn 5.

PART 3 - EXECUTION

3.01 INSTALLATION, GENERAL

- A. Set rough carpentry to required levels and lines, with members plumb, true to line, cut, and fitted. Fit rough carpentry to other construction; scribe and cope as needed for accurate fit. Locate furring, nailers, blocking, and similar supports to comply with requirements for attaching other construction.

- B. Provide blocking and framing as indicated and as required to support facing materials, fixtures, specialty items, and trim.
 - 1. Provide metal clips for fastening gypsum board or lath at corners and intersections where framing or blocking does not provide a surface for fastening edges of panels. Space clips not more than 16 inches o.c.

 - C. Provide fire blocking in furred spaces, stud spaces, and other concealed cavities as indicated and as follows:
 - 1. Fire block furred spaces of walls, at each floor level, at ceiling, and at not more than 96 inches o.c. with solid wood blocking or noncombustible materials accurately fitted to close furred spaces.
 - 2. Fire block concealed spaces of wood-framed walls and partitions at each floor level, at ceiling line of top story, and at not more than 96 inches o.c. Where fire blocking is not inherent in framing system used, provide closely fitted solid wood blocks of same width as framing members and 2-inch nominal- thickness.
 - 3. Fire block concealed spaces between floor sleepers with same material as sleepers to limit concealed spaces to not more than 100 sq. ft. and to solidly fill space below partitions.
 - 4. Fire block concealed spaces behind combustible cornices and exterior trim at not more than 20 feet o.c.

 - D. Sort and select lumber so that natural characteristics will not interfere with installation or with fastening other materials to lumber. Do not use materials with defects that interfere with function of member or pieces that are too small to use with minimum number of joints or optimum joint arrangement.

 - E. Comply with AWPA M4 for applying field treatment to cut surfaces of preservative-treated lumber.
 - 1. Use inorganic boron for items that are continuously protected from liquid water.
 - 2. Use copper naphthenate for items not continuously protected from liquid water.

 - F. Securely attach rough carpentry work to substrate by anchoring and fastening as indicated, complying with the following:
 - 1. NES NER-272 for power-driven fasteners.
 - 2. Table 2304.9.1, "Fastening Schedule," in ICC's International Building Code.

 - G. Use common wire nails, unless otherwise indicated. Select fasteners of size that will not fully penetrate members where opposite side will be exposed to view or will receive finish materials. Make tight connections between members. Install fasteners without splitting wood; do not countersink nail heads, unless otherwise indicated.
- 3.02 WOOD BLOCKING, AND NAILER INSTALLATION
- A. Install where indicated and where required for attaching other work. Form to shapes indicated and cut as required for true line and level of attached work. Coordinate locations with other work involved.

- B. Attach items to substrates to support applied loading. Recess bolts and nuts flush with surfaces, unless otherwise indicated.
- C. Where wood-preserved-treated lumber is installed adjacent to metal decking, install continuous flexible flashing separator between wood and metal decking.

3.03 PLYWOOD SUBTOPS

- A. Secure to supports as indicated on Drawings.
- B. Variation from Level: 1/8 inch in 5 feet maximum.

3.04 PLYWOOD BACKING PANELS

- A. Install with the "C" or best face on exposed side.
- B. Install plywood backing panels by fastening to studs; coordinate locations with utilities requiring backing panels.

3.05 SHEATHING AND FLOORING

- A. Install sheathing in accordance with Drawings. Set rough carpentry to required levels and lines, with members plumb, true to line, cut, and fitted. Fit rough carpentry to other construction; scribe and cope as needed for accurate fit.
 - 1. Comply with acceptable recommendations contained in APA Form No. E30K, "APA Design/Construction Guide: Residential and Commercial," for types of structural-use panels and applications indicated.
 - 2. Comply with "Code Plus" provisions in above referenced guide.
 - 3. Install with the "C" or best face on exposed side.
 - 4. Install wall sheathing with long dimension vertical.
 - 5. Sheathing shall have edges blocked and nailed for diaphragm or shear wall stresses as shown on the drawings.
 - 6. Fastening Methods:
 - a. Screw to cold-formed metal framing.
 - b. Nail to wood framing.
 - c. Space panels 1/8 inch apart at edges and ends.
 - d. Install construction adhesive compatible for wood framing, on top chord of pre-fabricated floor joist members, in addition to nail fasteners.

3.06 WOOD FURRING INSTALLATION

- A. Install level and plumb with closure strips at edges and openings. Shim with wood as required for tolerance of finish work.
- B. Furring to Receive Plywood or Hardboard Paneling: Install 1-by-3-inch nominal- size furring horizontally and vertically at 24 inches o.c.

3.07 PROTECTION

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

END OF SECTION 06 1001

SECTION 06 40 00 - ARCHITECTURAL WOODWORK

PART 1 - GENERAL

1.01 SUMMARY

- A. Section Includes:
 - 1. Plastic-laminate cabinets and countertops.
 - 2. Shop finishing interior woodwork.
- B. Interior architectural woodwork includes wood furring, blocking, shims, and hanging strips for installing woodwork, unless concealed within other construction before woodwork installation.

1.02 SUBMITTALS

- A. Product Data: Submit manufacturer's literature for each type of product indicated, and finishing materials and processes.
 - 1. Include data for fire-retardant treatment from chemical treatment manufacturer and certification by treating plant that treated materials comply with requirements.
- B. Shop Drawings: Show location of each item, materials, fastening methods, jointing details, and accessories, dimensioned plans and elevations, large-scale details (minimum scale of detail drawings is 1 1/2 inches = 1 foot), attachment devices, and other components.
 - 1. Show locations and sizes of furring, blocking, and hanging strips, including concealed blocking and reinforcement specified in other Sections.
 - 2. Show locations and sizes of cutouts and holes penetrations through installed architectural woodwork.
 - 3. Drawings are for general intent only. Project contains custom millwork fabrications requiring coordination with additional materials as indicated on Interior Drawings and specified in related specification sections. Millwork fabricator shall submit Shop Drawings indicating intended fabrication of millwork items, including all indicated materials.
- C. Samples:
 - 1. Laminate: Submit 2 samples, 4x6 inches, of each color of laminate indicated.
- D. Product Certificates: Signed by manufacturers of woodwork certifying that products furnished comply with requirements.
- E. Qualification Data: For firms and persons specified in "Quality Assurance" Article to demonstrate their capabilities and experience. Include lists of completed projects with project names and addresses, names and addresses of architects and owners, and other information specified.
- F. Maintenance Data:

1. Submit methods for maintaining materials and finishes.

1.03 QUALITY ASSURANCE

- A. Installer Qualifications: An experienced installer who has completed architectural woodwork similar in material, design, and extent to that indicated for this Project and whose work has resulted in construction with a record of successful in-service performance.
- B. Fabricator Qualifications: Company specializing in fabricating the product specified in this section with minimum of 10 year documented experience fabricating items similar in size and scope to products on this project as well as sufficient production capacity to produce required units. Fabricator shall comply with AWS certification program standards.
- C. Preinstallation Conference: Conduct conference at Project site to comply with requirements in Section 01 3000 – Administrative Requirements.

1.04 DELIVERY, STORAGE, AND HANDLING

- A. Do not deliver woodwork until painting and similar operations that could damage woodwork have been completed in installation areas. If woodwork must be stored in other than installation areas, store only in areas where environmental conditions comply with requirements specified in "Project Conditions" Article.
- B. Comply with AWS standards for delivery, project humidity levels and acclimation.

1.05 PROJECT CONDITIONS

- A. Environmental Limitations: Do not deliver or install woodwork until building is enclosed, wet work is complete, and HVAC system is operating and maintaining temperature and relative humidity at occupancy levels during the remainder of the construction period.
- B. Field Measurements: Where woodwork is indicated to fit to other construction, verify dimensions of other construction by field measurements before fabrication and indicate measurements on Shop Drawings. Coordinate fabrication schedule with construction progress to avoid delaying the Work.
 1. Locate concealed framing, blocking, and reinforcements that support woodwork by field measurements before being enclosed and indicate measurements on Shop Drawings.
 2. Established Dimensions: Where field measurements cannot be made without delaying the Work, establish dimensions and proceed with fabricating woodwork without field measurements. Provide allowance for trimming at site, and coordinate construction to ensure that actual dimensions correspond to established dimensions.

1.06 COORDINATION

- A. Coordinate sizes and locations of framing, blocking, furring, reinforcements, and other related units of Work specified in other Sections to ensure that interior architectural woodwork can be supported and installed as indicated.

PART 2 - PRODUCTS

2.01 PERFORMANCE REQUIREMENTS

- A. Quality Standard: Unless otherwise indicated, comply with the following AWS's "Architectural Woodwork Standards," for grades of interior architectural woodwork, construction, finishes, and other requirements.
 - 1. The Contract Documents contain selections chosen from options in the quality standard and additional requirements beyond those of the quality standard. Comply with those selections and requirements in addition to the quality standard.
 - 2. Grade: Custom Grade.
 - 3. Provide certificates indicating the woodwork, including installation, complies with requirements of grades specified.
- B. Structural Performance: Countertop fabricator shall design countertops, countertop support brackets, and concealed blocking as required to accommodate the following loads:
 - 1. Dead Loads: Material loads as determined by manufacturer.
 - 2. Live Loads: Uniform load of 50 lbs/ft; concentrated load of 250 lbs at any location.
 - a. Uniform and concentrated loads need not be assumed to act concurrently.
- C. Fire-Test-Response Characteristics: Provide materials and products with specified fire-test-response characteristics as determined by testing identical products per test method indicated by UL, ITS, or another testing and inspecting agency acceptable to authorities having jurisdiction. Identify with appropriate markings of applicable testing and inspecting agency in the form of separable paper label or, where required by authorities having jurisdiction, imprint on surfaces of materials that will be concealed from view after installation.
 - 1. Flame spread and smoke developed shall conform to applicable code requirements for laminates and fire-retardant treated wood in accordance with ASTM E84, unless otherwise indicated on the Drawings.

2.02 MATERIALS

- A. General: Provide materials that comply with requirements of the AWI quality standard for each type of woodwork and quality grade specified, unless otherwise indicated.
- B. Wood Sheet Products:
 - 1. Medium-Density Fiberboard: ANSI A208.2, Grade MD, made with binder containing no urea formaldehyde. Provide Grade MD-Exterior Glue at locations subject to moisture or exterior conditions.
 - 2. Particleboard: ANSI A208.1, Grade MD. Provide Grade MD-Exterior Glue at locations subject to moisture or exterior conditions. Provide sanded faces for drawer and shelving construction.
- C. Wood Products: Comply with the following:
 - 1. Hardboard (WD1): AHA A135.4.
 - 2. Medium-Density Fiberboard: ANSI A208.2, Grade MD, made with binder containing no urea formaldehyde.

3. Particleboard: ANSI A208.1, Grade M-2-Exterior Glue.
 4. Softwood Plywood: DOC PS 1, Medium Density Overlay.
- D. Composite Wood and Agrifiber Products: Provide materials that comply with requirements of referenced quality standard for each type of woodwork and quality grade specified unless otherwise indicated.
1. Composite Wood Products: Products shall be made without urea formaldehyde, but in no case shall formaldehyde emission rates be greater than the following when tested according to ASTM D 6007 or ASTM E 1333:
 - a. Hardwood Plywood: 0.05 ppm.
 - b. MDF More Than 5/16 Inch Thick: 0.11 ppm.
 - c. MDF 5/16 Inch or Less in Thickness: 0.13 ppm.
 2. Medium-Density Fiberboard: ANSI A208.2, Grade 130.
 3. Softwood Plywood: DOC PS 1, medium-density overlay.
 - a. Wet Areas: Marine grade plywood; APA A-B Marine Grade, medium density overlay.
 4. Thermoset Decorative Panels: Medium-density fiberboard finished with thermally fused, melamine-impregnated decorative paper and complying with requirements of NEMA LD 3, Grade VGL, for test methods 3.3, 3.4, 3.6, 3.8, and 3.10.
- E. Adhesives:
1. General: Do not use adhesives that contain urea formaldehyde.
 2. VOC Limits for Installation Adhesives and Glues: Use installation adhesives that comply with the following limits for VOC content when calculated according to 40 CFR 59, Subpart D (EPA Method 24):
 - a. Wood Glues: 30 g/L.
 - b. Contact Adhesive: 250 g/L.

2.03 LAMINATE MATERIALS

- A. High-Pressure Decorative Laminate: NEMA LD 3, grades as indicated, or if not indicated, as required by woodwork quality standard.
1. Manufacturer: Provide products indicated on the Drawing "FINISH LEGEND" or comparable products of one the following:
 - a. Abet Laminati, Inc.
 - b. Formica Corporation.
 - c. Lamin-Art, Inc.
 - d. Pionite; Panolam Industries International, Inc.
 - e. Wilsonart LLC.
- B. Laminate Cladding for Exposed Surfaces:
1. Horizontal Surfaces: Grade HGS.
 2. Vertical Surfaces: Grade VGS.
 3. Edges: PVC edge banding, 0.12 inch thick, matching laminate in color, pattern, and finish. Hot melt applied.
 4. Pattern Direction: Vertically for drawer fronts, doors, and fixed panels, unless otherwise indicated.

- C. Materials: for Semiexposed Surfaces:
 - 1. Surfaces Other Than Drawer Bodies: Thermofoil.
 - a. Edges of Shelves: PVC edge banding, 0.12 inch thick, matching laminate in color, pattern, and finish.
 - b. For semiexposed backs of panels with exposed plastic-laminate surfaces, provide surface of high-pressure decorative laminate, NEMA LD 3, Grade CLS.
 - 2. Drawer Sides and Backs: Solid-hardwood lumber.
 - 3. Drawer Bottoms: Hardwood plywood.
- D. Colors, Patterns, and Finishes: Provide materials and products that result in colors and textures of exposed laminate surfaces complying with the following requirements:
 - 1. As selected by Interior Designer from manufacturer's full range. See Finish Schedule.
- E. Adhesive for Bonding Plastic Laminate: As recommended by plastic laminate manufacturer to suit application.

2.04 CABINET HARDWARE AND ACCESSORIES

- A. Hardware Standard: Comply with BHMA A156.9 for items indicated by referencing BHMA numbers or items referenced to this standard.
- B. Frameless Concealed Hinges – (European Type): BHMA A156.9, B01602, 135 degrees of opening self-closing.
- C. Pulls (HD-1): As selected by Interior Designer. See Interior Design Drawings and Finish Schedule.
- D. Catches: Magnetic catches, BHMA A156.9, B03141.
- E. Shelf Rests: BHMA A156.9, B04013; plastic, two-pin type with shelf hold-down clip.
- F. Drawer Slides: Side-mounted, full-extension, soft-close, zinc-plated steel drawer slides with steel ball bearings, BHMA A156.9, B05091, and rated for the following loads:
 - 1. Box Drawer Slides: 100 lbf.
 - 2. File Drawer Slides: 200 lbf.
 - 3. Pencil Drawer Slides: 45 lbf.
 - 4. Trash Bin Slides: 150 lbf.
- G. Door and Drawer Silencers: BHMA A156.16, L03011.
- H. Grommets for Cable Passage through Countertops: 2-inch OD, black, molded-plastic grommets and matching plastic caps with slot for wire passage.
- I. Exposed Hardware Finishes: For exposed hardware, provide finish that complies with BHMA A156.18 for BHMA finish number indicated.
 - 1. As selected by Interior Designer. See Interior Design Drawings and Finish Schedule.
- J. Countertop Support Brackets: As specified in Section 12 3600 – Solid Surface Countertops.

- K. For concealed hardware, provide manufacturer's standard finish that complies with product class requirements in BHMA A156.9.

2.05 MISCELLANEOUS MATERIALS

- A. Furring, Blocking, Shims, and Hanging Strips: Fire-retardant-treated softwood lumber, kiln dried to less than 15 percent moisture content.
- B. Anchors: Select material, type, size, and finish required for each substrate for secure anchorage. Provide metal expansion sleeves or expansion bolts for post-installed anchors. Use nonferrous-metal or hot-dip galvanized anchors and inserts at inside face of exterior walls and at floors.
- C. Adhesives:
 - 1. Do not use adhesives that contain urea formaldehyde.
 - 2. Adhesive for Bonding Plastic Laminate: Contact cement.
 - a. Adhesive for Bonding Edges: Hot-melt adhesive or adhesive specified above for faces.
 - 3. VOC Limits for Installation Adhesives and Glues: Use installation adhesives that comply with the following limits for VOC content when calculated according to 40 CFR 59, Subpart D (EPA Method 24):
 - a. Wood Glues: 30 g/L.
 - b. Contact Adhesive: 250 g/L.

2.06 FABRICATION

- A. Interior Woodwork Grade: Provide Custom grade interior woodwork complying with the referenced quality standard.
- B. Wood Moisture Content: Comply with requirements of referenced quality standard for wood moisture content in relation to ambient relative humidity during fabrication and in installation areas.
- C. Sand fire-retardant-treated wood lightly to remove raised grain on exposed surfaces before fabrication.
- D. Complete fabrication, including assembly, finishing, and hardware application, to maximum extent possible, before shipment to Project site. Disassemble components only as necessary for shipment and installation. Where necessary for fitting at site, provide ample allowance for scribing, trimming, and fitting.
 - 1. Trial fit assemblies at fabrication shop that cannot be shipped completely assembled. Install dowels, screws, bolted connectors, and other fastening devices that can be removed after trial fitting. Verify that various parts fit as intended and check measurements of assemblies against field measurements indicated on Shop Drawings before disassembling for shipment.
- E. Shop cut openings, to maximum extent possible, to receive hardware, appliances, plumbing fixtures, electrical work, and similar items. Locate openings accurately and use templates or

roughing-in diagrams to produce accurately sized and shaped openings. Sand edges of cutouts to remove splinters and burrs.

1. Seal edges of openings in countertops with a coat of varnish.

2.07 ACCESSORIES

- A. Furring, Blocking, Shims, and Hanging Strips: Softwood or hardwood lumber, fire-retardant-treated as required, kiln-dried to less than 15 percent moisture content.
- B. Anchors: Select material, type, size, and finish required for each substrate for secure anchorage. Provide nonferrous-metal or hot-dip galvanized anchors and inserts on inside face of exterior walls and elsewhere as required for corrosion resistance. Provide toothed-steel or lead expansion sleeves for drilled-in-place anchors.

2.08 PLASTIC LAMINATE CABINETS AND COUNTERTOPS

- A. Quality Standard: Comply with AWS Section 10 requirements for cabinets.
- B. Cabinet Construction:
 1. Style: Style A, Frameless.
 2. Type: Type I, multiple self-supporting units rigidly joined together.
 3. Door and Drawer Front Style: Flush overlay.
 - a. Reveal Dimension: As shown on Drawings.
- C. Dust Panels: 1/4-inch plywood or tempered hardboard above compartments and drawers unless located directly under tops.
- D. Concealed Backs of Panels with Exposed Plastic-Laminate Surfaces: High-pressure decorative laminate, NEMA LD 3, Grade BKL.
- E. Drawer Construction: Fabricate with exposed fronts fastened to subfront with mounting screws from interior of body.
 1. Join subfronts, backs, and sides with glued rabbeted joints supplemented by mechanical fasteners or glued dovetail joints.
- F. Plastic Laminate Countertops:
 1. Comply with "NAAWS" for high-pressure decorative laminate countertops, Custom grade.
 2. Core Material: Softwood Plywood, DOC PS 1, medium-density overlay.
 - a. Core Material at Sinks: Provide marine grade plywood at locations subject to moisture; APA A-B Marine Grade, medium density overlay.
 3. Core Thickness: 3/4 inch.
 - a. Build up countertop thickness to 1 1/2 inches at front, back, and ends with additional layers of core material laminated to top, unless otherwise indicated on the Drawings.
 4. Edge Treatment: 3mm PVC Edge, hot melt applied; as indicated on Finish Schedule.
 5. Backer Sheet: Provide plastic-laminate backer sheet, NEMA LD 3, Grade BKL, on underside of countertop substrate.

2.09 SHOP FINISHING

- A. Quality Standard: Comply with AWS Section 5, unless otherwise indicated.
 - 1. Grade: Provide finishes of same grades as items to be finished.

- B. Preparations for Finishing: Comply with referenced quality standard for sanding, filling countersunk fasteners, sealing concealed surfaces, and similar preparations for finishing architectural woodwork, as applicable to each unit of work.
 - 1. Backpriming: Apply one coat of sealer or primer, compatible with finish coats, to concealed surfaces of woodwork. Apply two coats to back of paneling and to end-grain surfaces. Concealed surfaces of plastic-laminate-clad woodwork do not require backpriming when surfaced with plastic laminate, backing paper, or thermoset decorative overlay.

- C. Patterns and Color Sections: Refer to Drawings.

PART 3 - EXECUTION

3.01 PREPARATION

- A. Condition woodwork to average prevailing humidity conditions in installation areas before installation.

- B. Before installing architectural woodwork, examine shop-fabricated work for completion and complete work as required, including removal of packing and backpriming.

3.02 INSTALLATION

- A. Quality Standard: Install woodwork to comply with AWS, Custom Grade.

- B. Install woodwork level, plumb, true, and straight. Shim as required with concealed shims. Install level and plumb (including tops) to a tolerance of 1/8 inch in 96 inches.

- C. Scribe and cut woodwork to fit adjoining work and refinish cut surfaces and repair damaged finish at cuts.

- D. Anchor woodwork to anchors or blocking built in or directly attached to substrates. Secure with countersunk, concealed fasteners and blind nailing as required for complete installation. Use fine finishing nails or finishing screws for exposed fastening, countersunk and filled flush with woodwork and matching final finish if transparent finish is indicated.

- E. Cabinets: Install without distortion so doors and drawers fit openings properly and are accurately aligned. Adjust hardware to center doors and drawers in openings and to provide unencumbered operation. Complete installation of hardware and accessory items as indicated.
 - 1. Install cabinets with no more than 1/8 inch in 96-inch sag, bow, or other variation from a straight line.

2. Maintain veneer sequence matching of cabinets with transparent finish.
3. Fasten wall cabinets through back, near top and bottom, at ends and not more than 16 inches o.c. with appropriate fasteners.

F. Support Bracket Installation:

1. Provide support brackets at spacing required to accommodate countertop loads. Where typical spacing interferes with lavatory location, revise spacing or add supplemental brackets to accommodate lavatory and loads.
2. Install flush-mount support brackets to vertical wood stud blocking prior to installation of gypsum board or tile backing panel. Fasten brackets with quantity and type of fasteners as determined by fabricator to achieve full capacity of each support bracket.

3.03 FIELD FINISHING

- A. Complete the finishing work specified in this Section to extent not completed at shop or before installation of woodwork.
- B. Fill nail holes with matching filler where exposed.
- C. Final finishing: As specified in Section 09 91 00 – Painting and Coating.

3.04 ADJUSTING AND CLEANING

- A. Repair damaged and defective woodwork, where possible, to eliminate functional and visual defects; where not possible to repair, replace woodwork. Adjust joinery for uniform appearance.
- B. Clean woodwork on exposed and semiexposed surfaces. Touch up shop-applied finishes to restore damaged or soiled areas.
- C. Protection: Protect installed work as required by the manufacturer to maintain product performance, design criteria and warranty.

END OF SECTION 06 4000

SECTION 06 4116 – WALL PROTECTION

PART 1 - GENERAL

1.01 SUMMARY

- A. Section Includes:
 - 1. Plastic-Laminate-Clad Wall Protection.

1.02 COORDINATION

- A. Coordinate sizes and locations of framing, blocking, furring, reinforcements, and other related units of Work specified in other Sections to support loads imposed by installed and fully loaded cabinets.

1.03 SUBMITTALS

- A. Product Data: For each type of product.
- B. Shop Drawings: For plastic-laminate-clad wall protection installation.
 - 1. Include plans, elevations, sections and attachment details.
- C. Samples: For each exposed product and for each color and texture specified, in manufacturer's or fabricator's standard size.

1.04 QUALITY ASSURANCE

- A. Fabricator Qualifications: Shop that employs skilled workers who custom fabricate products similar to those required for this Project and whose products have a record of successful in-service performance.

1.05 FIELD CONDITIONS

- A. Environmental Limitations: Do not deliver or install until building is enclosed, wet-work is complete, and HVAC system is fully operational.

PART 2 - PRODUCTS

2.01 PLASTIC-LAMINATE WALL PROTECTION

- A. Basis of Design (WP-1): Formica Hardstop Panel
 - 1. Color: Beige Elm 5794-NG, run grain vertically.
 - 2. Location: Wall protection locations to receive hardboard, or similar substrate. Locations as indicated on Drawings.
- B. Adhesive for Bonding: Unpigmented contact cement.

- C. Trims:
 - 1. All Trims: Clear anodized aluminum.

PART 3 - EXECUTION

3.01 PREPARATION

- A. Before installation, condition panels to humidity conditions in installation areas for not less than 72 hours.

3.02 INSTALLATION

- A. Plastic-Laminate Wall Protection:
 - 1. Anchor wainscot to supporting substrate with adhesive. Do not use face fastening, unless covered by trim or otherwise indicated.
 - 2. Install flush paneling with no more than 1/16 inch in 96 inch vertical cup or bow and 1/8 inch in 96 inch horizontal variation from a true plane.
 - 3. Provide H trim at vertical joints.
 - 4. Provide cap trim at top, bottom and exposed ends.
 - 5. Install full width panels to the greatest extent possible. At ends provide equal spaced panels on each elevation.

END OF SECTION 06 4116

SECTION 06 6413 – FIBERGLASS REINFORCED PLASTIC (FRP) PANELING

PART 1 - GENERAL

1.01 SUMMARY

- A. Section Includes:
 - 1. Glass-fiber reinforced plastic (FRP) wall paneling and trim accessories.

1.02 SUBMITTALS

- A. Product Data: For each type of product.
- B. Samples: For plastic paneling and trim accessories, in manufacturer's standard sizes.

1.03 PROJECT CONDITIONS

- A. Environmental Limitations: Do not deliver or install plastic paneling until spaces are enclosed and weathertight and temporary HVAC system is operating and maintaining ambient temperature and humidity conditions at occupancy levels during the remainder of the construction period.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

- A. Source Limitations: Obtain plastic paneling and trim accessories from single manufacturer.

2.02 PLASTIC SHEET PANELING

- A. Glass-Fiber-Reinforced Plastic Paneling (FRP-1): Gelcoat-finished, glass-fiber-reinforced plastic panels complying with ASTM D 5319. Panels shall be USDA accepted for incidental food contact.
 - 1. Basis of Design: Varietex by Crane Composites, Inc.
 - 2. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Crane Composites, Inc.
 - b. Marlite.
 - c. Nudo Products, Inc.
 - 3. Surface-Burning Characteristics: As follows when tested by a qualified testing agency according to ASTM E 84. Identify products with appropriate markings of applicable testing agency.
 - a. Flame-Spread Index: 25 or less.
 - b. Smoke-Developed Index: 450 or less.
 - 4. Nominal Thickness: Not less than 0.09 inch.

5. Coating: Multi-layer print, primer and finish coats applied over-layer.
 - a. Surface Finish: Linen.
 - b. Back Surface: Smooth. Imperfections which do not affect functional properties are not cause for rejection.
6. Color: As shown on Finish Schedule.

2.03 ACCESSORIES

- A. Trim Accessories: Manufacturer's standard thin-wall semi-rigid vinyl extrusions designed to retain and cover edges of panels. Provide division bars, inside corners, outside corners, bottom trim, and caps as needed to conceal edges.
 1. Color: Match panels.
- B. Adhesive: As recommended by plastic paneling manufacturer and with a VOC content of 50 g/L or less.
- C. Sealant: Mildew-resistant, single-component, neutral-curing silicone sealant recommended by plastic paneling manufacturer and complying with requirements in Section 07 9200 "Joint Sealants."
 1. Sealant shall have a VOC content of 250 g/L or less.

PART 3 - EXECUTION

3.01 EXAMINATION

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

3.02 PREPARATION

- A. Prepare substrate by sanding high spots and filling low spots as needed to provide flat, even surface for panel installation.
- B. Clean substrates of substances that could impair adhesive bond, including oil, grease, dirt, and dust.
- C. Condition panels by unpacking and placing in installation space before installation according to manufacturer's written recommendations.
- D. Lay out paneling before installing. Locate panel joints where indicated or, if not specifically indicated, to provide equal panels at ends of walls not less than half the width of full panels.
 1. Mark plumb lines on substrate at panel joint locations for accurate installation.
 2. Locate trim accessories and panel joints to allow clearance at panel edges according to manufacturer's written instructions.

3.03 INSTALLATION

- A. Install plastic paneling according to manufacturer's written instructions using full sheet mastic coverage method and trowel recommended by the adhesive manufacturer. Allow 1/8 inch at joints for expansion.
- B. Install panels in a full spread of adhesive.
- C. Install trim accessories with adhesive. Do not fasten through panels.
- D. Fill grooves in trim accessories with sealant before installing panels, and bed inside corner trim in a bead of sealant.
- E. Maintain uniform space between panels and wall fixtures. Fill space with sealant.
- F. Remove excess sealant and smears as paneling is installed. Clean with solvent recommended by sealant manufacturer and then wipe with clean dry cloths until no residue remains.

END OF SECTION 06 6413

SECTION 07 1113 - BITUMINOUS DAMPPROOFING

PART 1 - GENERAL

1.01 SECTION INCLUDES

- A. Cold-applied, emulsified-asphalt dampproofing.
- B. Protection course.
- C. Accessory materials.

1.02 RELATED REQUIREMENTS

- A. Section 03 3000 - Cast-in-Place Concrete: Concrete substrate and waterstops.
- B. Civil Drawings: Fill.

1.03 ADMINISTRATIVE REQUIREMENTS

- A. Preinstallation Meeting: Conduct a preinstallation meeting one week prior to the start of the work of this section; require attendance by all affected installers.
 - 1. Establish procedures to maintain optimum working conditions and to coordinate this work with related and adjacent work. Agenda for meeting shall include review of special details and flashing.

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: Submit manufacturer's complete set of standard details and 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 5 years documented experience.

1.06 FIELD CONDITIONS

- A. Maintain ambient temperatures above 40 degrees F (5 degrees C) for 24 hours before and during application until dampproofing has cured.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

- A. Basis of Design Manufacturer:
 - 1. Henry Company: www.henry.com.
HE789 - Fibered Asphalt Emulsion Dampproofing.
- B. Other Acceptable Bituminous Dampproofing Manufacturers:
 - 1. Manufacturers listed below and proposed for use shall submit evidence of ability to meet all requirements specified.
 - 2. W.R. Meadows, Inc: www.wrmeadows.com/sle.
 - 3. BASF: www.buildingsystems.basf.com.
 - 4. Carlisle Coatings and Waterproofing: www.carlisleccw.com.
 - 5. Substitutions: See Section 01 6000 - Product Requirements.

2.02 BITUMINOUS DAMPPROOFING

- A. Bituminous Dampproofing: Cold-applied water-based emulsion; asphalt with mineral colloid or chemical emulsifying agent; with fiber reinforcement; asbestos-free; suitable for application on vertical and horizontal surfaces.
 - 1. Composition - Vertical Application: ASTM D1227 Type III or ASTM D1187/D1187M Type I.
 - 2. Composition - Horizontal and Low-Slope Application: ASTM D1227 Type II or III.
 - 3. VOC Content: Not more than permitted by local, State, and federal regulations.
- B. Primers, Mastics, and Related Materials: Type as recommended by dampproofing manufacturer.

2.03 ACCESSORIES

- A. Protection Course: Type recommended by waterproofing manufacturer.

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 APPLICATION

- A. Perform work in accordance with NRCA Roofing and Waterproofing Manual.

- B. Comply with manufacturer's written instructions for substrate preparation, dampproofing application, cure time between coats, and drying time before backfilling unless more stringent requirements are indicated.
 - 1. Apply dampproofing to provide continuous plane of protection.
 - 2. Apply additional coats if recommended in writing by manufacturer or to achieve a smooth surface and uninterrupted coverage.

- C. Where dampproofing footings and foundation walls, apply from finished-grade line to top of footing; extend over top of footing and down a minimum of 6 inches (150 mm) over outside face of footing.
 - 1. Extend dampproofing 12 inches (300 mm) onto intersecting walls and footings, but do not extend onto surfaces exposed to view when Project is completed.
 - 2. Install flashings and corner protection stripping at internal and external corners, changes in plane, construction joints, cracks, and where shown as "reinforced," by embedding an 8-inch- (200-mm-) wide strip of asphalt-coated glass fabric in a heavy coat of dampproofing. Dampproofing coat for embedding fabric is in addition to other coats required.

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

- E. Place protection course directly over dampproofing, butt joints, and adhere to tacky dampproofing.

- F. Scribe and cut boards around projections, penetrations, and interruptions.

END OF SECTION

SECTION 07 2100 - THERMAL INSULATION

PART 1 - GENERAL

1.01 SECTION INCLUDES

- A. Foam Board Insulation.
- B. Fiber Board Insulation.

1.02 RELATED REQUIREMENTS

- A. Section 09 2116 – Gypsum Board Assemblies: For acoustic insulation installed as a component of assemblies.

1.03 SUBMITTALS

- A. Qualification Data: For Installer.
- B. Product Data: Provide data on product characteristics, performance criteria, and product limitations.
- C. Test Report: Submit report of full-size mockup test for NFPA 285 fire performance, with project cladding assemblies highlighted, for foam insulation on exterior.
- D. Shop Drawings: Indicate required flashings, control joints, and expansion joints, and sealing details at openings, projections, penetrations, and sleeves to maintain continuous thermal barrier.
- E. Manufacturer's Installation Instructions: Indicate special preparation of substrate, installation and attachment methods, and perimeter conditions requiring special attention.
 - 1. Include recommended fastening components and spacing to control sag.

1.04 QUALITY ASSURANCE

- A. Installer Qualifications: Company specializing in performing the work of this section with minimum 2 years' experience.

1.05 MOCKUP

- A. Construct mockup of 100 sq. ft. of horizontal insulation exposed in unconditioned space, representing finished work including internal and external corners.
 - 1. Locate where convenient.
 - 2. Mockup may remain as part of the Work.

1.06 DELIVERY, STORAGE AND HANDLING

- A. As required by the manufacturer for a warrantable installation of the installed products to meet Performance and Design Criteria.

PART 2 - PRODUCTS

2.01 DESCRIPTION

- A. Foam board, and Batt Insulation.

2.02 MATERIALS

A. Foam Board Insulation:

1. Expanded Polystyrene Board Insulation: ASTM C578.
 - a. Basis of Design: EPS by INSULFOAM. Comparable and substituted products will be judged based on the following performance criteria, features, warranty, and qualifications.
 - b. Performance Criteria:
 - 1) Flame Spread Index: 25 or less, when tested in accordance with ASTM E84.
 - 2) Smoke Developed Index: 450 or less, when tested in accordance with ASTM E84.
 - 3) Complies with fire-resistance requirements as part of an exterior non-load-bearing exterior wall assembly when tested in accordance with NFPA 285 in cladding systems matching project.
 - 4) Water Absorption: 4 percent by volume, maximum, when tested in accordance with ASTM D2842.
 - 5) Board Density: 0.7 lb/cu. ft.
 - 6) Compressive Resistance: 25 psi.
 - c. Features:
 - 1) Board Size: 48 x 96 inch.
 - 2) Board Thickness: 2 inches.
 - 3) Board Edges: Square.
 - d. Locations: Below grade along inside of stem walls. See detail E5/A3.10.

B. Sound Batt Insulation:

1. Sound Attenuations Blanket Insulation: Mineral wool batts; mineral fiber (inorganic material; rock and blast furnace slag); ASTM E136 noncombustible; moisture-resistant; ASTM C665 noncorrosive Type I; non-deteriorating; mildew-proof; vermin-proof; available in 1-1/2 inch to 7 inch thickness, widths of 17 inches and 25 inches, lengths of 48 inches; density of 2.5 PCF. Tested to ASTM C518. R-3.7 per inch of thickness. Unfaced Flame Spread = 0. Smoke Development = 0.
2. Product: Thermafiber SAFB (Sound Attenuation Fire Blankets) Insulation or approved equal.

2.03 ACCESSORIES

- A. All accessory materials required by the manufacturer for a warrantable installation of the installed product in a manner that meets the Performance and Design Criteria.
- B. Insulation Fasteners: Impaling clip of unfinished steel with washer retainer and clips, to be adhered to surface to receive insulation, length to suit insulation thickness and substrate, capable of securely and rigidly fastening insulation in place.

PART 3 - EXECUTION

3.01 EXAMINATION

- A. Verify existing conditions meet the manufacturer's requirements before starting work.

3.02 PREPARATION

- A. Prepare surfaces to receive work in accordance with manufacturer's instructions.

3.03 INSTALLATION

- A. General: Install all materials in accordance with manufacturer's instructions based on conditions present.

3.04 PROTECTION

- A. Protect installed work as required by the manufacturer to maintain product performance, design criteria, and warranty.

END OF SECTION 07 2100

SECTION 07 2616 - UNDERSLAB VAPOR BARRIER

PART 1 - GENERAL

1.01 SUMMARY

- A. Section includes:
 - 1. Underslab Vapor Barrier.
 - 2. Seam tape, mastic, pipe boots, and accessories.
- B. Related Sections:
 - 1. Section 03 30 00 - Cast-in-Place Concrete: General structural applications of concrete.

1.02 SUBMITTALS

- A. Product Data: Submit manufacturer's data for each type of manufactured material and product indicated.
- B. Product certificates signed by the manufacturer of the products certifying that their products comply with specified requirements.
- C. Manufacturer's installation instructions for placement, seaming and pipe boot installation.
- D. Manufacturer's Certificates: Certify products meet or exceed specified requirements.
- E. Manufacturer's Field Reports: Manufacturer' Representative shall provide Field Reports including project, report date, activity and location, environmental conditions, recommendations, results and acceptance or non-acceptance of on-site conditions.
- F. Qualifications: For Manufacturer and Installer.

1.03 QUALITY ASSURANCE

- A. Manufacturer Qualifications: A manufacturer with a minimum of 5 years documented experience manufacturing and supplying specified vapor barrier and who also maintains a technical representative to perform testing and inspection on site, to support technical decisions and procedures used.
- B. Installer Qualifications: An installer trained and approved by manufacturer as qualified to perform work of this Section with not less than 5 years experience.
- C. Field Testing: Provide on site tests patch samples for evaluation of surface preparation techniques and application workmanship.

1.04 DELIVERY, STORAGE, AND HANDLING

- A. Delivery: Deliver materials to site in manufacturer's original, unopened containers and packaging, with labels clearly identifying product name and manufacturer.
- B. Storage: Store materials in a clean, dry area in accordance with manufacturer's instructions.
- C. Handling: Protect materials during handling and installation to prevent damage.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

- A. Acceptable Manufacturers: Subject to compliance with requirements, provide products as manufactured by one of the following:
 - 1. Forifiber Building Systems Group; Moistop Ultra 15.
 - 2. Raven Industries Inc; Vapor Block 15.
 - 3. Stego Industries, LLC; Stego Wrap 15 mil, Class A.

2.02 MATERIALS

- A. Underslab Vapor Barrier:
 - 1. Classification: ASTM E 1745, Class A.
 - 2. Minimum thickness according to ACI 302.2R-06: 15 mils.
 - 3. Permeance:
 - a. Permeance Ratings as per ASTM E-96 or ASTM F-1249
 - b. New material: Less than 0.01 perms
 - c. After mandatory conditioning as per ASTM E-154 Sections 8, 11, 12, & 13: Less than 0.01 perms
 - 4. Compatible with radiant flooring installations.
 - 5. Basis of Design: Stego Wrap 15-mil Vapor Barrier; Stego Industries LLC.

2.03 ACCESSORIES

- A. Seam Tape: Water Vapor Transmission Rate: ASTM E 96, 0.3 perms or lower.
 - 1. 3 3/4 inches, minimum; polyethylene film and acrylic, pressure-sensitive adhesive; Stego Tape, or approved equal.
 - 2. 6 inches, minimum; polyethylene film, aperture film and acrylic pressure-sensitive adhesive; Stego Crete Claw Tape, or approved equal.
- B. Vapor Proofing Mastic: Medium-viscosity, water-based, polymer-modified anionic bituminous/asphalt emulsion; Tensile strength, 32 psi per ASTM D412; Stego Mastic, or approved equal.
- C. Pipe Boots: Manufacturer's standard prefabricated pipe boots constructed from vapor barrier material, pressure sensitive tape and/or mastic.

PART 3 - EXECUTION

3.01 PREPARATION

- A. Ensure that subsoil is approved by architect or geotechnical firm
 1. Level and tamp or roll aggregate, sand or tamped earth base.

3.02 EXAMINATION

- A. Examine areas to receive reinforced vapor retarders. Ensure subgrade is smooth, level and compacted with no sharp projections. Notify Architect if areas are not acceptable. Do not begin installation until unacceptable conditions have been corrected

3.03 INSTALLATION

- A. Underslab Vapor Barrier: Place, protect, and repair vapor-barrier sheets according to ASTM E 1643 and manufacturer's written instructions.
 1. Unroll vapor barrier with the longest dimension parallel with the direction of the pour.
 2. Install in largest practical widths.
 3. Lap Vapor Barrier/Retarder over footings or seal to foundation walls.
 4. Overlap Lap joints 6 inches and seal with manufacturers recommended tape.
 5. Do not penetrate vapor barrier except to allow for reinforcing steel and permanent utilities.
 6. Seal all penetrations, including pipes, per manufacturer's instructions, to create a monolithic membrane between the surface of the slab and moisture sources below and at the slab perimeter.
 7. Tears, punctures and penetrations shall be taped to maintain the moisture vapor resistance integrity of vapor barrier.
 8. Repair damaged areas by cutting patches of vapor barrier, overlapping damaged area 6 inches and taping all four sides with tape.

3.04 FIELD QUALITY CONTROL

- A. Owner and Contractor's Representative:
 1. Prior to application, verify conditions are acceptable for application.
 2. Make final inspections following installation and prior to concrete pour. Contractor to provide photograph documentation of vapor barrier installation, including terminations and penetrations.
 3. Verify work conforms to manufacturer's instructions and meets manufacturer's provisions prior to installation of concrete.
- B. Correct defective work identified by the manufacturer's representative in accordance with manufacturer's instructions.
 1. Cost of corrections and subsequent inspections to determine compliance of corrective action shall be at the Contractor's expense.

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TWIN FALLS TRAINING FACILITY
SECTION 07 2616
UNDERSLAB VAPOR BARRIER

3.05 PROTECTION

- A. Take precautions when installing reinforcing steel, utilities and concrete not to damage vapor barriers.

END OF SECTION 07 2616

SECTION 07 4213 – FORMED METAL WALL PANELS

PART 1 - GENERAL

1.01 SUMMARY

- A. Section Includes:
 - 1. Exposed-fastener, lap-seam metal wall panels, with required closures and trim.

1.02 DEFINITION

- A. Metal Wall Panel Assembly: Metal wall panels, attachment system components, miscellaneous metal framing, and accessories necessary for a complete wall system.

1.03 SUBMITTALS

- A. Product Data: For each type of product indicated. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for each type of wall panel and accessory.
- B. Shop Drawings: Show fabrication and installation layouts of metal wall panels; details of edge conditions, joints, panel profiles, corners, anchorages, attachment system, trim, flashings, closures, and accessories; and special details. Distinguish between factory-, shop- and field-assembled work.
 - 1. Accessories: Include details of the following items, at a scale of not less than 1-1/2 inches per 12 inches:
 - a. Flashing and trim.
 - b. Anchorage systems.
 - c. Wall mounted equipment backing and flashing conditions.
- C. Samples for Initial Selection: For each type of metal wall panel indicated with factory-applied color finishes.
 - 1. Include similar Samples of trim and accessories involving color selection.
 - 2. Include manufacturer's color charts consisting of strips of cured sealants showing the full range of colors available for each sealant exposed to view.
- D. Qualification Data: For Installer.
- E. Product Test Reports: Based on evaluation of comprehensive tests performed by a qualified testing agency, for each product.
- F. Field quality-control reports.
- G. Maintenance Data: For metal wall panels to include in maintenance manuals.
- H. Warranties: Sample of special warranties.

1.04 QUALITY ASSURANCE

- A. Installer Qualifications: An employer of workers trained and approved by manufacturer.
- B. Testing Agency Qualifications: Qualified according to ASTM E 329 for testing indicated.
- C. Source Limitations: Obtain each type of metal wall panel from single source from single manufacturer.
- D. Fire-Resistance Ratings: Where indicated, provide metal wall panels identical to those of assemblies tested for fire resistance per ASTM E 119 by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.
 - 1. Indicate design designations from UL's "Fire Resistance Directory" or from the listings of another qualified testing agency.
- E. Preinstallation Conference: Conduct conference at Project site.
 - 1. Meet with Owner, Architect, Owner's insurer if applicable, testing and inspecting agency representative, metal wall panel Installer, metal wall panel manufacturer's representative, structural-support Installer, and installers whose work interfaces with or affects metal wall panels.
 - 2. Review and finalize construction schedule and verify availability of materials, Installer's personnel, equipment, and facilities needed to make progress and avoid delays.
 - 3. Review methods and procedures related to metal wall panel installation, including manufacturer's written instructions.
 - 4. Examine support conditions for compliance with requirements, including alignment between and attachment to structural members.
 - 5. Review flashings, special siding details, and condition of other construction that will affect metal wall panels.
 - 6. Review governing regulations and requirements for insurance, certificates, and tests and inspections if applicable.
 - 7. Review temporary protection requirements for metal wall panel assembly during and after installation.
 - 8. Review wall panel observation and repair procedures after metal wall panel installation.

1.05 DELIVERY, STORAGE, AND HANDLING

- A. Deliver components, sheets, metal wall panels, and other manufactured items so as not to be damaged or deformed. Package metal wall panels for protection during transportation and handling.
- B. Unload, store, and erect metal wall panels in a manner to prevent bending, warping, twisting, and surface damage.
- C. Stack metal wall panels horizontally on platforms or pallets, covered with suitable weathertight and ventilated covering. Store metal wall panels to ensure dryness, with positive slope for drainage of water. Do not store metal wall panels in contact with other materials that might cause staining, denting, or other surface damage.

- D. Retain strippable protective covering on metal wall panel for period of metal wall panel installation.

1.06 PROJECT CONDITIONS

- A. Weather Limitations: Proceed with installation only when existing and forecasted weather conditions permit assembly of metal wall panels to be performed according to manufacturers' written instructions and warranty requirements.
- B. Field Measurements: Verify locations of structural members and wall opening dimensions by field measurements before metal wall panel fabrication and indicate measurements on Shop Drawings.

1.07 COORDINATION

- A. Coordinate metal wall panel assemblies with rain drainage work, flashing, trim, and construction of other adjoining work to provide a leakproof, secure, and noncorrosive installation.

1.08 WARRANTY

- A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of metal wall panel assemblies that fail in materials or workmanship within specified warranty period.
 - 1. Failures include, but are not limited to, the following:
 - a. Structural failures including rupturing, cracking, or puncturing.
 - b. Deterioration of metals and other materials beyond normal weathering.
 - 2. Warranty Period: Two years from date of Substantial Completion.

PART 2 - PRODUCTS

2.01 PERFORMANCE REQUIREMENTS

- A. General Performance: Metal wall panel assemblies shall comply with performance requirements without failure due to defective manufacture, fabrication, installation, or other defects in construction.
- B. Air Infiltration: Air leakage through assembly of not more than 0.06 cfm/sq. ft. of wall area when tested according to ASTM E 283 at the following test-pressure difference:
- C. Water Penetration under Static Pressure: No water penetration when tested according to ASTM E 331 at the following test-pressure difference:
 - 1. Test-Pressure Difference: 6.24 lbf/sq. ft..
- D. Structural Performance: Provide metal wall panel assemblies capable of withstanding the effects the following loads and stresses within limits and under conditions indicated, based on testing according to ASTM E 330:

1. Wind Loads: As indicated on Drawings.
 2. Other Design Loads: As indicated on Drawings.
 3. Deflection Limits: Metal wall panel assemblies shall withstand wind loads with horizontal deflections no greater than 1/240 of the span.
- E. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes by preventing buckling, opening of joints, overstressing of components, failure of joint sealants, failure of connections, and other detrimental effects. Base calculations on surface temperatures of materials due to both solar heat gain and nighttime-sky heat loss.
1. Temperature Change (Range): 120 deg F, ambient; 180 deg F, material surfaces.

2.02 PANEL MATERIALS

- A. Basis-of-Design Products: Subject to compliance with requirements, provide R-Panel including support framing and clips, as manufactured by Nucor Buildings Group; to match premanufactured building.
- B. Manufacturers:
1. AEP Span
 2. Centria Systems
 3. Firestone Building Products
 4. Kingspan Group
 5. Metal Sales
 6. Nucor Buildings Group.
- C. Uncoated Steel Sheet: ASTM A653 Structural Steel (SS) or Forming Steel (FS), exposed surface uncoated weathering steel (ASTM A606-4), continuous coil-coated with manufacturer's standard coating for concealed surfaces.
- D. Steel Coil: Zinc coated steel sheet, coating designation (ASTM A606-4), structural quality, Grade 50, 26 gauge, weathering steel.
- E. Panel Sealants: As specified in Section 07 9200 – Joint Sealants.

2.03 FORMED METAL WALL PANELS

- A. General: Provide factory-formed metal wall panels designed to be field assembled by lapping side edges of adjacent panels and mechanically attaching panels to supports using exposed fasteners in side laps. Include accessories required for weathertight installation.
- B. Corrugated-Profile, Exposed-Fastener Metal Wall Panels:
1. Panel Profile: R-Panel by Nucor Buildings Group; to match premanufactured building.
 - a. Gauge: 26 min.
 - b. Color:
 - 1) Pre-fabricated Metal Building: Per Section 13 3419 – Metal Building Systems, manufacturer.
 - 2) Trash Enclosure: Pearl Gray; unless otherwise specified.

- C. Accessories: Manufacturer's standard flashing and trim to provide complete system.
- D. Attachment Assembly, General: Install attachment assembly required to support metal wall panels and to provide a complete installation, including vertical and horizontal supports, clips and fasteners.
 - 1. Include attachment to supports, panel-to-panel joinery, panel-to-dissimilar-material joinery, and panel-system joint seals.

2.04 MISCELLANEOUS METAL FRAMING

- A. Miscellaneous Metal Framing, General: ASTM C 645, cold-formed metallic-coated steel sheet, ASTM A 653, G60 hot-dip galvanized or coating with equivalent corrosion resistance unless otherwise indicated.
- B. Zee Clips: 0.079-inch nominal thickness.
- C. Base Channels: 0.079-inch nominal thickness.
- A. Panel Fasteners: Self-tapping screws, bolts, nuts, self-locking rivets and bolts, end-welded studs, and other suitable fasteners designed to withstand design loads. Provide exposed fasteners with heads matching color of metal wall panels by means of plastic caps or factory-applied coating. Provide EPDM, PVC, or neoprene sealing washers.

2.05 ACCESSORIES

- A. Wall Panel Accessories: Provide components required for a complete metal wall panel assembly including trim, copings, fasciae, mullions, sills, corner units, clips, flashings, sealants, gaskets, fillers, closure strips, and similar items. Match material and finish of metal wall panels, unless otherwise indicated.
 - 1. Closures: Provide closures at eaves and rakes, fabricated of same metal as metal wall panels.
 - 2. Backing Plates: Provide metal backing plates at panel end splices and wall mounted equipment locations, fabricated from material recommended by manufacturer.
 - 3. Closure Strips: Closed-cell, expanded, cellular, rubber or crosslinked, polyolefin-foam or closed-cell laminated polyethylene; minimum 1-inch- thick, flexible closure strips; cut or premolded to match metal wall panel profile. Provide closure strips where indicated or necessary to ensure weathertight construction.
- B. Flashing and Trim: Formed from 0.018-inch minimum thickness, zinc-coated (galvanized) steel sheet or aluminum-zinc alloy-coated steel sheet prepainted with coil coating. Provide flashing and trim as required to seal against weather and to provide finished appearance. Locations include, but are not limited to, bases, drips, sills, jambs, corners, endwalls, framed openings, rakes, fasciae, roof flashings, wall mounted equipment penetrations, fixture mounts, soffits, reveals, and fillers. Finish flashing and trim with same finish system as adjacent metal wall panels.

2.06 FABRICATION

- A. General: Fabricate and finish metal wall panels and accessories at the factory to greatest extent possible, by manufacturer's standard procedures and processes, as necessary to fulfill indicated performance requirements demonstrated by laboratory testing. Comply with indicated profiles and with dimensional and structural requirements.
- B. Fabricate metal wall panels in a manner that eliminates condensation on interior side of panel and with joints between panels designed to form weathertight seals.
- C. Provide panel profile, including major ribs and intermediate stiffening ribs, if any, for full length of panel.
- D. Fabricate metal wall panel joints with factory-installed captive gaskets or separator strips that provide a tight seal and prevent metal-to-metal contact, and that will minimize noise from movements within panel assembly.
- E. Sheet Metal Accessories: Fabricate flashing and trim to comply with recommendations in SMACNA's "Architectural Sheet Metal Manual" that apply to the design, dimensions, metal, and other characteristics of item indicated.
 - 1. Form exposed sheet metal accessories that are without excessive oil canning, buckling, and tool marks and that are true to line and levels indicated, with exposed edges folded back to form hems.
 - 2. Seams for Other Than Aluminum: Fabricate nonmoving seams in accessories with flat-lock seams. Tin edges to be seamed, form seams, and solder.
 - 3. Sealed Joints: Form nonexpansion but movable joints in metal to accommodate elastomeric sealant to comply with SMACNA standards.
 - 4. Conceal fasteners and expansion provisions where possible. Limit exposed fasteners on faces of accessories exposed to view to greatest extent possible.
 - 5. Fabricate cleats and attachment devices from same material as accessory being anchored or from compatible, noncorrosive metal recommended by metal wall panel manufacturer.
 - a. Size: As recommended by SMACNA's "Architectural Sheet Metal Manual" or metal wall panel manufacturer for application but not less than thickness of metal being secured.

2.07 GENERAL FINISH REQUIREMENTS

- A. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.
- B. Appearance of Finished Work: Variations in appearance of abutting or adjacent pieces are acceptable if they are within one-half of the range of approved Samples. Noticeable variations in the same piece are not acceptable. Variations in appearance of other components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

PART 3 - EXECUTION

3.01 EXAMINATION

- A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances, metal wall panel supports, and other conditions affecting performance of work.
 - 1. Examine wall framing to verify that girts, angles, channels, studs, and other structural panel support members and anchorage have been installed within alignment tolerances required by metal wall panel manufacturer and provide adequate backing for anchoring of building equipment.
 - 2. Examine wall siding to verify that siding joints are supported by framing or blocking and that installation is within flatness tolerances required by metal wall panel manufacturer.
 - 3. Verify that weather-resistant sheathing paper has been installed over sheathing or backing substrate to prevent air infiltration or water penetration.
 - 4. For the record, prepare written report, endorsed by Installer, listing conditions detrimental to performance of work.
- B. Examine roughing-in for components and systems penetrating metal wall panels to verify actual locations of penetrations relative to seam locations of metal wall panels before metal wall panel installation or proposed metal panel penetrations comply with Pre-engineered metal building acceptable locations.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 PREPARATION

- A. Miscellaneous Framing: Install subgirts, base angles, sills, furring, and other miscellaneous wall panel support members and anchorages according to ASTM C 754 and metal wall panel manufacturer's written recommendations.

3.03 THERMAL INSULATION INSTALLATION

- A. Blanket Insulation: Install insulation concurrently with metal wall panel installation, in thickness indicated to cover entire wall, according to manufacturer's written instructions and as follows:
 - 1. Set vapor-retarder-faced insulation with vapor-retarder facing as indicated on premanufactured metal building Drawings. Do not obstruct ventilation spaces, except for firestopping.
 - 2. Tape joints and ruptures in vapor retarder, and seal each continuous area of insulation to surrounding construction to ensure airtight installation.
 - 3. Install insulation straight and true in one-piece lengths. Comply with the installation methods.
 - 4. Retainer Strips: Install retainer strips at each longitudinal insulation joint, straight and taut, nesting with framing to hold insulation in place.

3.04 METAL WALL PANEL INSTALLATION

- A. General: Install metal wall panels according to manufacturer's written instructions in orientation, sizes, and locations indicated on Drawings. Install panels perpendicular to girts and subgirts unless otherwise indicated. Anchor metal wall panels and other components of the Work securely in place, with provisions for thermal and structural movement.
1. Shim or otherwise plumb substrates receiving metal wall panels.
 2. Flash and seal metal wall panels at perimeter of all openings. Fasten with self-tapping screws. Do not begin installation until backing and flashings that will be concealed by metal wall panels are installed.
 3. Install screw fasteners in predrilled holes.
 4. Locate and space fastenings in uniform vertical and horizontal alignment.
 5. Install flashing and trim as metal wall panel work proceeds.
 6. Locate panel splices over supports. Stagger panel splices and end laps to avoid a four-panel lap splice condition.
 7. Apply elastomeric sealant continuously between metal base channel (sill angle) and concrete and elsewhere as indicated or, if not indicated, as necessary for waterproofing.
 8. Align bottom of metal wall panels and fasten with blind rivets, bolts, or self-tapping screws. Fasten flashings and trim around openings and similar elements with self-tapping screws incorporating neoprene washers or use blind rivets. Maintain weathertight condition.
 9. Provide weathertight escutcheons for pipe and conduit penetrating exterior walls. Provide weatherproof flashings and counterflashings for mechanical ductwork penetrating exterior walls.
- B. Fasteners:
1. Steel Wall Panels: Use stainless-steel fasteners for surfaces exposed to the exterior; use galvanized steel fasteners for surfaces exposed to the interior.
- C. Metal Protection: Where dissimilar metals will contact each other or corrosive substrates, protect against galvanic action as recommended by metal wall panel manufacturer.
- D. Joint Sealers: Install gaskets, joint fillers, and sealants where indicated and where required for weathertight performance of metal wall panel assemblies. Provide types of gaskets, fillers, and sealants indicated or, if not indicated, types recommended by metal wall panel manufacturer.
1. Seal metal wall panel end laps with double beads of tape or sealant, full width of panel. Seal side joints where recommended by metal wall panel manufacturer.
 2. Prepare joints and apply sealants to comply with requirements in Division 07 Section "Joint Sealants."
- E. Lap-Seam Metal Wall Panels: Fasten metal wall panels to supports with fasteners at each lapped joint at location and spacing recommended by manufacturer.
1. Lap ribbed or fluted sheets one full rib corrugation. Apply panels and associated items for neat and weathertight enclosure. Avoid "panel creep" or application not true to line.
 2. Provide metal-neoprene-backed EPDM bonded washers under heads of exposed fasteners bearing on weather side of metal wall panels.

3. Locate and space exposed fasteners in uniform vertical and horizontal alignment. Use proper tools to obtain controlled uniform compression for positive seal without rupture of washer.
 4. Install screw fasteners with power tools having controlled torque adjusted to compress washer tightly without damage to washer, screw threads, or panels. Install screws in predrilled holes.
 5. Provide sealant tape at lapped joints of metal wall panels and between panels and protruding equipment, vents, and accessories.
 6. Apply a continuous ribbon of sealant tape to weather-side surface of fastenings on end laps; on side laps of nesting-type panels; on side laps of corrugated nesting-type, ribbed, or fluted panels; and elsewhere as needed to make panels weathertight.
 7. At panel splices, nest panels with minimum 6-inch end lap, sealed with butyl-rubber sealant and fastened together by interlocking clamping plates.
- F. Zee Clips: Provide Zee clips of size indicated or, if not indicated, as required to act as standoff from subgirts for thickness of insulation indicated. Attach to subgirts with fasteners.

3.05 ACCESSORY INSTALLATION

- A. General: Install accessories with positive anchorage to building and weathertight mounting, and provide for thermal expansion. Coordinate installation with flashings and other components.
1. Install components required for a complete metal wall panel assembly including trim, copings, corners, seam covers, flashings, sealants, gaskets, fillers, closure strips, and similar items.
- B. Flashing and Trim: Comply with performance requirements, manufacturer's written installation instructions, and SMACNA's "Architectural Sheet Metal Manual." Provide concealed fasteners where possible, and set units true to line and level as indicated. Install work with laps, joints, and seams that will be permanently watertight and weather resistant.
1. Install exposed flashing and trim that is without excessive oil canning, buckling, and tool marks and that is true to line and levels indicated, with exposed edges folded back to form hems. Install sheet metal flashing and trim to fit substrates and to result in waterproof and weather-resistant performance.
 2. Expansion Provisions: Provide for thermal expansion of exposed flashing and trim. Space movement joints at a maximum of 10 feet with no joints allowed within 24 inches of corner or intersection. Where lapped expansion provisions cannot be used or would not be sufficiently weather resistant and waterproof, form expansion joints of intermeshing hooked flanges, not less than 1 inch deep, filled with mastic sealant (concealed within joints).

3.06 CLEANING AND PROTECTION

- A. Remove temporary protective coverings and strippable films, if any, as metal wall panels are installed, unless otherwise indicated in manufacturer's written installation instructions. On completion of metal wall panel installation, clean finished surfaces as recommended by metal wall panel manufacturer. Maintain in a clean condition during construction.

- B. After metal wall panel installation, clear weep holes and drainage channels of obstructions, dirt, and sealant.
- C. Replace metal wall panels that have been damaged or have deteriorated beyond successful repair by finish touchup or similar minor repair procedures.

END OF SECTION 07 4213

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 REFERENCE STANDARDS

- A. ASTM E814 - Standard Test Method for Fire Tests of Penetration Firestop Systems; 2013a.
- B. ASTM E1966 - Standard Test Method for Fire Resistive Joint Systems; 2007 (Reapproved 2011).
- C. ASTM E2837 - Standard Test Method for Determining Fire Resistance of Continuity Head-of-Wall Joint Systems Installed Between Rated Wall Assemblies and Nonrated Horizontal Assemblies; 2011.
- D. ITS (DIR) - Directory of Listed Products; Intertek Testing Services NA, Inc.; current edition.
- E. FM P7825 - Approval Guide; Factory Mutual Research Corporation; current edition.
- F. UL 2079 - Standard for Tests for Fire Resistance of Building Joint Systems; Underwriters Laboratories Inc.; 2004.
- G. UL (FRD) - Fire Resistance Directory; Underwriters Laboratories Inc.; current edition.

1.03 SUBMITTALS

- A. Product Data: Provide data on product characteristics, performance ratings, and limitations.
- B. Product Schedule: For each firestopping system. Include location, illustration of firestopping system, and design designation of qualified testing and inspecting agency.
- C. Qualification Data: For Installer.
- D. Manufacturer's Installation Instructions: Indicate preparation and installation instructions.
- E. Product Test Reports: For each firestopping system, for tests performed by a qualified testing agency.
- F. Installer Certificates: From Installer indicating that firestopping systems have been installed in compliance with requirements and manufacturer's written instructions.

1.04 QUALITY ASSURANCE

- A. Fire Testing: Provide firestopping assemblies of designs that provide the scheduled fire ratings when tested in accordance with methods indicated and ASTM E814.
 - 1. Listing in the current-year classification or certification books of UL, FM, or ITS (Warnock Hersey) will be considered as constituting an acceptable test report.
- B. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum three years experience.
- C. Installer Qualifications: Firm that has been approved by FM Approval according to FM Approval 4991, "Approval Standard for Firestop Contractors," or been evaluated by UL and found to comply with its "Qualified Firestop Contractor Program Requirements."

1.05 PROJECT CONDITIONS

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

1.06 COORDINATION

- A. Coordinate construction of openings and penetrating items to ensure that firestopping systems can be installed according to specified firestopping system design.
- B. Coordinate sizing of sleeves, openings, core-drilled holes, or cut openings to accommodate firestopping systems.

PART 2 - PRODUCTS

2.01 PERFORMANCE REQUIREMENTS

- A. Fire-Test-Response Characteristics:
 - 1. Perform firestopping system tests by a qualified testing agency acceptable to authorities having jurisdiction.
 - 2. Test per testing standards referenced. Provide rated systems complying with the following requirements:
 - a. Firestopping systems shall bear classification marking of a qualified testing agency.
 - 1) UL in its "Fire Resistance Directory."
 - 2) Intertek Group in its "Directory of Listed Building Products."
 - 3) FM Approval in its "Approval Guide."

2.02 FIRESTOPPING - GENERAL REQUIREMENTS

- A. Manufacturers:
 - 1. Basis of Design: Hilti Construction Chemicals, Inc.
 - 2. Isolatek International.
 - 3. Nelson Firestop Products.
 - 4. RectorSeal Corporation (The)
 - 5. Specified Technologies Inc.
 - 6. 3M Fire Protection Products.
 - 7. Tremco.
- B. Primers, Sleeves, Forms, Insulation, Packing, Stuffing, and Accessories: Type required for tested assembly design.
- C. Free of asbestos, halogens and volatile components after curing and shall not slump or sag (except for self-leveling products).
- D. Capable of maintaining an effective barrier against flames, heat and smoke in compliance with the requirements of ASTM E814 and UL 1479.
- E. Non-combustible per ASTM E136.
- F. UV resistant where exposed to sunlight.
- G. Water resistant where exposed to moisture.
- H. Firestop system shall accommodate movement without adversely affecting fire rating of wall/floor assembly.
- I. Shrink resistant.
- J. Paintable or capable of receiving finish materials in those areas which are exposed to view and which are scheduled to receive finishes.

2.03 FIRESTOPPING ASSEMBLY REQUIREMENTS

- A. Head-of-Wall Firestopping at Joints Between Non-Rated Floor or Roof Assembly and Fire-Rated Wall: Use any system that has been tested according to ASTM E2837 to have fire resistance F Rating equal to required fire rating of floor or wall, whichever is greater.
- B. Floor-to-Floor, Wall-to-Wall, and Wall-to-Floor Joints, Except Perimeter, Where Both Are Fire-Rated: Use any system that has been tested according to ASTM E1966 or UL 2079 to have fire resistance F Rating equal to required fire rating of the assembly in which the joint occurs.
- C. Through Penetration Firestopping: Use any system that has been tested according to ASTM E814 to have fire resistance F Rating equal to required fire rating of penetrated assembly.

2.04 FIRESTOPPING SYSTEMS

- A. Materials: Include components required for code approved installation. See Drawing Sheets A806-A811 for detailed Firestopping information and matrix.
- B. Fire Ratings: Use any system listed by UL or tested in accordance with ASTM E814 that has F Rating equal to fire rating of penetrated assembly and T Rating Equal to F Rating and that meets all other specified requirements.
- C. Fill Materials:
 - 1. Cast-In-Place Firestop Devices: Factory-assembled devices for use in cast-in-place concrete floors and consisting of an outer metallic sleeve lined with an intumescent strip, a radial extended flange attached to one end of the sleeve for fastening to concrete formwork, and a neoprene gasket.
 - 2. Latex Sealants: Single-component latex formulations that after cure do not re-emulsify during exposure to moisture.
 - 3. Firestop Devices: Factory-assembled collars formed from galvanized steel and lined with intumescent material sized to fit specific diameter of penetrant.
 - 4. Intumescent Composite Sheets: Rigid panels consisting of aluminum-foil-faced elastomeric sheet bonded to galvanized steel sheet.
 - 5. Intumescent Putties: Nonhardening dielectric, water-resistant putties containing no solvents, inorganic fibers, or silicone compounds.
 - 6. Intumescent Wrap Strips: Single-component intumescent elastomeric sheets.
 - 7. Mortars: Prepackaged, dry mixes consisting of a blend of inorganic binders, hydraulic cement, fillers, and lightweight aggregate formulated for mixing with water at Project site to form a nonshrinking, homogeneous mortar.
 - 8. Pillows/Bags: Reusable, heat-expanding pillows/bags consisting of glass-fiber cloth cases filled with a combination of mineral-fiber, water-insoluble expansion agents and fire-retardant additives.
 - 9. Silicone Foams: Multicomponent, silicone-based liquid elastomers that, when mixed, expand and cure in place to produce a flexible, nonshrinking foam.
 - 10. Silicone Sealants: Single-component, silicone-based, neutral-curing elastomeric sealants of grade indicated below:
 - a. Grade: Pourable (self-leveling) formulation for openings in floors and other horizontal surfaces and nonsag formulation for openings in vertical and other surfaces requiring a nonslumping, gunnable sealant, unless indicated firestop system limits use to nonsag grade for both opening conditions.
 - b. Grade for Horizontal Surfaces: Pourable (self-leveling) formulation for openings in floors and other horizontal surfaces.
 - c. Grade for Vertical Surfaces: Nonsag formulation for openings in vertical and other surfaces.
- D. Accessories: Provide components for each through-penetration firestop system that are needed to install fill materials and to comply with "Performance Requirements" Article. Use only components specified by through-penetration firestop system manufacturer and approved by the qualified testing and inspecting agency for firestop systems indicated.

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 matter 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.
- B. Do not cover installed firestopping until inspected by authority having jurisdiction.
- C. Install labeling required by code.

3.04 CLEANING

- A. Clean adjacent surfaces of firestopping materials.

3.05 PROTECTION

- A. Protect adjacent surfaces from damage by material installation.

END OF SECTION 07 8400

SECTION 07 9200 - JOINT SEALANTS

PART 1 - GENERAL

1.01 SUMMARY

- A. Section Includes:
1. Silicone joint sealants.
 2. Urethane joint sealants.
 3. Latex joint sealants.
 4. Backer Rods.

1.02 PRECONSTRUCTION TESTING

- A. Preconstruction Compatibility and Adhesion Testing: Submit to joint-sealant manufacturers, for testing indicated below, samples of materials that will contact or affect joint sealants.
1. Use ASTM C 1087 to determine whether priming and other specific joint preparation techniques are required to obtain rapid, optimum adhesion of joint sealants to joint substrates.
 2. Submit not fewer than eight pieces of each kind of material, including joint substrates, shims, joint-sealant backings, secondary seals, and miscellaneous materials.
 3. Schedule sufficient time for testing and analyzing results to prevent delaying the Work.
 4. For materials failing tests, obtain joint-sealant manufacturer's written instructions for corrective measures including use of specially formulated primers.
 5. Testing will not be required if joint-sealant manufacturers submit joint preparation data that are based on previous testing, not older than 24 months, of sealant products for adhesion to, and compatibility with, joint substrates and other materials matching those submitted.

1.03 SUBMITTALS

- A. Product Data: For each joint-sealant product indicated.
- B. Shop Drawings: Illustrations in sufficient detail to show installation and interface of the work of this Section with the work of adjacent trades.
- C. Samples for Verification: For each kind and color of joint sealant required, provide Samples with joint sealants in 1/2-inch-wide joints formed between two 6-inch-long strips of material matching the appearance of exposed surfaces adjacent to joint sealants.
- D. Joint-Sealant Schedule: Include the following information:
1. Joint-sealant application, joint location, and designation.
 2. Joint-sealant manufacturer and product name.
 3. Joint-sealant formulation.
 4. Joint-sealant color.

- E. Qualification Data: For qualified Installer.
- F. Product Certificates: For each kind of joint sealant and accessory, from manufacturer.
- G. Product Test Reports: Based on evaluation of comprehensive tests performed by a qualified testing agency, indicating that sealants comply with requirements.
- H. Compatibility and Adhesion Test Reports: From sealant manufacturer, indicating the following:
 - 1. Materials forming joint substrates and joint-sealant backings have been tested for compatibility and adhesion with joint sealants.
 - 2. Interpretation of test results and written recommendations for primers and substrate preparation needed for adhesion.

1.04 QUALITY ASSURANCE

- A. Installer Qualifications: Installer shall be experienced with project similar in material, design, and extent to those indicated for this Project and shall be approved by sealant manufacturer.
- B. Source Limitations: Obtain each kind of joint sealant from single source from single manufacturer. All exterior building sealants shall be provided by the same manufacturer.
- C. Preconstruction Compatibility and Adhesion Testing:
 - 1. Use manufacturers standard test methods to determine whether priming and other specific joint preparation techniques are required to obtain rapid, optimum adhesion of joint sealants to joint substrates.
 - 2. Perform tests under environmental conditions replicating those that will exist during installation.
- D. Preconstruction Field-Adhesion Testing: Before installing sealants, perform adhesion field tests for each type of sealant and joint substrate indicated.
 - 1. Locate test joints where indicated or, if not indicated, as directed by Architect.
 - 2. Notify Architect seven days in advance of dates and times when test joints will be erected.
 - 3. Arrange for tests to take place with joint sealant manufacturer's technical representative present.
 - 4. Test Method: Standard hand-pull method.
- E. Mockups: Provide as specified in Section 01 4000 – Quality Requirements.
 - 1. Install a minimum 4 lineal feet of sealant at narrowest joint and widest joint width of each condition.

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

1.05 PROJECT CONDITIONS

- A. Do not proceed with installation of joint sealants under the following conditions:

1. When ambient and substrate temperature conditions are outside limits permitted by joint-sealant manufacturer or are below 40 deg F.
2. When joint substrates are wet.
3. Where joint widths are less than those allowed by joint-sealant manufacturer for applications indicated.
4. Where contaminants capable of interfering with adhesion have not yet been removed from joint substrates.

1.06 WARRANTY

- A. Special Installer's Warranty: Manufacturer's standard form in which Installer agrees to repair or replace joint sealants that do not comply with performance and other requirements specified in this Section within specified warranty period.
 1. Warranty Period: Two years.
- B. Special warranties specified in this article exclude deterioration or failure of joint sealants from the following:
 1. Movement of the structure caused by structural settlement or errors attributable to design or construction resulting in stresses on the sealant exceeding sealant manufacturer's written specifications for sealant elongation and compression.
 2. Disintegration of joint substrates from natural causes exceeding design specifications.
 3. Mechanical damage caused by individuals, tools, or other outside agents.
 4. Changes in sealant appearance caused by accumulation of dirt or other atmospheric contaminants.

PART 2 - PRODUCTS

2.01 MATERIALS, GENERAL

- A. Compatibility: Provide joint sealants, backings, and other related materials that are compatible with one another and with joint substrates under conditions of service and application, as demonstrated by joint-sealant manufacturer, based on testing and field experience.
- B. VOC Content of Interior Sealants: Sealants and sealant primers used inside the weatherproofing system shall comply with the following limits for VOC content when calculated according to 40 CFR 59, Subpart D (EPA Method 24):
 1. Architectural Sealants: 250 g/L.
 2. Sealant Primers for Nonporous Substrates: 250 g/L.
 3. Sealant Primers for Porous Substrates: 775 g/L.
- C. Stain-Test-Response Characteristics: Where sealants are specified to be nonstaining to porous substrates, provide products that have undergone testing according to ASTM C 1248 and have not stained porous joint substrates indicated for Project.
- D. Suitability for Contact with Food: Where sealants are indicated for joints that will come in repeated contact with food, provide products that comply with 21 CFR 177.2600.

- E. Colors of Exposed Joint Sealants: As selected by Architect from manufacturer's full range.
- F. Acceptable Manufacturers: Subject to compliance with requirements, provide products as manufactured by one of the following:
 - 1. Pecora.
 - 2. Tremco Vulkem.
 - 3. Dow Corning Corp.
 - 4. Sika Corp.
 - 5. Sonneborn/Chemrex.

2.02 SILICONE JOINT SEALANTS

- A. Mildew-Resistant, Single-Component, Acid-Curing Silicone Joint Sealant: ASTM C 920, Type S, Grade NS, Class 25, for Use NT.
 - 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Dow Corning Corporation; 786 Mildew Resistant.
 - b. GE Advanced Materials - Silicones; Sanitary SCS1700.
 - c. Pecora Corporation; 860.
 - d. Tremco Incorporated; Tremsil 200 Sanitary.
- B. Single-Component, Nonsag, Acid-Curing Silicone Joint Sealant: ASTM C 920, Type S, Grade NS, Class 25, for Uses NT, G, and A.
 - 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Dow Corning Corporation; 999-A.
 - b. GE Advanced Materials - Silicones; Contractors SCS1000.
 - c. Pecora Corporation; 860.
 - d. Tremco Incorporated; Proglaze.
 - 2. Joint-Sealant Color: Clear.

2.03 URETHANE JOINT SEALANTS

- A. Single-Component, Pourable, Traffic-Grade, Urethane Joint Sealant: ASTM C 920, Type S, Grade P, Class 25, for Use T.
 - 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. BASF Building Systems; Sonolastic SL 1.
 - b. Pecora Corporation; Urexpan NR-201.
 - c. Sika Corporation. Construction Products Division; Sikaflex - 1CSL.
 - d. Tremco Incorporated; Vulkem 45SSL.
- B. Single-Component, Nonsag, Urethane Joint Sealant: ASTM C 920, Type S, Grade NS, Class 25, for Use NT.
 - 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. BASF Building Systems; Sonolastic NP1.
 - b. Pecora Corporation; Dynatrol I-XL.
 - c. Sika Corporation, Construction Products Division; Sikaflex - 1a.
 - d. Tremco Incorporated; DymonicFc.

2.04 LATEX JOINT SEALANTS

- A. Latex Joint Sealant: Acrylic latex or siliconized acrylic latex, ASTM C 834, Type OP, Grade NF.
 - 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. BASF Building Systems; Sonolac.
 - b. Pecora Corporation; AC-20+.
 - c. Schnee-Morehead, Inc.; SM 8200.
 - d. Tremco Incorporated; Tremflex 834.

2.05 JOINT SEALANT BACKING

- A. General: Provide sealant backings of material that are nonstaining; are compatible with joint substrates, sealants, primers, and other joint fillers; and are approved for applications indicated by sealant manufacturer based on field experience and laboratory testing.
- B. Cylindrical Sealant Backings: ASTM C 1330, Type C (closed-cell material with a surface skin), and of size and density to control sealant depth and otherwise contribute to producing optimum sealant performance.
 - 1. Type O: Open-cell material.
 - 2. Type C: Closed-cell material.
 - 3. Type B: Bicellular material with a surface skin.
 - a. Product: Sof Rod by Nomaco.
- C. Elastomeric Tubing Sealant Backings: Neoprene, butyl, EPDM, or silicone tubing complying with ASTM D1056, nonabsorbent to water and gas, and capable of remaining resilient at temperatures down to minus 26 deg. F.
- D. Bond-Breaker Tape: Polyethylene tape or other plastic tape recommended by sealant manufacturer for preventing sealant from adhering to rigid, inflexible joint-filler materials or joint surfaces at back of joint. Provide self-adhesive tape where applicable.

2.06 MISCELLANEOUS MATERIALS

- A. Primer: Material recommended by joint-sealant manufacturer where required for adhesion of sealant to joint substrates indicated, as determined from preconstruction joint-sealant-substrate tests and field tests.
- B. Cleaners for Nonporous Surfaces: Chemical cleaners acceptable to manufacturers of sealants and sealant backing materials, free of oily residues or other substances capable of staining or harming joint substrates and adjacent nonporous surfaces in any way, and formulated to promote optimum adhesion of sealants to joint substrates.
- C. Masking Tape: Nonstaining, nonabsorbent material compatible with joint sealants and surfaces adjacent to joints.

PART 3 - EXECUTION

3.01 EXAMINATION

- A. Examine joints indicated to receive joint sealants, with Installer present, for compliance with requirements for joint configuration, installation tolerances, and other conditions affecting joint-sealant performance.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 PREPARATION

- A. Surface Cleaning of Joints: Clean out joints immediately before installing joint sealants to comply with joint-sealant manufacturer's written instructions and the following requirements:
 - 1. Remove all foreign material from joint substrates that could interfere with adhesion of joint sealant, including dust, paints (except for permanent, protective coatings tested and approved for sealant adhesion and compatibility by sealant manufacturer), old joint sealants, oil, grease, waterproofing, water repellents, water, surface dirt, and frost.
 - 2. Clean porous joint substrate surfaces by brushing, grinding, mechanical abrading, or a combination of these methods to produce a clean, sound substrate capable of developing optimum bond with joint sealants. Remove loose particles remaining after cleaning operations above by vacuuming or blowing out joints with oil-free compressed air. Porous joint substrates include the following:
 - a. Concrete.
 - b. Unglazed surfaces of ceramic tile.
 - 3. Remove laitance and form-release agents from concrete.
 - 4. Clean nonporous joint substrate surfaces with chemical cleaners or other means that do not stain, harm substrates, or leave residues capable of interfering with adhesion of joint sealants. Nonporous joint substrates include the following:
 - a. Metal.
 - b. Glass.
 - c. Porcelain enamel.
 - d. Glazed surfaces of ceramic tile.
- B. Joint Priming: Prime joint substrates where recommended by joint-sealant manufacturer or as indicated by preconstruction joint-sealant-substrate tests or prior experience. Apply primer to comply with joint-sealant manufacturer's written instructions. Confine primers to areas of joint-sealant bond; do not allow spillage or migration onto adjoining surfaces.
- C. Masking Tape: Use masking tape where required to prevent contact of sealant or primer with adjoining surfaces that otherwise would be permanently stained or damaged by such contact or by cleaning methods required to remove sealant smears. Remove tape immediately after tooling without disturbing joint seal.

3.03 INSTALLATION OF JOINT SEALANTS

- A. General: Comply with joint-sealant manufacturer's written installation instructions for products and applications indicated, unless more stringent requirements apply.
- B. Sealant Installation Standard: Comply with recommendations in ASTM C 1193 for use of joint sealants as applicable to materials, applications, and conditions indicated.
- C. Install sealant backings of kind indicated to support sealants during application and at position required to produce cross-sectional shapes and depths of installed sealants relative to joint widths that allow optimum sealant movement capability.
 - 1. Do not leave gaps between ends of sealant backings.
 - 2. Do not stretch, twist, puncture, or tear sealant backings.
 - 3. Remove absorbent sealant backings that have become wet before sealant application and replace them with dry materials.
- D. Install bond-breaker tape behind sealants where sealant backings are not used between sealants and backs of joints.
- E. Install sealants using proven techniques that comply with the following and at the same time backings are installed:
 - 1. Place sealants so they directly contact and fully wet joint substrates.
 - 2. Completely fill recesses in each joint configuration.
 - 3. Produce uniform, cross-sectional shapes and depths relative to joint widths that allow optimum sealant movement capability.
- F. Tooling of Nonsag Sealants: Immediately after sealant application and before skinning or curing begins, tool sealants according to requirements specified in subparagraphs below to form smooth, uniform beads of configuration indicated; to eliminate air pockets; and to ensure contact and adhesion of sealant with sides of joint.
 - 1. Remove excess sealant from surfaces adjacent to joints.
 - 2. Use tooling agents that are approved in writing by sealant manufacturer and that do not discolor sealants or adjacent surfaces.
 - 3. Provide concave joint profile per Figure 8A in ASTM C 1193, unless otherwise indicated.
 - 4. Provide flush joint profile where indicated per Figure 8B in ASTM C 1193.
 - 5. Provide recessed joint configuration of recess depth and at locations indicated per Figure 8C in ASTM C 1193.
 - a. Use masking tape to protect surfaces adjacent to recessed tooled joints.
- G. Acoustical Sealant Installation: At sound-rated assemblies and elsewhere as indicated, seal construction at perimeters, behind control joints, and at openings and penetrations with a continuous bead of acoustical sealant. Install acoustical sealant at both faces of partitions at perimeters and through penetrations. Comply with ASTM C 919 and with manufacturer's written recommendations.

3.04 FIELD QUALITY CONTROL

- A. Field-Adhesion Testing: Field test joint-sealant adhesion to joint substrates as follows:
1. Extent of Testing: Test completed and cured sealant joints as follows:
 - a. Perform 10 tests for the first 1000 feet of joint length for each kind of sealant and joint substrate.
 - b. Perform 1 test for each 1000 feet of joint length thereafter or 1 test per each floor per elevation.
 2. Test Method: Test joint sealants according to Method A, Field-Applied Sealant Joint Hand Pull Tab, in Appendix X1 in ASTM C 1193 or Method A, Tail Procedure, in ASTM C 1521.
 - a. For joints with dissimilar substrates, verify adhesion to each substrate separately; extend cut along one side, verifying adhesion to opposite side. Repeat procedure for opposite side.
 3. Inspect tested joints and report on the following:
 - a. Whether sealants filled joint cavities and are free of voids.
 - b. Whether sealant dimensions and configurations comply with specified requirements.
 - c. Whether sealants in joints connected to pulled-out portion failed to adhere to joint substrates or tore cohesively. Include data on pull distance used to test each kind of product and joint substrate. Compare these results to determine if adhesion passes sealant manufacturer's field-adhesion hand-pull test criteria.
 4. Record test results in a field-adhesion-test log. Include dates when sealants were installed, names of persons who installed sealants, test dates, test locations, whether joints were primed, adhesion results and percent elongations, sealant fill, sealant configuration, and sealant dimensions.
 5. Repair sealants pulled from test area by applying new sealants following same procedures used originally to seal joints. Ensure that original sealant surfaces are clean and that new sealant contacts original sealant.
- B. Evaluation of Field-Adhesion Test Results: Sealants not evidencing adhesive failure from testing or noncompliance with other indicated requirements will be considered satisfactory. Remove sealants that fail to adhere to joint substrates during testing or to comply with other requirements. Retest failed applications until test results prove sealants comply with indicated requirements.

3.05 CLEANING

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

3.06 PROTECTION

- A. Protect joint sealants during and after curing period from contact with contaminating substances and from damage resulting from construction operations or other causes so sealants are without deterioration or damage at time of Final Completion. If, despite such

protection, damage or deterioration occurs, cut out and remove damaged or deteriorated joint sealants immediately so installations with repaired areas are indistinguishable from original work.

3.07 INTERIOR JOINT-SEALANT SCHEDULE

- A. Joint-Sealant Application: Interior joints in horizontal traffic surfaces; Traffic Grade, Urethane Joint Sealant.
1. Joint Locations:
 - a. Isolation joints in cast-in-place concrete slabs.
 - b. Control and expansion joints in paving.
 - c. Control and expansion joints in tile flooring.
 - d. Other joints as indicated.
 2. Urethane Joint Sealant: Single component, pourable, traffic grade.
 3. Joint-Sealant Color: As selected by Architect from manufacturer's full range of colors.
- B. Joint-Sealant Application: Interior joints in vertical surfaces and horizontal non-traffic surfaces; Urethane Joint Sealant.
1. Joint Locations:
 - a. Control and expansion joints on exposed interior surfaces of exterior walls.
 - b. Perimeter joints of exterior openings where indicated.
 - c. Tile control and expansion joints.
 - d. Vertical joints on exposed surfaces of interior metal building walls and partitions.
 - e. Other joints as indicated.
 2. Urethane Joint Sealant: Single-Component, Nonsag, Urethane Joint Sealant.
 3. Joint-Sealant Color: As selected by Architect from manufacturer's full range of colors.
- C. Joint-Sealant Application: Interior joints in vertical drywall surfaces and perimeter joints in drywall; Latex Joint Sealant.
1. Joint Locations:
 - a. Interior non-moving exposed sealant joints in gypsum drywall construction
 - b. Perimeter joints between interior wall surfaces and frames.
 - c. Other joints as indicated.
 2. Latex Joint Sealant: Acrylic Latex Joint Sealant.
 3. Joint-Sealant Color: As selected by Architect from manufacturer's full range of colors.
- D. Joint-Sealant Application: Mildew-resistant interior joints in vertical surfaces and horizontal non-traffic surfaces; Mildew-Resistant, Silicone Joint Sealant.
1. Joint Sealant Location:
 - a. Joints between plumbing fixtures and adjoining walls, floors, and counters.
 - b. Other joints as indicated.
 2. Joint Sealant: Single component, nonsag, mildew resistant, acid curing silicone.
 3. Joint-Sealant Color: As selected by Architect from manufacturer's full range of colors.
- E. Joint-Sealant Application: Interior acoustical joints in vertical surfaces and horizontal nontraffic surfaces.
1. Joint Locations:

- a. Acoustical joints where indicated.
- b. Other joints as indicated.
2. Joint Sealant:
 - a. Acoustical Sealant
 - b. Fire Rated Acoustical Sealant in rated partitions.
3. Joint-Sealant Color: As selected by Architect from manufacturer's full range of colors.

END OF SECTION 07 9200

SECTION 08 1113 - HOLLOW METAL DOORS AND FRAMES

PART 1 - GENERAL

1.01 SUMMARY

A. Section Includes:

1. Standard and custom hollow metal doors and frames.
2. Louvers installed in hollow metal doors.
3. Light frames and glazing installed in hollow metal doors.

B. Related Sections:

1. Division 01 Section "General Conditions."
2. Section 08 1400 - Wood Doors.
3. Section 08 7100 – Door Hardware.
4. Section 08 8000 - Glazing, for glass view panels in hollow metal doors.
5. Sections 09 9100 – Painting, for field painting hollow metal doors and frames.

C. Codes and References: Comply with the version year adopted by the Authority Having Jurisdiction.

1. ANSI/SDI A250.8 - Recommended Specifications for Standard Steel Doors and Frames.
2. ANSI/SDI A250.4 - Test Procedure and Acceptance Criteria for Physical Endurance for Steel Doors, Frames, Frames Anchors and Hardware Reinforcing.
3. ANSI/SDI A250.6 - Recommended Practice for Hardware Reinforcing on Standard Steel Doors and Frames.
4. ANSI/SDI A250.10 - Test Procedure and Acceptance Criteria for Prime Painted Steel Surfaces for Steel Doors and Frames.
5. ANSI/SDI A250.11 - Recommended Erection Instructions for Steel Frames.
6. ASTM A1008 - Standard Specification for Steel Sheet, Cold-Rolled, Carbon, Structural, High-Strength Low-Alloy and High-Strength Low-Alloy with Improved Formability.
7. ASTM A653 - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.
8. ASTM A924 - Standard Specification for General Requirements for Steel Sheet, Metallic-Coated by the Hot-Dip Process.
9. ASTM C 1363 - Standard Test Method for Thermal Performance of Building Assemblies by Means of a Hot Box Apparatus.
10. ANSI/BHMA A156.115 - Hardware Preparation in Steel Doors and Frames.
11. ANSI/SDI 122 - Installation and Troubleshooting Guide for Standard Steel Doors and Frames.
12. ANSI/NFPA 80 - Standard for Fire Doors and Fire Windows; National Fire Protection Association.
13. ANSI/NFPA 105: Standard for the Installation of Smoke Door Assemblies.
14. NFPA 252 - Standard Methods of Fire Tests of Door Assemblies; National Fire Protection Association.
15. UL 10C - Positive Pressure Fire Tests of Door Assemblies.

16. UL 1784 - Standard for Air Leakage Tests of Door Assemblies.

1.02 SUBMITTALS

- A. Product Data: For each type of product indicated. Include construction details, material descriptions, core descriptions, hardware reinforcements, profiles, anchors, fire-resistance rating, and finishes.
- B. Door hardware supplier is to furnish templates, template reference number and/or physical hardware to the steel door and frame supplier in order to prepare the doors and frames to receive the finish hardware items.
- C. Shop Drawings: Include the following:
 1. Elevations of each door design.
 2. Details of doors, including vertical and horizontal edge details and metal thicknesses.
 3. Frame details for each frame type, including dimensioned profiles and metal thicknesses.
 4. Locations of reinforcement and preparations for hardware.
 5. Details of anchorages, joints, field splices, and connections.
 6. Details of accessories.
 7. Details of moldings, removable stops, and glazing.
 8. Details of conduit and preparations for power, signal, and control systems.
- D. Samples for Verification:
 1. Samples are only required by request of the architect and for manufacturers that are not current members of the Steel Door Institute.

1.03 QUALITY ASSURANCE

- A. Source Limitations: Obtain hollow metal doors and frames through one source from a single manufacturer wherever possible.
- B. Quality Standard: In addition to requirements specified, furnish SDI-Certified manufacturer products that comply with ANSI/SDI A250.8, latest edition, "Recommended Specifications for Standard Steel Doors and Frames".
- C. Fire-Rated Door Assemblies: Assemblies complying with NFPA 80 that are listed and labeled by a qualified testing agency, for fire-protection ratings indicated, based on testing at positive pressure according to UL10C (neutral pressure at 40" above sill) or UL 10C.
 1. Oversize Fire-Rated Door Assemblies Construction: For units exceeding sizes of tested assemblies, attach construction label certifying doors are built to standard construction requirements for tested and labeled fire rated door assemblies except for size.
 2. Temperature-Rise Limit: Where indicated and at vertical exit enclosures (stairwell openings) and exit passageways, provide doors that have a maximum transmitted temperature end point of not more than 450 deg F (250 deg C) above ambient after 30 minutes of standard fire-test exposure.
 3. Smoke Control Door Assemblies: Comply with NFPA 105.

- a. Smoke "S" Label: Doors to bear "S" label, and include smoke and draft control gasketing applied to frame and on meeting stiles of pair doors.
 - D. Fire-Rated, Borrowed-Light Frame Assemblies: Assemblies complying with NFPA 80 that are listed and labeled, by a testing and inspecting agency acceptable to authorities having jurisdiction, for fire-protection ratings indicated, based on testing according to NFPA 257. Provide labeled glazing material.
 - E. Sound Transmission Class (STC) Rated Doors: Provide sound transmission class rated doors fabricated as sound-reducing types with testing according to ASTM E 90, and classifications according to ASTM E 413. Submit manufacturer's written results of STC ratings from testing performed by a qualified independent testing agency for sound resistant doors.
 - F. Pre-Submittal Conference: Conduct conference in compliance with requirements in Division 01 Section "Project Meetings" with attendance by representatives of Supplier, Installer, and Contractor to review proper methods and procedures for installing hollow metal doors and frames and to verify installation of electrical knockout boxes and conduit at frames with electrified or access control hardware.
- 1.04 DELIVERY, STORAGE, AND HANDLING
- A. Deliver hollow metal work palletized, wrapped, or crated to provide protection during transit and Project site storage. Do not use non-vented plastic.
 - B. Deliver welded frames with two removable spreader bars across bottom of frames, tack welded to jambs and mullions.
 - C. Store hollow metal work under cover at Project site. Place in stacks of five units maximum in a vertical position with heads up, spaced by blocking, on minimum 4-inch high wood blocking. Do not store in a manner that traps excess humidity.
 - 1. Provide minimum 1/4-inch space between each stacked door to permit air circulation. Door and frames to be stacked in a vertical upright position.
- 1.05 PROJECT CONDITIONS
- A. Field Measurements: Verify actual dimensions of openings by field measurements before fabrication.
- 1.06 COORDINATION
- A. Coordinate installation of anchorages for hollow metal frames. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, and items with integral anchors. Deliver such items to Project site in time for installation.
 - B. Building Information Modeling (BIM) Support: Utilize designated BIM software tools and obtain training needed to successfully participate in the Project BIM processes. All technical disciplines are responsible for the product data integration and data reliability of their Work into the coordinated BIM applications.

1.07 WARRANTY

- A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace doors that fail in materials or workmanship within specified warranty period.
- B. Warranty includes installation and finishing that may be required due to repair or replacement of defective doors.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide steel doors and frames from a SDI Certified manufacturer:
 - 1. CECO Door Products (C).
 - 2. Curries Company (CU).
 - 3. Steelcraft; a division of Ingersoll-Rand.

2.02 MATERIALS

- A. Cold-Rolled Steel Sheet: ASTM A 1008/A 1008M, Commercial Steel (CS), Type B; suitable for exposed applications.
- B. Metallic-Coated Steel Sheet: ASTM A 653/A 653M, Commercial Steel (CS), Type B; with minimum G60 (Z180) or A60 (ZF180) metallic coating.
- C. Frame Anchors: ASTM A 653/A 653M, Commercial Steel (CS), Commercial Steel (CS), Type B; with minimum G60 (Z180) or A60 (ZF180) metallic coating.

2.03 HOLLOW METAL DOORS

- A. General: Provide 1-3/4 inch doors of design indicated, not less than thickness indicated; fabricated with smooth surfaces, without visible joints or seams on exposed faces unless otherwise indicated. Comply with ANSI/SDI A250.8 and ANSI/NAAMM HMMA 867.
- B. Exterior Doors: Face sheets fabricated of commercial quality hot-dipped zinc coated steel that complies with ASTM A 653/A 653M, Coating Designation A60. Provide doors complying with requirements indicated below by referencing ANSI/SDI A250.8 for level and model and ANSI/SDI A250.4 for physical performance level:
 - 1. Design: Flush panel, thermally insulated.
 - 2. Level/Model: Level 3 and Physical Performance Level A (Extra Heavy Duty), Minimum 16 gauge (0.053-inch - 1.3-mm) thick steel, Model 2.
 - 3. Vertical Edges: Vertical edges to have the face sheets joined by a continuous weld extending the full height of the door. Welds are to be ground, filled and dressed smooth. Beveled Lock Edge, 1/8 inch in 2 inches (3 mm in 50 mm).
 - 4. Top and Bottom Edges: Reinforce tops and bottoms of doors with a continuous steel channel not less than 16 gauge, extending the full width of the door and welded to the

- face sheet. Doors with an inverted top channel to include a steel closure channel, screw attached, with the web of the channel flush with the face sheets of the door. Plastic or composite channel fillers are not acceptable.
5. Hinge Reinforcement: Minimum 7 gauge (3/16") plate 1-1/4" x 9" or minimum 14 gauge continuous channel with pierced holes, drilled and tapped.
 6. Hardware Reinforcements: Fabricate according to ANSI/SDI A250.6 with reinforcing plates from same material as door face sheets.
 7. Insulating Value: U-value of 0.50 when tested in accordance with ASTM C1363.
- C. Interior Doors: Face sheets fabricated of commercial quality cold rolled steel that complies with ASTM A 1008/A 1008M. Provide doors complying with requirements indicated below by referencing ANSI/SDI A250.8 for level and model and ANSI/SDI A250.4 for physical performance level:
1. Design: Flush panel.
 - a. Fire Door Core: As required to provide fire-protection and temperature-rise ratings indicated.
 2. Level/Model: Level 2 and Physical Performance Level B (Heavy Duty), Minimum 18 gauge (0.042-inch - 1.0-mm) thick steel, Model 2.
 3. Vertical Edges: Vertical edges to have the face sheets joined by a continuous weld extending the full height of the door. Welds are to be ground, filled and dressed smooth. Beveled Lock Edge, 1/8 inch in 2 inches (3 mm in 50 mm).
 4. Top and Bottom Edges: Reinforce tops and bottoms of doors with a continuous steel channel not less than 16 gauge, extending the full width of the door and welded to the face sheet.
 5. Hinge Reinforcement: Minimum 7 gauge (3/16") plate 1-1/4" x 9" or minimum 14 gauge continuous channel with pierced holes, drilled and tapped.
 6. Hardware Reinforcements: Fabricate according to ANSI/SDI A250.6 with reinforcing plates from same material as door face sheets.
 7. Fire-Rated Steel Doors:
 - a. Performance Criteria:
 - 1) Fire Rating: As indicated on Door and Frame Schedule, tested in accordance with UL 10C ("positive pressure").
 - a) Provide units listed and labeled by UL.
 - b) Attach fire rating label to each fire rated unit.

2.04 HOLLOW METAL FRAMES

- A. General: Comply with ANSI/SDI A250.8 and with details indicated for type and profile.
- B. Exterior Frames: Fabricated of hot-dipped zinc coated steel that complies with ASTM A 653/A 653M, Coating Designation A60.
 1. Fabricate frames with mitered or coped corners; fully welded profile. Profile as indicated on drawings.
- C. Interior Frames: Fabricated from cold-rolled steel sheet that complies with ASTM A 1008/A 1008M.

1. Fabricate frames with mitered or coped corners; full welded profile. Profile as indicated on drawings.
- D. Fire rated frames: Fabricate frames in accordance with NFPA 80, listed and labeled by a qualified testing agency, based on testing at positive pressure according to UL 10C, for fire-protection ratings indicated.
- E. Hardware Reinforcement: Fabricate according to ANSI/SDI A250.6 Table 4 with reinforcement plates from same material as frames.

2.05 LOUVERS

- A. Metal Louvers: Unless otherwise indicated provide louvers to meet the following requirements.
 1. Blade Type: Vision proof inverted V or inverted Y.
 2. Metal and Finish: Galvanized steel, 0.040 inch thick, factory primed for paint finish with baked enamel or powder coated finish. Match pre-finished door paint color where applicable.
- B. Louvers for Fire Rated Doors: Metal louvers with fusible link and closing device, listed and labeled for use in doors with fire protection rating of 1-1/2 hours and less.
 1. Manufacturers: Subject to compliance with requirements, provide louvers to meet rating indicated.
 2. Metal and Finish: Galvanized steel, 0.040 inch thick, factory primed for paint finish with baked enamel or powder coated finish. Match pre-finished door paint color where applicable.

2.06 FRAME ANCHORS

- A. Jamb Anchors:
 1. Masonry Type: Adjustable strap-and-stirrup or T-shaped anchors to suit frame size, formed from A60 metallic coated material, not less than 0.042 inch thick, with corrugated or perforated straps not less than 2 inches wide by 10 inches long; or wire anchors not less than 0.177 inch thick.
 2. Stud Wall Type: Designed to engage stud and not less than 0.042 inch thick.
 3. Compression Type for Drywall Slip-on (Knock-Down) Frames: Adjustable compression anchors.
- B. Floor Anchors: Floor anchors to be provided at each jamb, formed from A60 metallic coated material, not less than 0.042 inches thick.
- C. Mortar Guards: Formed from same material as frames, not less than 0.016 inches thick.

2.07 LIGHT OPENINGS AND GLAZING

- A. Stops and Moldings: Provide stops and moldings around glazed lites where indicated. Form corners of stops and moldings with butted or mitered hairline joints at fabricator's shop. Fixed and removable stops to allow multiple glazed lites each to be removed independently.

Coordinate frame rabbet widths between fixed and removable stops with the type of glazing and installation indicated.

- B. Moldings for Glazed Lites in Doors and Loose Stops for Glazed Lites in Frames: Minimum 20 gauge thick, fabricated from same material as door face sheet in which they are installed.
- C. Fixed Frame Moldings: Formed integral with hollow metal frames, a minimum of 5/8 inch (16 mm) high unless otherwise indicated. Provide fixed frame moldings and stops on outside of exterior and on secure side of interior doors and frames.

2.08 ACCESSORIES

- A. Mullions and Transom Bars: Join to adjacent members by welding or rigid mechanical anchors.
- B. Grout Guards: Formed from same material as frames, not less than 0.016 inches thick.

2.09 FABRICATION

- A. Fabricate hollow metal work to be rigid and free of defects, warp, or buckle. Accurately form metal to required sizes and profiles, with minimum radius for thickness of metal. Where practical, fit and assemble units in manufacturer's plant. When shipping limitations so dictate, frames for large openings are to be fabricated in sections for splicing or splining in the field by others.
- B. Tolerances: Fabricate hollow metal work to tolerances indicated in ANSI/SDI A250.8.
- C. Hollow Metal Doors:
 - 1. Exterior Doors: Provide optional weep-hole openings in bottom of exterior doors to permit moisture to escape where specified.
 - 2. Glazed Lites: Factory cut openings in doors with applied trim or kits to fit. Factory install glazing where indicated.
 - 3. Continuous Hinge Reinforcement: Provide welded continuous 12 gauge strap for continuous hinges specified in hardware sets in Division 08 Section "Door Hardware".
- D. Hollow Metal Frames:
 - 1. Shipping Limitations: Where frames are fabricated in sections due to shipping or handling limitations, provide alignment plates or angles at each joint, fabricated of same thickness metal as frames.
 - 2. Welded Frames: Weld flush face joints continuously; grind, fill, dress, and make smooth, flush, and invisible.
 - a. Welded frames are to be provided with two steel spreaders temporarily attached to the bottom of both jambs to serve as a brace during shipping and handling. Spreader bars are for bracing only and are not to be used to size the frame opening.
 - 3. High Frequency Hinge Reinforcement: Provide high frequency hinge reinforcements at door openings 48-inches and wider with mortise butt type hinges at top hinge locations.
 - 4. Continuous Hinge Reinforcement: Provide welded continuous 12 gauge straps for continuous hinges specified in hardware sets in Division 08 Section "Door Hardware".

5. Provide countersunk, flat- or oval-head exposed screws and bolts for exposed fasteners unless otherwise indicated for removable stops, provide security screws at exterior locations.
 6. Mortar Guards: Provide guard boxes at back of hardware mortises in frames at all hinges and strike preps regardless of grouting requirements.
 7. Floor Anchors: Weld anchors to bottom of jambs and mullions with at least four spot welds per anchor.
 8. Jamb Anchors: Provide number and spacing of anchors as follows:
 - a. Masonry Type: Locate anchors not more than 18 inches from top and bottom of frame. Space anchors not more than 32 inches o.c. and as follows:
 - 1) Two anchors per jamb up to 60 inches high.
 - 2) Three anchors per jamb from 60 to 90 inches high.
 - 3) Four anchors per jamb from 90 to 120 inches high.
 - 4) Four anchors per jamb plus 1 additional anchor per jamb for each 24 inches or fraction thereof above 120 inches high.
 - b. Stud Wall Type: Locate anchors not more than 18 inches from top and bottom of frame. Space anchors not more than 32 inches o.c. and as follows:
 - 1) Three anchors per jamb up to 60 inches high.
 - 2) Four anchors per jamb from 60 to 90 inches high.
 - 3) Five anchors per jamb from 90 to 96 inches high.
 - 4) Five anchors per jamb plus 1 additional anchor per jamb for each 24 inches or fraction thereof above 96 inches high.
 - 5) Two anchors per head for frames above 42 inches wide and mounted in metal stud partitions.
 9. Door Silencers: Except on weatherstripped or gasketed doors, drill stops to receive door silencers. Silencers to be supplied by frame manufacturer regardless if specified in Division 08 Section "Door Hardware".
 10. Bituminous Coating: Where frames are fully grouted with an approved Portland Cement based grout or mortar, coat inside of frame throat with a water based bituminous or asphaltic emulsion coating to a minimum thickness of 3 mils DFT, tested in accordance with UL 10C and applied to the frame under a 3rd party independent follow-up service procedure.
- E. Hardware Preparation: Factory prepare hollow metal work to receive template mortised hardware; include cutouts, reinforcement, mortising, drilling, and tapping according to the Door Hardware Schedule and templates furnished as specified in Division 08 Section "Door Hardware."
1. Locate hardware as indicated, or if not indicated, according to ANSI/SDI A250.8.
 2. Reinforce doors and frames to receive non-template, mortised and surface mounted door hardware.
 3. Comply with applicable requirements in ANSI/SDI A250.6 and ANSI/DHI A115 Series specifications for preparation of hollow metal work for hardware.
 4. Coordinate locations of conduit and wiring boxes for electrical connections with Division 26 Sections.

2.10 STEEL FINISHES

- A. Prime Finishes: Doors and frames to be cleaned, and chemically treated to insure maximum finish paint adhesion. Surfaces of the door and frame exposed to view to receive a factory applied coat of rust inhibiting shop primer.
 - 1. Shop Primer: Manufacturer's standard, fast-curing, lead and chromate free primer complying with ANSI/SDI A250.10 acceptance criteria; recommended by primer manufacturer for substrate; and compatible with substrate and field-applied coatings.

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. General Contractor to verify the accuracy of dimensions given to the steel door and frame manufacturer for existing openings or existing frames (strike height, hinge spacing, hinge back set, etc.).
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 PREPARATION

- A. Remove welded in shipping spreaders installed at factory. Restore exposed finish by grinding, filling, and dressing, as required to make repaired area smooth, flush, and invisible on exposed faces.
- B. Prior to installation, adjust and securely brace welded hollow metal frames for square, level, twist, and plumb condition.
- C. Tolerances shall comply with SDI-117 "Manufacturing Tolerances Standard Steel Doors and Frames."
- D. Drill and tap doors and frames to receive non-template, mortised, and surface-mounted door hardware.

3.03 INSTALLATION

- A. General: Install hollow metal work plumb, rigid, properly aligned, and securely fastened in place; comply with Drawings and manufacturer's written instructions and related requirements of specified door and frame standards or custom guidelines indicated.
- B. Hollow Metal Frames: Install hollow metal frames of size and profile indicated. Comply with ANSI/SDI A250.11 and NFPA 80 at fire rated openings.

1. Set frames accurately in position, plumbed, leveled, aligned, and braced securely until permanent anchors are set. After wall construction is complete and frames properly set and secured, remove temporary braces, leaving surfaces smooth and undamaged. Shim as necessary to comply with installation tolerances.
 2. Floor Anchors: Provide floor anchors for each jamb and mullion that extends to floor, and secure with post-installed expansion anchors.
 3. Grout Requirements: Brace frames so pressure of grout will not deform frames. Do not grout vertical or horizontal closed mullion members.
- C. Hollow Metal Doors: Fit hollow metal doors accurately in frames, within clearances specified below. Shim as necessary.
1. Non-Fire-Rated Standard Steel Doors:
 - a. Jamb and Head: 1/8 inch plus or minus 1/16 inch.
 - b. Between Edges of Pairs of Doors: 1/8 inch plus or minus 1/16 inch.
 - c. Between Bottom of Door and Top of Threshold: Maximum 3/8 inch.
 - d. Between Bottom of Door and Top of Finish Floor (No Threshold): Maximum 3/4 inch.
 2. Fire-Rated Doors: Install doors with clearances according to NFPA 80.
- D. Field Glazing: Comply with installation requirements in Section 08 8000 - Glazing and with hollow metal manufacturer's written instructions.
- 3.04 ADJUSTING AND CLEANING
- A. Final Adjustments: Check and readjust operating hardware items immediately before final inspection. Leave work in complete and proper operating condition. Remove and replace defective work, including hollow metal work that is warped, bowed, or otherwise unacceptable.
 - B. Remove grout and other bonding material from hollow metal work immediately after installation.
 - C. Prime-Coat and Painted Finish Touchup: Immediately after erection, sand smooth rusted or damaged areas of prime coat, or painted finishes, and apply touchup of compatible air drying, rust-inhibitive primer, zinc rich primer (exterior and galvanized openings) or finish paint.

END OF SECTION 08 1113

SECTION 08 14 00 - WOOD DOORS

PART 1 - GENERAL

1.01 SUMMARY

- A. Section Includes:
 - 1. Solid-core wood doors.
 - 2. Shop priming wood doors.
 - 3. Factory fitting flush wood doors to frames and factory machining for hardware.

1.02 SUBMITTALS

- A. Product Data: Submit manufacturer's data for each type of door, including details of core and edge construction and trim for openings.
- B. Shop Drawings: Submit drawings showing schedule of doors indicating location, size, and hand of each door; elevation of each kind of door; construction details not covered in Product Data; including stiles, rails, panels, moldings and sticking, location and extent of hardware blocking and other pertinent data. Note discrepancies between the Drawings and door schedules, and the requirements of regulatory and testing agencies. Include the following:
 - 1. Dimensions of doors for factory fitting.
 - 2. Locations and dimensions of mortises and holes for hardware.
 - 3. Undercuts.
- C. Samples:
 - 1. Wood Veneer: Submit samples, 8 inches x 10 inches, for each material and factory applied finish.
 - 2. Frames for Light Openings: 6 inches long, for each material, type and finish required.
- D. Product Certificates: For each type of door, from manufacturer.
- E. Sample Warranty: For special warranty.
- F. Quality Standard Compliance Certificates: AWI Quality Certification Program certificates.

1.03 QUALITY ASSURANCE

- A. Source Limitations: Obtain flush wood doors through one source from a single manufacturer.
- B. Quality Standard: In addition to requirements specified, comply with the Architectural Woodwork Standards.
 - 1. AWI Certification: Provide AWI Quality Certification Compliance Certificate or Labels
- C. Fire-Rated Wood Doors: Doors complying with NFPA 80 that are listed and labeled by a qualified testing agency.

- D. Coordination: Contractor shall be responsible for coordinating and obtaining necessary information from Hardware and hollow metal frame Manufacturers. Door Manufacturer shall be responsible for coordinating necessary information received by Contractor from Hardware and hollow metal frame Manufacturers in order that doors shall be properly prepared to receive hinges and hardware. Contractor shall provide door supplier with approved frame schedule, hardware schedule, and hardware templates a minimum of 60 days prior to desired delivery date of doors.

1.04 DELIVERY, STORAGE, AND HANDLING

- A. Comply with requirements of referenced standard and manufacturer's written instructions.
- B. Package doors individually in plastic bags or cardboard cartons or as required to protect door edges and faces.
- C. Mark each door on top and bottom rail with opening number used on Shop Drawings.
- D. Store doors flat and protect from construction activity, dirt, and exposure to sunlight.
- E. Handling:
 - 1. Always handle doors with clean hands or gloves.
 - 2. Do not drag doors across one another.
 - 3. Maintain factory packaging or other means of protection on doors, until date of Substantial Completion.

1.05 PROJECT CONDITIONS

- A. Environmental Limitations: Do not deliver or install doors until building is enclosed, wet work is complete, and HVAC system is operating and will maintain temperature and relative humidity at occupancy levels during the remainder of the construction period.

1.06 WARRANTY

- A. Warranty: Manufacturer's standard form, signed by manufacturer, Installer, and Contractor, in which manufacturer agrees to repair or replace doors that are defective in materials or workmanship or have warped (bow, cup, or twist) more than 1/4 inch in a 42-by-84-inch section, within specified warranty period.
 - 1. Warranty shall also include removal of defective door, hanging, installation or hardware and finishing that may be required due to repair or replacement of defective doors.
 - 2. Warranty shall be in effect during the following period of time from date of Substantial Completion:
 - a. Solid Core Interior Doors: Life of Installation.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

- A. Acceptable Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Algoma Hardwoods Inc.
 - 2. Eggers Industries; Architectural Door Division.
 - 3. Lynden Door, Inc.
 - 4. Mohawk Flush Doors, Inc.
 - 5. Marshfield Doors Systems.
 - 6. Vancouver Door
 - 7. Graham Wood Doors VT Industries, Inc.
 - 8. Or approved equal.

2.02 PERFORMANCE REQUIREMENTS

- A. Low-Emitting Materials: Fabricate doors with adhesives and composite wood products that do not contain urea formaldehyde.

2.03 DOOR CONSTRUCTION

- A. General: Provide AWS Quality Certification Labels or AWI Letter of Licensing for Project indicating that doors comply with requirements of grades specified.
- B. AWS Performance Grade: Custom Grade.
 - 1. Heavy Duty unless otherwise indicated.
- C. Thickness: As specified on Drawings.
- D. Interior Doors Construction: Five or seven plies. Stiles and rails are bonded to core, then entire unit abrasive planed before veneering.
 - 1. Solid-Core: MDF.
 - a. Core: Either glued wood stave or structural composite lumber.
 - 2. Fire Rated Doors: Provide core specified or mineral core as needed to provide fire-protection rating indicated.
 - a. Edge Construction: Provide edge construction with intumescent seals concealed by outer stile. Comply with specified requirements for exposed edges.
 - b. Pairs: Provide fire-retardant stiles that are listed and labeled for applications indicated without formed-steel edges. Provide stiles with concealed intumescent seals. Comply with specified requirements for exposed edges.
- E. Exposed Surfaces:
 - 1. Veneers:
 - a. Wood Veneer Facing:
 - 1) Wood Veneer Facing for Transparent Finish: Plain Sliced White Maple Species, veneer grade as specified by quality standard.
 - 2. Exposed Vertical and Top Edges: Closed-grain hardwood.

2.04 HARDWARE

- A. Door Gasketing: BHMA A156.22
 - 1. General: Provide continuous smoke, light, or sound gasketing on interior doors where indicated or scheduled. Provide noncorrosive fasteners for exterior applications and elsewhere as indicated.
 - a. Perimeter Gasketing: Apply to head and jamb, forming seal between door and frame.
 - b. Door Bottoms: Apply to bottom of door, forming seal with threshold when door is closed.
 - 2. Air Leakage: Not to exceed 0.50 cfm per foot of crack length for gasketing other than for smoke control, as tested according to ASTM E 283.
 - 3. Sound-Rated Gasketing: Assemblies that are listed and labeled by a testing and inspecting agency, for sound ratings indicated, based on testing according to ASTM E 1408.
 - 4. Replaceable Seal Strips: Provide only those units where resilient or flexible seal strips are easily replaceable and readily available from stocks maintained by manufacturer.
 - 5. Gasketing Materials: ASTM D 2000 and AAMA 701/702.

2.05 LIGHT FRAMES

- A. Wood Beads for Light Openings in Wood Doors: Provide manufacturer's standard wood beads, unless otherwise indicated.
 - 1. Wood Species: Same species as door faces.
 - 2. Profile: As selected by Architect.
- B. Metal Frames for Light Openings in Fire-Rated Doors: Manufacturer's standard frame formed of 0.048 inch thick, cold-rolled steel sheet; and approved for use in doors of fire-protection rating indicated.
 - 1. Opaque Finish Doors: Factory primed for paint finish.
- C. Glazing: As specified in Section 08 8000 – Glazing.

2.06 FABRICATION

- A. Face Veneers, Crossbands and Backers: When wood veneer or medium density overlay faces are specified, doors shall be 5 ply, made up of a face veneer, crossbanding and a core unit, all securely bonded together utilizing type 1 (fully waterproof) adhesive and the hot press assembly technique. All plies must be placed at right angles to adjacent plies. Face veneers shall have a minimum thickness of 1/50 after factory sanding and the individual pieces of veneer forming the face veneer must be spliced or edge glued together
- B. Factory fit doors to suit frame-opening sizes indicated, with the following uniform clearances and bevels, unless otherwise indicated.
 - 1. Comply with requirements of NFPA 80 for fire-rated doors.

- C. Factory machine doors for hardware that is not surface applied. Locate hardware to comply with DHI-WDHS-3. Comply with final hardware schedules, door frame Shop Drawings, DHI A115-W series standards, and hardware templates.
 - 1. Coordinate measurements of hardware mortises in metal frames to verify dimensions and alignment before factory machining.
- D. Openings: Cut and trim openings through doors in factory.
 - 1. Light Openings: Trim openings with moldings of material and profile indicated.
 - 2. Glazing: Factory install glazing in doors indicated to be factory finished. Comply with applicable requirements in Section 08 8000 – Glazing.

2.07 FACTORY FINISHING

- A. Comply with referenced quality standard for factory finishing.
 - 1. Complete fabrication, including fitting doors for openings and machining for hardware that is not surface applied, before finishing.
 - 2. Finish faces, all four edges, edges of cutouts, and mortises.
- B. Factory finish doors where indicated in schedules or on Drawings as factory finished.
- C. Transparent Finish:
 - 1. Architectural Woodwork Standards Grade: Custom.
 - 2. Finish: ANSI/WDMA I.S. 1A TR-6 Catalyzed Polyurethane.
 - 3. Staining: Natural transparent finish.
 - 4. Effect: Open-grain finish.
 - 5. Sheen: Satin.

PART 3 - EXECUTION

3.01 EXAMINATION

- A. Examine doors and installed door frames before hanging doors.
 - 1. Verify that frames comply with indicated requirements for type, size, location, and swing characteristics and have been installed with level heads and plumb jambs.
 - 2. Reject doors with defects.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 INSTALLATION

- A. Hardware: For installation see Section 08 7100 – Door Hardware.
- B. Installation Instructions: Install doors to comply with manufacturer's written instructions and the referenced quality standard, and as indicated.

- C. Job-Fitted Doors: Align and fit doors in frames with uniform clearances and bevels as indicated below; do not trim stiles and rails in excess of limits set by manufacturer. Machine doors for hardware. Seal edges of doors, edges of cutouts, and mortises after fitting and machining.
 - 1. Clearances: Provide 1/8 inch at heads, jambs, and between pairs of doors. Provide 1/8 inch from bottom of door to top of decorative floor finish or covering unless otherwise indicated. Where threshold is shown or scheduled, provide 1/4 inch from bottom of door to top of threshold unless otherwise indicated.
 - 2. Bevel doors 1/8 inch in 2 inches at lock and hinge edges.
- D. Factory-Fitted Doors: Align in frames for uniform clearance at each edge.
- E. Doors that are cut or planed for fitting shall be immediately resealed with a transparent wood sealer. Doors shall operate freely without sticking or binding, without hinge-bound conditions and with hardware installed, properly adjusted and functioning.
- F. Site Finishing:
 - 1. Field Finish: Provide as specified in Section 09 91 00 - Painting and in accordance with Door Manufacturer's written instructions

3.03 ADJUSTING

- A. Operation: Rehang or replace doors that do not swing or operate freely. Adjust for smooth and balanced door movement in accordance with manufacturer's instructions.
- B. Finished Doors: Replace doors that are damaged or that do not comply with requirements. Doors may be repaired or refinished if work complies with requirements and shows no evidence of repair or refinishing.

3.04 CLEANING

- A. During the course of the Work and on completion of the Work, remove excess materials, equipment and debris and dispose of away from premises. Leave Work in clean condition.

END OF SECTION 08 1400

SECTION 08 3113 - ACCESS DOORS AND FRAMES

PART 1 - GENERAL

1.01 SUMMARY

- A. This Section includes the following:
 - 1. Access doors and frames for walls and ceilings.

1.02 SUBMITTALS

- A. Product Data: For each type of access door and frame indicated. Include construction details, fire ratings, materials, individual components and profiles, and finishes.
- B. Shop Drawings: Show fabrication and installation details of access doors and frames for each type of substrate. Include plans, elevations, sections, details, and attachments to other work.
- C. Samples: For each door face material, at least 3 by 5 inches in size, in specified finish.
- D. Access Door and Frame Schedule: Provide complete access door and frame schedule, including types, locations, sizes, latching or locking provisions, and other data pertinent to installation.
- E. Ceiling Coordination Drawings: Reflected ceiling plans, drawn to scale, on which ceiling-mounted items including access doors and frames, lighting fixtures, diffusers, grilles, speakers, sprinklers, and special trim are shown and coordinated with each other.

1.03 QUALITY ASSURANCE

- A. Source Limitations: Obtain each type of access door(s) and frame(s) through one source from a single manufacturer.
- B. Size Variations: Obtain Architect's acceptance of manufacturer's standard-size units, which may vary slightly from sizes indicated.

1.04 COORDINATION

- A. Verification: Determine specific locations and sizes for access doors needed to gain access to concealed plumbing, mechanical, or other concealed work, and indicate in the schedule specified in "Submittals" Article.

PART 2 - PRODUCTS

2.01 STEEL MATERIALS

- A. Steel Plates, Shapes, and Bars: ASTM A 36/A 36M.

1. ASTM A 123/A 123M, for galvanizing steel and iron products.
 2. ASTM A 153/A 153M, for galvanizing steel and iron hardware.
- B. Steel Sheet: Uncoated or electrolytic zinc-coated, ASTM A 591/A 591M with cold-rolled steel sheet substrate complying with ASTM A 1008/A 1008M, Commercial Steel (CS), exposed.
- C. Steel Finishes: Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.
1. Surface Preparation for Steel Sheet: Clean surfaces to comply with SSPC-SP 1, "Solvent Cleaning," to remove dirt, oil, grease, or other contaminants that could impair paint bond. Remove mill scale and rust, if present, from uncoated steel, complying with SSPC-SP 5/NACE No. 1, "White Metal Blast Cleaning," or SSPC-SP 8, "Pickling."
 2. Surface Preparation for Metallic-Coated Steel Sheet: Clean surfaces with nonpetroleum solvent so surfaces are free of oil and other contaminants. After cleaning, apply a conversion coating suited to the organic coating to be applied over it. Clean welds, mechanical connections, and abraded areas, and apply galvanizing repair paint specified below to comply with ASTM A 780.
 - a. Galvanizing Repair Paint: High-zinc-dust-content paint for regalvanizing welds in steel, complying with SSPC-Paint 20.
 3. Factory-Primed Finish: Apply shop primer immediately after cleaning and pretreating.
- D. Drywall Beads: Edge trim formed from 0.0299-inch zinc-coated steel sheet formed to receive joint compound and in size to suit thickness of gypsum board.

2.02 ACCESS DOORS AND FRAMES FOR WALLS AND CEILINGS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Bilco Company
 2. J. L. Industries, Inc.
 3. Karp Associates, Inc.
 4. Larsen's Manufacturing Company.
 5. Milcor Limited Partnership.
 6. Nystrom Building Products Co.
- B. Flush Access Doors and Frames with Exposed Trim: Fabricated from steel sheet.
1. Locations: Wall and ceiling surfaces.
 2. Door: 14 gauge thick sheet metal, set flush with exposed face flange of frame.
 3. Frame: Minimum 16 gauge thick sheet metal with 1 inch wide, surface-mounted trim.
 4. Hinges: Spring-loaded concealed pin type.
 5. Lock: NO handle with screw driver slot for quarter turn cam latch.

2.03 FABRICATION

- A. General: Provide access door and frame assemblies manufactured as integral units ready for installation.

- B. Metal Surfaces: For metal surfaces exposed to view in the completed Work, provide materials with smooth, flat surfaces without blemishes. Do not use materials with exposed pitting, seam marks, roller marks, rolled trade names, or roughness.
- C. Doors and Frames: Grind exposed welds smooth and flush with adjacent surfaces. Furnish attachment devices and fasteners of type required to secure access panels to types of supports indicated.
 - 1. Exposed Flanges: Nominal 1 to 1-1/2 inches wide around perimeter of frame.
 - 2. Provide mounting holes in frames for attachment of units to metal or wood framing.
 - 3. Provide mounting holes in frame for attachment of masonry anchors. Furnish adjustable metal masonry anchors.
- D. Latching Mechanisms: Furnish number required to hold doors in flush, smooth plane when closed.
 - 1. For recessed panel doors, provide access sleeves for each locking device. Furnish plastic grommets and install in holes cut through finish.

PART 3 - EXECUTION

3.01 INSTALLATION

- A. Comply with manufacturer's written instructions for installing access doors and frames.
- B. Set frames accurately in position and attach securely to supports with plane of face panels aligned with adjacent finish surfaces.
- C. Install doors flush with adjacent finish surfaces or recessed to receive finish material.

3.02 ADJUSTING AND CLEANING

- A. Adjust doors and hardware after installation for proper operation.

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ACCESS DOORS AND FRAMES

- B. Remove and replace doors and frames that are warped, bowed, or otherwise damaged.

END OF SECTION 08 3113

SECTION 08 3613 - SECTIONAL DOORS

PART 1 - GENERAL

1.01 SUMMARY

- A. Section includes electrically operated sectional doors.
- B. Operating hardware and supports.
- C. Electrical controls.

1.02 SUBMITTALS

- A. Product Data: For each type and size of sectional door and accessory.
 - 1. Include construction details, material descriptions, dimensions of individual components, profile door sections, and finishes.
 - 2. Include operating characteristics, electrical characteristics, and furnished accessories.
- B. Shop Drawings: For each installation and for special components not dimensioned or detailed in manufacturer's product data.
 - 1. Include plans, elevations, sections, and mounting details.
 - 2. Include details of equipment assemblies. Indicate dimensions, required clearances, method of field assembly, components, and location and size of each field connection.
 - 3. Include points of attachment and their corresponding static and dynamic loads imposed on structure.
 - 4. Include diagrams for power, signal, and control wiring.
- C. Delegated-Design Submittal: For sectional doors indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.
 - 1. Detail fabrication and assembly of seismic restraints.
 - 2. Summary of forces and loads on roof structure, walls and jambs.
- D. Qualification Data: For Installer.
- E. Sample Warranties: For special warranties.
- F. Installer Certificates: Signed by manufacture certifying that installer comply with specified requirements.
- G. Maintenance Data: For sectional doors to include in maintenance manuals.

1.03 QUALITY ASSURANCE

- A. Provide the following documentation at the Project site, available upon request to inspectors of the Authority Having Jurisdiction:
 - 1. Manufacturer's installation instructions.
 - 2. Evidence that the overhead door has been evaluated for the wind load appropriate for the Project site. Evidence shall consist of one of the following:
 - a. DASMA evaluation label attached to each sectional door;
 - b. Copy of ICC Evaluation Service report;
 - c. Copy of wind test evaluation, performed in accordance with ASTM E 330 or ANSI/DASMA 108 and sealed by an independent professional engineer or recognized testing agency; or
 - d. Copy of "rational analysis" sealed by professional engineer
- B. Installer Qualifications: An entity that employs installers and supervisors who are trained and approved by manufacturer for both installation and maintenance of units required for this Project.

1.04 WARRANTY

- A. Special Warranty: Manufacturer agrees to repair or replace components of sectional doors that fail in materials or workmanship within specified warranty period.
 - 1. Failures include, but are not limited to, the following:
 - a. Structural failures including, but not limited to, excessive deflection.
 - b. Failure of components or operators before reaching required number of operation cycles.
 - c. Faulty operation of hardware.
 - d. Deterioration of metals, metal finishes, and other materials beyond normal weathering and use; rust through.
 - e. Delamination of exterior or interior facing materials.
 - 2. Warranty Period: One years from date of Final Completion.
- B. Special Finish Warranty: Manufacturer agrees to repair or replace components that show evidence of deterioration of factory-applied finishes within specified warranty period.
 - 1. Warranty Period: 5 years from date of Final Completion.

PART 2 - PRODUCTS

2.01 PERFORMANCE REQUIREMENTS

- A. General Performance: Sectional doors shall comply with performance requirements specified without failure due to defective manufacture, fabrication, installation, or other defects in construction and without requiring temporary installation of reinforcing components.
- B. Delegated Design: Design sectional doors, including comprehensive engineering analysis by a qualified professional engineer, using performance requirements and design criteria indicated.

- C. Structural Performance, Exterior Doors: Capable of withstanding the effects of gravity loads and the following loads and stresses without evidencing permanent deformation of door components.
 - 1. Wind Load: Uniform pressure (velocity pressure) of 20 lbf/sq. ft., acting inward and outward; as indicated on Drawings.
 - 2. Air Infiltration: Maximum rate of 0.08 cfm/sq.ft. at 15 and 25 mph when tested according to ASTM E283 or DASMA 105.
 - 3. Deflection Limits: Design sectional doors to withstand design wind loads without evidencing permanent deformation or disengagement of door components.
 - a. Deflection of door sections in horizontal position (open) shall not exceed 1/120 of the door width.
 - b. Deflection of horizontal track assembly shall not exceed 1/240 of the door height.
- D. Seismic Performance: Sectional doors shall withstand the effects of earthquake motions determined according to ASCE/SEI 7.
 - 1. Component Importance Factor: As indicated on the Drawings.
- E. Safety Glazing: Provide safety glazing that complies with 16 CFR 1201, Category II.
 - 1. Safety Glazing Labeling: Permanently mark glazing with certification label of the SGCC or another certification agency acceptable to authorities having jurisdiction. Label shall indicate manufacturer's name, type of glass, thickness, and safety glazing standard with which glass complies.
- F. Insulated Glazing: Visible Light Transmittance 0.36 minimum.
- G. Operation Cycles: Door components and operators capable of operating for not less than 20,000. One operation cycle is complete when a door is opened from the closed position to the fully open position and returned to the closed position.

2.02 MANUFACTURERS

- A. Steel Sectional Door: Sectional door formed with hinged sections and fabricated according to DASMA TDS-163; unless otherwise indicated.
 - 1. Basis of Design Product: Subject to compliance with requirements, Model 596 Thermacore Sectional Door by Overhead Door Company, or comparable product by one of the following:
 - a. Clopay Doors; Continental Door Co.
 - b. Wayne-Dalton Corp.
 - c. Or approved equal.
- B. Source Limitations: Obtain sectional doors from single source from single manufacturer.
 - 1. Obtain operators and controls from sectional door manufacturer.

2.03 SECTIONAL DOORS

- A. Basis of Design: Model 596 Thermacore Sectional Door by Overhead Door Company; or approved equal.

- B. Steel Sectional Door: Sectional door formed with hinged sections and fabricated according to DASMA TDS-163; unless otherwise indicated.
 - 1. Minimum U-Factor: .057.
 - 2. R-value: R-17 minimum.

- C. Door Assembly: Solid panels and full vision glazing with manufacturer's standard, nonglazed panels at areas indicated on drawings.
 - 1. Overall Panel Thickness: 2 inches with 20 gauge exterior panel.
 - 2. Insulation: Manufacturer's standard 1 3/8 inch polystyrene.
 - 3. Back Panel: 30 gauge steel cover; prepainted to match exterior surface.
 - 4. Exterior Surface: Textured.

- D. Tracks: Manufacturer's standard, galvanized steel track system of configuration indicated, 2 inches wide, designed for lift type indicated and clearances indicated on Drawings. Provide complete system including brackets, bracing, and reinforcement to ensure rigid support of ball-bearing roller guides for required door type, size, weight, and loading.
 - 1. Galvanized Steel: ASTM A653, minimum G60 zinc coating.
 - 2. Slope tracks at an angle from vertical or design tracks to ensure tight closure at jams when door unit is closed.
 - 3. Track Reinforcement and Supports: Galvanized-steel members to support track without sag, sway, and vibration during opening and closing of doors. Slot vertical sections of track spaced 2 inches apart for door-drop safety device.
 - a. For Vertical Track: Continuous reinforcing angle attached to track and attached to wall with jamb brackets.
 - b. 13 gauge galvanized steel track brackets.
 - 4. Track Configuration: High-Lift Track.
 - 5. Coordination. Coordinate high-lift track support and loads with Pre-manufactured metal building manufacturer for connections and additional loads on walls and roof structure. Additional supporting structure to be included in base bid.

- E. Hardware: Heavy-duty, corrosion-resistant hardware, with hot-dip galvanized, stainless-steel, or other corrosion-resistant fasteners, to suit door type.
 - 1. Hinges: Heavy-duty, galvanized-steel hinges of not less than 0.079 inch nominal coated thickness at each end stile and at each intermediate stile, according to manufacturer's written recommendations for door size. Attach hinges to door sections through stiles and rails with bolts and lock nuts or lock washers and nuts. Use rivets or self-tapping fasteners where access to nuts is impossible. Provide double-end hinges where required, for doors more than 16 feet wide unless otherwise recommended by door manufacturer.
 - a. Minimum of 14 gauge galvanized steel hinges.
 - 2. Rollers: Heavy-duty rollers with steel ball-bearings in case-hardened steel races, mounted with varying projections to suit slope of track. Extend roller shaft through both hinges where double hinges are required. Provide 3 inch diameter roller tires for 3 inch wide track and 2 inch diameter roller tires for 2 inch wide track.
 - 3. Sliding end stile locking device provided with spring-loaded bolt for inside operation only.

4. Doors 16 feet 4 inches (5102 mm) and wider provided with double end hinges and stiles and long stem rollers.
- F. Counterbalance Mechanism:
1. Torsion springs: Counter-balance mechanism consisting of adjustable-tension torsion springs fabricated from steel-spring wire complying with ASTM A229, mounted on a torsion shaft made of steel tube or solid sheet. Provide springs designed for number of operation cycles indicated. Springs to be oil tempered, helical wound and custom computed for each door. Springs to comply with ANSI/DASMA 102-2011 as follows:
 - a. High Cycle Spring: 50,000 cycles.
 2. Cable Drums and Shaft for Doors: Cable drums to be die cast aluminum or gray-iron casting cable drums mounted on torsion shaft and grooved to receive door-lifting cables as door is raised. Mount counterbalance mechanism with manufacturer's standard ball-bearing brackets at each end of torsion shaft. Provide one additional midpoint bracket for shafts up to 16 feet long and two additional brackets at one-third points to support shafts more than 16 feet long unless closer spacing is recommended by door manufacturer.
 3. Cables: Galvanized-steel, multistrand, lifting cable to provide minimum safety factor of seven to one.
 4. Cable Safety Device: Include a spring-loaded steel or spring-loaded bronze cam mounted to bottom door roller assembly on each side and designed to automatically stop door if either lifting cable breaks.
 5. Bracket: Provide anchor support bracket as required to connect stationary end of spring to the wall and to level the shaft and prevent sag.
 6. Provide mounting plates and framing for torsion bar mounting. Coordinate with metal building manufacturer.
- G. Handle: Galvanized steel step plate/lift handle provided on inside and outside of bottom section.
- H. Locking Devices: Fabricate with cylinder lock, deadbolt, and adjustable locking bars to engage through slots in tracks.
1. Locking Device Assembly: Single-jamb side locking bars, operable from inside, with chain lock keeper.
- I. Weather stripping: Replaceable, adjustable, continuous, compressible weather-stripping gaskets of flexible vinyl, rubber or neoprene fitted to bottom, jambs, top of sectional door, and around each panel section.
- J. Glazing: Clear tempered insulating glass unit with low emissivity coating; 1/2 inch overall thickness, consisting of 1/4 inch Kind FT (fully-tempered) clear glass lite and 1/4 inch Kind FT (fully tempered) clear glass lite. Set glazing in vinyl, rubber, or neoprene glazing channel for metal-framed doors. Provide removable stops of same material as door-section frames on interior face.
1. Safety Glazing: Label as specified.
 2. Size: As shown on Drawings, Solid panels with stacked full vision glazing panels.
 3. See Section 08 8000 – Glazing for additional glazing and installation requirements.

2.04 ELECTRIC DOOR OPERATORS

- A. Electric door operator assembly of size and capacity recommended and provided by door manufacturer for door and "operation cycles" requirement specified, with electric motor and factory-prewired motor controls, starter, gear-reduction unit, solenoid-operated brake, clutch, control stations, control devices, integral gearing for locking door, and accessories required for proper operation.
 - 1. Comply with NFPA 70.
 - 2. Control equipment complying with NEMA ICS 1, NEMA ICS 2, and NEMA ICS 6; with NFPA 70, Class 2 control circuit, maximum 24-V ac or dc.
- B. Usage Classification: Electric operator and components capable of operating for not less than number of cycles per hour indicated for each door.
 - 1. Heavy duty, up to 25 cycles per hour and up to 90 cycles per day.
- C. Door-Operator Type: Manufacturer's standard unit consisting of electric motor, gears, pulleys, belts, sprockets, chains, and controls needed to operate door and meet required usage classification.
 - 1. Jackshaft, Center or side-Mounted: Jackshaft operator mounted on the inside front wall above door and connected to torsion shaft with an adjustable coupling or drive chain.
 - 2. Provide and install steel plate mounting brackets as required.
- D. Safety: Listed according to UL 325 by a qualified testing agency for commercial or industrial use; moving parts of operator enclosed or guarded if exposed and mounted at 8 feet or lower.
 - 1. Safety Interlock Switch: Equip power-operated doors with safety interlock switch to disengage power supply when door is locked.
- E. Motors: Reversible-type motor with controller (disconnect switch) for motor exposure indicated.
 - 1. Motor Exposure: Interior.
 - 2. Electrical Characteristics:
 - a. Phase: Single Phase, 1 horse power
 - b. Volts: 120 V.
 - c. Hertz: 60.
 - 3. Motor Size: Minimum size as indicated. If not indicated, large enough to start, accelerate, and operate door in either direction from any position, at a speed not less than 8 in./sec. and not more than 12 in./sec., without exceeding nameplate ratings or service factor.
 - 4. Operating Controls, Controllers (Disconnect Switches), Wiring Devices, and Wiring: Manufacturer's standard unless otherwise indicated.
 - 5. Coordinate wiring requirements and electrical characteristics of motors and other electrical devices with building electrical system and each location where installed.
 - 6. Use adjustable motor-mounting bases for belt-driven operators.
- F. Limit Switches: Equip motorized door with adjustable switches interlocked with motor controls and set to automatically stop door at fully opened and fully closed positions.

- G. Control Station: Three-button control station in fixed location with momentary-contact push-button controls labeled "Open" and "Stop" and sustained- or constant-pressure, push-button control labeled "Close."
 - 1. Interior-Mounted Units: Full-guarded, surface-mounted, heavy-duty type, with weatherproof NEMA 4 Rated enclosure.
 - 2. Location: As indicated on Drawings, or if not indicated as determined by the Architect.
 - 3. Radio Controls: Provide one (1) radio receiver and (1) single button remote per each door. Remotes to open and close doors with single operation.
- H. Emergency Manual Operation: Equip electrically powered door with capability for emergency manual chain-hoist operation.
- I. Obstruction Detection Device: Automatic photoelectric sensor on bottom edge of door.
 - 1. Sensor Edge Bulb Color: Black.
- J. Emergency Operation Disconnect Device: Equip operator with hand-operated disconnect mechanism for automatically engaging manual operator and releasing brake for emergency manual operation while disconnecting motor without affecting timing of limit switch. Mount mechanism so it is accessible from floor level. Include interlock device to automatically prevent motor from operating when emergency operator is engaged.
- K. Motor Removal: Design operator so motor may be removed without disturbing limit-switch adjustment and without affecting emergency manual operation.
 - 1. Basis of Design: Model RSX by Overhead Door.

2.05 GENERAL FINISH REQUIREMENTS

- A. Comply with NAAMM/NOMMA's "Metal Finishes Manual for Architectural and Metal Products (AMP 500-06)" for recommendations for applying and designating finishes.
- B. 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 FINISHES

- A. High-Performance, Organic, Aluminum Finish (Two-Coat Fluoropolymer): AA-C12C40R1x (Chemical Finish: Cleaned with inhibited chemicals; Chemical Finish: Conversion coating; Organic Coating: Manufacturer's standard two-coat, thermocured system consisting of specially formulated inhibitive primer and fluoropolymer color topcoat containing not less than 70 percent polyvinylidene fluoride resin by weight). Prepare, pretreat, and apply coating to exposed metal surfaces to comply with AAMA 2605 and with coating and resin manufacturers' written instructions.
 - 1. Color: As selected by Architect from Manufacturer's full range of colors.

PART 3 - EXECUTION

3.01 EXAMINATION

- A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for substrate construction and other conditions affecting performance of the Work.
- B. Examine locations of electrical connections. Coordinate connection requirements of Door Manufacturer's supplied controls and components with electrical contractor for project, to provide a complete operating system.
 - 1. Verify that electrical power is of the correct characteristics for door operation.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 INSTALLATION

- A. Install sectional doors and operating equipment complete with necessary hardware, anchors, inserts, hangers, and equipment supports; according to manufacturer's written instructions and as specified.
- B. Tracks:
 - 1. Fasten vertical track assembly to opening jambs and framing, spaced not more than 24 inches apart.
 - 2. Hang high-lift track assembly from structural overhead framing with angles or channel hangers attached to framing by welding or bolting, or both. Provide sway bracing, diagonal bracing, and reinforcement as required for rigid installation of track and door-operating equipment.
 - 3. Coordinate structural overhead framing requirements and loads with pre-manufactured metal building manufacturer for door loads and mounting criteria prior to building design completion and erection.
- C. Power-Operated Doors: Install according to UL 325.
- D. Fit and align door assembly including hardware. Install perimeter trim, closures and weatherstripping.

3.03 STARTUP SERVICES

- A. Engage a factory-authorized service representative to perform startup service.
 - 1. Complete installation and startup checks according to manufacturer's written instructions.
 - 2. Test and adjust controls and safety devices. Replace damaged and malfunctioning controls and equipment.

3.04 ADJUSTING

- A. Adjust hardware and moving parts to function smoothly so that doors operate easily, free of warp, twist, or distortion.
- B. Lubricate bearings and sliding parts as recommended by manufacturer.
- C. Adjust doors and seals to provide weather-resistant fit around entire perimeter.
- D. Align and adjust motors, pulleys, belts, sprockets, chains, and controls according to manufacturer's written instructions.
- E. Touch-up Painting: Immediately after welding galvanized materials, clean welds and abraded galvanized surfaces and repair galvanizing to comply with ASTM A 780/A 780M.

3.05 DEMONSTRATION

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain sectional doors.

END OF SECTION 08 3613

SECTION 08 4313 - ALUMINUM-FRAMED STOREFRONTS

PART 1 - GENERAL

1.01 SECTION INCLUDES

- A. Exterior storefront framing.
- B. Perimeter trims, thermal sub-sill flashing, stools, accessories, shims and anchors, and perimeter sealing of storefront units.
 - 1. Sheet metal flashing and trim.
 - 2. Seal framing to existing substrate to provide a leak proof, secure, and non-corrosive installation.

1.02 RELATED REQUIREMENTS

- A. Section 08 8000 - Glazing: Glazing incorporated into storefront framing.

1.03 ADMINISTRATIVE REQUIREMENTS

- A. Preinstallation Meeting: Convene at project site seven calendar days prior to scheduled beginning of construction activities of this section to review section requirements.
 - 1. Require attendance by representatives of installer and other entities directly affecting, or affected by, construction activities of this section.

1.04 SUBMITTALS

- A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
- B. Product Data: For each type of product.
 - 1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes.
- C. Shop Drawings: For aluminum-framed storefronts. Include plans, elevations, sections, full-size details, and attachments to other work.
 - 1. Include details of provisions for assembly expansion and contraction and for draining moisture occurring within the assembly to the exterior.
 - 2. Include full-size isometric details of each vertical-to-horizontal intersection of aluminum-framed storefronts, showing the following:
 - a. Joinery, including concealed welds.
 - b. Anchorage.
 - c. Expansion provisions.
 - d. Glazing.
 - e. Flashing and drainage.
 - 3. Show connection to and continuity with adjacent thermal, weather, air, and vapor barriers.

- D. Samples for Verification: Submit two samples each 12 x 12 inches (305 x 305 mm) in size illustrating finished aluminum surface, glass, and glazing materials.
- E. Delegated-Design Submittal: For aluminum-framed storefronts indicated to comply with performance requirements and design criteria, including analysis data signed, sealed and dated by the qualified professional engineer responsible for their preparation.
 - 1. Provide engineered layout and details/design wind loads for the storefront system.
 - 2. Attach manufacturer's cut-sheets & attachment details for the proposed storefront system.
 - 3. Pre-engineered data shall include wind load tables that identify compliance with the minimum wind load per IBC Section 1609.3 city as required for the building's risk category and Project location.
- F. Qualification Data: For Installer.
- G. Energy Performance Certificates: For aluminum-framed storefronts, accessories, and components, from manufacturer.
 - 1. Basis for Certification: NFRC-certified energy performance values for each aluminum-framed storefront.
- H. Product Test Reports: For aluminum-framed storefronts, for tests performed by a qualified testing agency.
- I. Source quality-control reports.
- J. Sample Warranties: For special warranties.
- K. Maintenance Data: For aluminum-framed storefronts to include in maintenance manuals.

1.05 QUALITY ASSURANCE

- A. 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.
- B. 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.

1.06 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.

1.07 DELIVERY, STORAGE, AND HANDLING

- A. Deliver materials in manufacturer's original, unopened, undamaged containers with identification labels intact.

- B. 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.

1.08 WARRANTY

- A. Special Warranty: Manufacturer and Installer agrees to repair or replace components of aluminum-framed storefronts that do not comply with requirements or that fail in materials or workmanship within specified warranty period.
 - 1. Failures include, but are not limited to, the following:
 - a. Structural failures including, but not limited to, excessive deflection.
 - b. Noise or vibration created by wind and thermal and structural movements.
 - c. Water penetration through fixed glazing and framing areas.
 - d. Failure of operating components.
 - 2. Warranty Period: Two years from date of Substantial Completion.
- B. Special Finish Warranty: Standard form in which manufacturer agrees to repair finishes or replace aluminum that shows evidence of deterioration of factory-applied finishes within specified warranty period.
 - 1. Deterioration includes, but is not limited to, the following:
 - a. Color fading more than 5 Hunter units when tested according to ASTM D 2244.
 - b. Chalking in excess of a No. 8 rating when tested according to ASTM D 4214.
 - c. Cracking, checking, peeling, or failure of paint to adhere to bare metal.
 - 2. Warranty Period: Ten years from date of Substantial Completion.

PART 2 - PRODUCTS

2.01 PERFORMANCE REQUIREMENTS

- A. General Performance: Comply with performance requirements specified, as determined by testing of aluminum-framed storefronts representing those indicated for this Project without failure due to defective manufacture, fabrication, installation, or other defects in construction.
 - 1. Aluminum-framed storefronts shall withstand movements of supporting structure including, but not limited to, story drift, twist, column shortening, long-term creep, and deflection from uniformly distributed and concentrated live loads.
 - 2. Failure also includes the following:
 - a. Thermal stresses transferring to building structure.
 - b. Glass breakage.
 - c. Noise or vibration created by wind and thermal and structural movements.
 - d. Loosening or weakening of fasteners, attachments, and other components.
 - e. Failure of operating units.
- B. Structural Loads:
 - 1. Wind Loads: As indicated on Drawings.
 - 2. Other Design Loads: As indicated on Drawings.

- C. Deflection of Framing Members: At design wind pressure, as follows:
 - 1. Deflection Normal to Wall Plane: Limited to edge of glass in a direction perpendicular to glass plane not exceeding 1/175 of the glass edge length for each individual glazing lite or an amount that restricts edge deflection of individual glazing lites to 3/4 inch (19.1 mm), whichever is less.
 - 2. Deflection Parallel to Glazing Plane: Limited to amount not exceeding that which reduces glazing bite to less than 75 percent of design dimension and that which reduces edge clearance between framing members and glazing or other fixed components to less than 1/8 inch (3.2 mm).
- D. Structural: Test according to ASTM E 330 as follows:
 - 1. When tested at positive and negative wind-load design pressures, assemblies do not evidence deflection exceeding specified limits.
 - 2. When tested at 150 percent of positive and negative wind-load design pressures, assemblies, including anchorage, do not evidence material failures, structural distress, or permanent deformation of main framing members exceeding 0.2 percent of span.
 - 3. Test Durations: As required by design wind velocity, but not less than 10 seconds.
- E. Air Infiltration: Test according to ASTM E 283 for infiltration as follows:
 - 1. Fixed Framing and Glass Area:
 - a. Maximum air leakage of 0.06 cfm/sq. ft. (0.30 L/s per sq. m) at a static-air-pressure differential of 6.24 lbf/sq. ft. (300 Pa).
- F. Water Penetration under Static Pressure: Test according to ASTM E 331 as follows:
 - 1. No evidence of water penetration through fixed glazing and framing areas when tested according to a minimum static-air-pressure differential of 20 percent of positive wind-load design pressure, but not less than 10 lbf/sq. ft. (480 Pa).
- G. Seismic Performance: Aluminum-framed storefronts shall withstand the effects of earthquake motions determined according to ASCE/SEI 7.
 - 1. Seismic Drift Causing Glass Fallout: Complying with criteria for passing based on building occupancy type when tested according to AAMA 501.6 at design displacement and 1.5 times the design displacement.
- H. Energy Performance: Certify and label energy performance according to NFRC as follows:
 - 1. Thermal Transmittance (U-factor): Refer to 2015 IECC Envelope Compliance Certificate (COMCHECK) for U-Values and Solar Heat Gain Coefficient.
- I. Noise Reduction: Test according to AAMA Specification 1801 and in accordance with ASTM E1425 and ASTM E90, the STC and OITC Rating shall not be less than:
 - 1. Sound Transmission Class (STC): 37.
 - 2. Outdoor-Indoor Transmission Class (OITC): 30.
- J. Thermal Movements: Allow for thermal movements resulting from ambient and surface temperature changes:
 - 1. Temperature Change: 120 deg F (67 deg C), ambient; 180 deg F (100 deg C), material surfaces.

2.02 MANUFACTURERS

- A. Basis of Design: Kawneer North America: www.kawneer.com.
 - 1. Exterior Storefront System: Trifab 451UT; Thermal Framing System.
 - a. System Dimensions: 2 inch x 4 1/2 inch nominal dimension.
- B. Other Acceptable Manufacturers:
 - 1. United States Aluminum Corp: www.usalum.com.
 - 2. Oldcastle Building Envelope: www.oldcastlebe.com.
 - 3. Substitutions: See Section 01 6000 - Product Requirements.
- C. Source Limitations: Obtain all components of aluminum-framed storefront system, including accessories, from single manufacturer.

2.03 STOREFRONT FRAMING SYSTEM

- A. Thermal Barrier (Exterior System): Thermal Break with a 1/4 inch (6.4 mm) separation consisting of a two-part chemically curing, high-density polyurethane, which is mechanically and adhesively joined to aluminum storefront sections.
 - 1. 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 exposed 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. Sub-Sill: Provide manufacturers high performance sub-sill with flashing dam.

2.04 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 inch (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. Weather Seals: Provide weather stripping with integral barrier fin or fins of semi-rigid, polypropylene sheet or polypropylene-coated material. Comply with AAMA 701/702.

- D. 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.
- E. 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.
- F. Thermal Sub-Sill Flashing with End Dams: Kawneer 401 IUT, or approved equal.
 - 1. Install over additional flashing dam as indicated.

2.05 GLAZING

- A. Glazing: Comply with Section 08 8000 - Glazing.
 - 1. Utilize insulated glazing in exterior doors and storefront system as required to meet the tested STC requirements for the project.
- B. Glazing Gaskets: Manufacturer's standard compression types; replaceable, extruded EPDM rubber (dry), and wet systems to comply with tested assemblies.
- 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. Sealant shall have a VOC content of 250 g/L or less.
 - 2. 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
 - 3. 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.

2.06 ACCESSORIES

- A. Joint Sealants: For installation at perimeter of aluminum-framed systems, as specified in Section 07 9200 - 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. Storefront Framing: Fabricate components for assembly using manufacturer's standard installation instructions.
- D. 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. Class I Color Anodized Finish: AAMA 611 AA-M12C22A41 Clear anodic coating or AAMA 612 color anodic coating with electrolytically deposited organic seal; not less than 0.7 mils (0.018 mm) thick.
 - 1. Color: Clear Satin Anodized.
- C. Touch-Up Materials: As recommended by coating manufacturer for field application.

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. Metal Surfaces: Dry; clean; free of grease, oil, dirt, rust, corrosion, and welding slag; without sharp edges or offsets at joints.

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

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 tight construction.
- 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.
- F. Metal Protection:
 - 1. Where aluminum will contact dissimilar metals, protect against galvanic action by painting contact surfaces with primer or by applying sealant or tape or installing nonconductive spacers as recommended by manufacturer for this purpose.
 - 2. Where aluminum will contact concrete or masonry, protect against corrosion by painting contact surfaces with bituminous paint.

3.03 ERECTION TOLERANCES

- A. Erection Tolerances: Install aluminum-framed storefronts to comply with the following maximum tolerances:
 - 1. Plumb: 1/8 inch in 10 feet (3.2 mm in 3 m); 1/4 inch in 40 feet (6.35 mm in 12.2 m).
 - 2. Level: 1/8 inch in 20 feet (3.2 mm in 6 m); 1/4 inch in 40 feet (6.35 mm in 12.2 m).
 - 3. Alignment:
 - a. Where surfaces abut in line or are separated by reveal or protruding element up to 1/2 inch (12.7 mm) wide, limit offset from true alignment to 1/16 inch (1.6 mm).
 - b. Where surfaces are separated by reveal or protruding element from 1/2 to 1 inch (12.7 to 25.4 mm) wide, limit offset from true alignment to 1/8 inch (3.2 mm).
 - c. Where surfaces are separated by reveal or protruding element of 1 inch (25.4 mm) wide or more, limit offset from true alignment to 1/4 inch (6 mm).
 - 4. Location: Limit variation from plane to 1/8 inch in 12 feet (3.2 mm in 3.6 m); 1/2 inch (12.7 mm) over total length.

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 4313

SECTION 08 7100 – DOOR HARDWARE

PART 1 - GENERAL

1.01 SUMMARY

- A. Section includes:
 - 1. Mechanical and electrified door hardware for:
 - a. Swinging doors.
 - 2. Electronic access control system components

- B. Section excludes:
 - 1. Windows
 - 2. Cabinets (casework), including locks in cabinets
 - 3. Signage
 - 4. Toilet accessories
 - 5. Overhead doors

- C. Related Sections:
 - 1. Division 01 Section "Alternates" for alternates affecting this section.
 - 2. Division 06 Section "Rough Carpentry"
 - 3. Division 07 Section "Joint Sealants" for sealant requirements applicable to threshold installation specified in this section.
 - 4. Division 08 Sections:
 - a. "Metal Doors and Frames"
 - b. "Flush Wood Doors"
 - c. "Entrances"
 - 5. Division 09 sections for touchup, finishing or refinishing of existing openings modified by this section.
 - 6. Division 26 "Electrical" sections for connections to electrical power system and for low-voltage wiring.
 - 7. Division 28 "Electronic Safety and Security" sections for coordination with other components of electronic access control system and fire alarm system.
 - a. Coordinate with Division 27 "Communications" for additional access control applications as required.

1.02 REFERENCES

- A. 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

- B. 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
- C. 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
- D. 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

1.03 SUBMITTALS

- A. General:
1. Submit in accordance with Conditions of Contract and Division 01 Submittal Procedures.
 2. Prior to forwarding submittal:
 - a. Comply with procedures for verifying existing door and frame compatibility for new hardware, as specified in PART 3, “EXAMINATION” article, herein.
 - b. Review drawings and Sections from related trades to verify compatibility with specified hardware.
 - c. Highlight, encircle, or otherwise specifically identify on submittals: deviations from Contract Documents, issues of incompatibility or other issues which may detrimentally affect the Work.
- B. Action Submittals:
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:
 - a. Wiring Diagrams: For power, signal, and control wiring and including:
 - 1) Details of interface of electrified door hardware and building safety and security systems.
 - 2) Schematic diagram of systems that interface with electrified door hardware.
 - 3) Point-to-point wiring.
 - 4) Risers.
 3. Samples for Verification: If requested by Architect, submit production sample of requested door hardware unit in finish indicated and tagged with full description for coordination with schedule.

- a. Samples will be returned to supplier. Units that are acceptable to Architect may, after final check of operations, be incorporated into Work, within limitations of key coordination requirements.
4. Door Hardware Schedule:
 - a. Submit concurrent with submissions of Product Data, Samples, and Shop Drawings. Coordinate submission of door hardware schedule with scheduling requirements of other work to facilitate fabrication of other work critical in Project construction schedule.
 - b. Submit under direct supervision of a Door Hardware Institute (DHI) certified Architectural Hardware Consultant (AHC) or Door Hardware Consultant (DHC) with hardware sets in vertical format as illustrated by Sequence of Format for the Hardware Schedule published by DHI.
 - c. Indicate complete designations of each item required for each opening, include:
 - 1) Door Index: door number, heading number, and Architect's hardware set number.
 - 2) Quantity, type, style, function, size, and finish of each hardware item.
 - 3) Name and manufacturer of each item.
 - 4) Fastenings and other pertinent information.
 - 5) Location of each hardware set cross-referenced to indications on Drawings.
 - 6) Explanation of all abbreviations, symbols, and codes contained in schedule.
 - 7) Mounting locations for hardware.
 - 8) Door and frame sizes and materials.
 - 9) Degree of door swing and handing.
 - 10) Operational Description of openings with electrified hardware covering egress, ingress (access), and fire/smoke alarm connections.
5. Key Schedule:
 - a. After Keying Conference, provide keying schedule that includes levels of keying, explanations of key system's function, key symbols used, and door numbers controlled.
 - b. Use ANSI/BHMA A156.28 "Recommended Practices for Keying Systems" as guideline for nomenclature, definitions, and approach for selecting optimal keying system.
 - c. Provide 3 copies of keying schedule for review prepared and detailed in accordance with referenced DHI publication. Include schematic keying diagram and index each key to unique door designations.
 - d. Index keying schedule by door number, keyset, hardware heading number, cross keying instructions, and special key stamping instructions.
 - e. Provide one complete bitting list of key cuts and one key system schematic illustrating system usage and expansion. Forward bitting list, key cuts and key system schematic directly to Owner, by means as directed by Owner.
 - f. Prepare key schedule by or under supervision of supplier, detailing Owner's final keying instructions for locks.
6. Templates: After final approval of hardware schedule, provide templates for doors, frames and other work specified to be factory or shop prepared for door hardware installation.

C. Informational Submittals:

1. Provide Qualification Data for Supplier, Installer and Architectural Hardware Consultant.
 2. Provide Product Data:
 - a. Certify that door hardware approved for use on types and sizes of labeled fire-rated doors complies with listed fire-rated door assemblies.
 - b. Include warranties for specified door hardware.
- D. Closeout Submittals:
1. Operations and Maintenance Data: Provide in accordance with Division 01 and include:
 - a. Complete information on care, maintenance, and adjustment; data on repair and replacement parts, and information on preservation of finishes.
 - b. Catalog pages for each product.
 - c. Factory order acknowledgement numbers (for warranty and service)
 - d. Name, address, and phone number of local representative for each manufacturer.
 - e. Parts list for each product.
 - f. Final approved hardware schedule edited to reflect conditions as installed.
 - g. Final keying schedule
 - h. Copies of floor plans with keying nomenclature
 - i. Copy of warranties including appropriate reference numbers for manufacturers to identify project.
 - j. As-installed wiring diagrams for each opening connected to power, both low voltage and 110 volts.

1.04 QUALITY ASSURANCE

- A. Qualifications and Responsibilities:
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 and that provides certified Architectural Hardware Consultant (AHC) or Door Hardware Consultant (DHC) available to Owner, Architect, and Contractor, at reasonable times during the Work for consultation.
 - a. Warehousing Facilities: In Project's vicinity.
 - b. Scheduling Responsibility: Preparation of door hardware and keying schedules.
 - c. Engineering Responsibility: Preparation of data for electrified door hardware, including Shop Drawings, based on testing and engineering analysis of manufacturer's standard units in assemblies like those indicated for this Project.
 - d. Coordination Responsibility: Assist in coordinating installation of electronic security hardware with Architect and electrical engineers and provide installation and technical data to Architect and other related subcontractors.
 - 1) Upon completion of electronic security hardware installation, inspect and verify that all components are working properly.
 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.
 3. Architectural Hardware Consultant: Person who is experienced in providing consulting services for door hardware installations that are comparable in material, design, and extent to that indicated for this Project and meets these requirements:
 - a. For door hardware: DHI certified AHC or DHC.

- b. Can provide installation and technical data to Architect and other related subcontractors.
 - c. Can inspect and verify components are in working order upon completion of installation.
 - d. Capable of producing wiring diagram and coordinating installation of electrified hardware with Architect and electrical engineers.
 - 4. Single Source Responsibility: Obtain each type of door hardware from single manufacturer.
- B. Pre-Installation Meetings
- 1. Keying Conference
 - a. Incorporate keying conference decisions into final keying schedule after reviewing door hardware keying system including:
 - 1) Function of building, flow of traffic, purpose of each area, degree of security required, and plans for future expansion.
 - 2) Preliminary key system schematic diagram.
 - 3) Requirements for key control system.
 - 4) Requirements for access control.
 - 5) Address for delivery of keys.
 - 2. Pre-installation Conference
 - a. Review and finalize construction schedule and verify availability of materials, Installer's personnel, equipment, and facilities needed to make progress and avoid delays.
 - b. Inspect and discuss preparatory work performed by other trades.
 - c. Inspect and discuss electrical roughing-in for electrified door hardware.
 - d. Review sequence of operation for each type of electrified door hardware.
 - e. Review required testing, inspecting, and certifying procedures.
 - f. Review questions or concerns related to proper installation and adjustment of door hardware.
 - 3. Electrified Hardware Coordination Conference:
 - a. Prior to ordering electrified hardware, schedule and hold meeting to coordinate door hardware with security, electrical, doors and frames, and other related suppliers.
- 1.05 DELIVERY, STORAGE, AND HANDLING
- A. Inventory door hardware on receipt and provide secure lock-up for hardware delivered to Project site. Promptly replace products damaged during shipping.
 - B. Tag each item or package separately with identification coordinated with final door hardware schedule, and include installation instructions, templates, and necessary fasteners with each item or package. Deliver each article of hardware in manufacturer's original packaging.
 - C. Maintain manufacturer-recommended environmental conditions throughout storage and installation periods.

- D. Provide secure lock-up for door hardware delivered to Project. Control handling and installation of hardware items so that completion of Work will not be delayed by hardware losses both before and after installation.
- E. 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.
- F. Deliver keys to manufacturer of key control system for subsequent delivery to Owner.

1.06 COORDINATION

- A. Coordinate layout and installation of floor-recessed door hardware with floor construction. Cast anchoring inserts into concrete.
- B. 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.
- C. Security: Coordinate installation of door hardware, keying, and access control with Owner's security consultant.
- D. Electrical System Roughing-In: Coordinate layout and installation of electrified door hardware with connections to power supplies and building safety and security systems.
- E. Existing Openings: Where existing doors, frames and/or hardware are to remain, field verify existing functions, conditions and preparations and coordinate to suit opening conditions and to provide proper door operation.

1.07 MAINTENANCE

- A. Furnish complete set of special tools required for maintenance and adjustment of hardware, including changing of cylinders.
- B. Turn over unused materials to Owner for maintenance purposes.

PART 2 - PRODUCTS

2.01 HINGES

- A. Manufacturers and Products:
 - 1. Scheduled Manufacturer and Product:
 - a. Ives 5BB series
 - 2. Acceptable Manufacturers and Products:
 - a. Hager BB1191/1279 series
 - b. McKinney TA/T4A series

B. Requirements:

1. Provide hinges conforming to ANSI/BHMA A156.1.
2. Provide five knuckle, ball bearing hinges.
3. 1-3/4 inch (44 mm) thick doors, up to and including 36 inches (914 mm) wide:
 - a. Exterior: Standard weight, bronze or stainless steel, 4-1/2 inches (114 mm) high
 - b. Interior: Standard weight, steel, 4-1/2 inches (114 mm) high
4. 1-3/4 inch (44 mm) thick doors over 36 inches (914 mm) wide:
 - a. Exterior: Heavy weight, bronze/stainless steel, 5 inches (127 mm) high
 - b. Interior: Heavy weight, steel, 5 inches (127 mm) high
5. 2 inches or thicker doors:
 - a. Exterior: Heavy weight, bronze or stainless steel, 5 inches (127 mm) high
 - b. Interior: Heavy weight, steel, 5 inches (127 mm) high
6. Adjust hinge width for door, frame, and wall conditions to allow proper degree of opening.
7. Provide three hinges per door leaf for doors 90 inches (2286 mm) or less in height, and one additional hinge for each 30 inches (762 mm) of additional door height.
8. Where new hinges are specified for existing doors or existing frames, provide new hinges of identical size to hinge preparation present in existing door or existing frame.
9. Hinge Pins: Except as otherwise indicated, provide hinge pins as follows:
 - a. Steel Hinges: Steel pins
 - b. Non-Ferrous Hinges: Stainless steel pins
 - c. Out-Swinging Exterior Doors: Non-removable pins
 - d. Out-Swinging Interior Lockable Doors: Non-removable pins
 - e. Interior Non-lockable Doors: Non-rising pins
10. Provide hinges with electrified options as scheduled in the hardware sets. Provide with number and gage of wires enough to accommodate electric function of specified hardware. Locate electric hinge at second hinge from bottom or nearest to electrified locking component. Provide mortar guard for each electrified hinge specified.

2.02 MORTISE LOCKS

A. Manufacturers and Products:

1. Scheduled Manufacturer and Product:
 - a. Schlage L9000 series
2. Acceptable Manufacturers and Products:
 - a. Owners Standard

B. Requirements:

1. Provide mortise locks conforming to ANSI/BHMA A156.13 Series 1000, Grade 1, and UL Listed for 3-hour fire doors.
2. Indicators: Where specified, provide indicator window measuring a minimum 2-inch x 1/2 inch with 180-degree visibility. Provide messages color-coded with full text and/or symbols, as scheduled, for easy visibility.
3. Provide locks manufactured from heavy gauge steel, containing components of steel with a zinc dichromate plating for corrosion resistance.
4. Provide lock case that is multi-function and field reversible for handing without opening case. Cylinders: Refer to "KEYING" article, herein.

5. Provide locks with standard 2-3/4 inches (70 mm) backset with full 3/4 inch (19 mm) throw stainless steel mechanical anti-friction latchbolt. Provide deadbolt with full 1-inch (25 mm) throw, constructed of stainless steel.
6. Provide standard ASA strikes unless extended lip strikes are necessary to protect trim.
7. Provide electrified options as scheduled in the hardware sets. Where scheduled, provide switches and sensors integrated into the locks and latches. Provide motor based electrified locksets that comply with the following requirements:
 - a. Universal input voltage – single chassis accepts 12 or 24VDC to allow for changes in the field without changing lock chassis.
 - b. Fail Safe/Fail Secure – changing mode between electrically locked (fail safe) and electrically unlocked (fail secure) is field selectable without opening the lock case
 - c. Low maximum current draw – maximum 0.4 amps to allow for multiple locks on a single power supply.
 - d. Low holding current – maximum 0.01 amps to produce minimal heat, eliminate “hot levers” in electrically locked applications, and to provide reliable operation in wood doors that provide minimal ventilation and air flow.
 - e. Connections – provide quick-connect Molex system standard.
8. Lever Trim: Solid brass, bronze, or stainless steel, cast or forged in design specified, with wrought roses and external lever spring cages. Provide thru-bolted levers with 2-piece spindles.

2.03 CYLINDRICAL LOCKS – GRADE 1

A. Manufacturers and Products:

1. Scheduled Manufacturer and Product:
 - a. Schlage ND series
2. Acceptable Manufacturers and Products:
 - a. Owners Standard

B. Requirements:

1. Provide cylindrical locks conforming to ANSI/BHMA A156.2 Series 4000, Grade 1, and UL Listed for 3-hour fire doors.
2. Cylinders: Refer to “KEYING” article, herein.
3. Provide locks with standard 2-3/4 inches (70 mm) backset, unless noted otherwise, with 1/2-inch latch throw. Provide proper latch throw for UL listing at pairs.
4. Provide locksets with separate anti-rotation thru-bolts, and no exposed screws.
5. Provide independently operating levers with two external return spring cassettes mounted under roses to prevent lever sag.
6. Provide standard ASA strikes unless extended lip strikes are necessary to protect trim.
7. Provide electrified options as scheduled in the hardware sets.
8. Lever Trim: Solid cast levers without plastic inserts and wrought roses on both sides.

2.04 EXIT DEVICES

A. Manufacturers and Products:

1. Scheduled Manufacturer and Product:

- a. Von Duprin 98/35A series
 2. Acceptable Manufacturers and Products:
 - a. Sargent 19-43-80 series
 - b. Falcon 25/24 series
 - B. Requirements:
 1. Provide exit devices tested to ANSI/BHMA A156.3 Grade 1 and UL listed for Panic Exit or Fire Exit Hardware.
 2. Cylinders: Refer to "KEYING" article, herein.
 3. Provide smooth touchpad type exit devices, fabricated of brass, bronze, stainless steel, or aluminum, plated to standard architectural finishes to match balance of door hardware.
 4. Touchpad must extend a minimum of one half of door width. No plastic inserts are allowed in touchpads.
 5. Provide exit devices with deadlatching feature for security and for future addition of alarm kits and/or other electrified requirements.
 6. Provide exit devices with weather resistant components that can withstand harsh conditions of various climates and corrosive cleaners used in outdoor pool environments.
 7. Provide flush end caps for exit devices.
 8. Provide exit devices with manufacturer's approved strikes.
 9. Provide exit devices cut to door width and height. Install exit devices at height recommended by exit device manufacturer, allowable by governing building codes, and approved by Architect.
 10. Mount mechanism case flush on face of doors or provide spacers to fill gaps behind devices. Where glass trim or molding projects off face of door, provide glass bead kits.
 11. Provide cylinder or hex-key dogging as specified at non fire-rated openings.
 12. Removable Mullions: 2 inches (51 mm) x 3 inches (76 mm) steel tube. Where scheduled as keyed removable mullion, provide type that can be removed by use of a keyed cylinder, which is self-locking when re-installed.
 13. Provide factory drilled weep holes for exit devices used in full exterior application, highly corrosive areas, and where noted in hardware sets.
 14. Provide electrified options as scheduled.
 15. Top latch mounting: double- or single-tab mount for steel doors, face mount for aluminum doors eliminating requirement of tabs, and double tab mount for wood doors.
 16. Provide exit devices with optional trim designs to match other lever and pull designs used on the project.

2.05 PUSHBUTTONS

- A. Manufacturers and Products:
 1. Scheduled Manufacturer and Product:
 - a. Locknetics IPB/MPB Series
 2. Acceptable Manufacturers and Products:
 - a. Securitron PB2/PB4 Series
 - b. Camden CM-3000/9000 Series

- B. Requirements:
 - 1. Provide push buttons as specified in hardware groups.

2.06 POWER SUPPLIES

- A. Manufacturers and Products:
 - 1. Scheduled Manufacturer and Product:
 - a. Schlage/Von Duprin PS900 Series
 - 2. Acceptable Manufacturers and Products:
 - a. Precision ELR series
 - b. Sargent 3500 series
- B. Requirements:
 - 1. Provide power supplies approved by manufacturer of supplied electrified hardware.
 - 2. Provide appropriate quantity of power supplies necessary for proper operation of electrified locking components as recommended by manufacturer of electrified locking components with consideration for each electrified component using power supply, location of power supply, and approved wiring diagrams. Locate power supplies as directed by Architect.
 - 3. Provide regulated and filtered 24 VDC power supply, and UL class 2 listed.
 - 4. Provide power supplies with the following features:
 - a. 12/24 VDC Output, field selectable.
 - b. Class 2 Rated power limited output.
 - c. Universal 120-240 VAC input.
 - d. Low voltage DC, regulated and filtered.
 - e. Polarized connector for distribution boards.
 - f. Fused primary input.
 - g. AC input and DC output monitoring circuit w/LED indicators.
 - h. Cover mounted AC Input indication.
 - i. Tested and certified to meet UL294.
 - j. NEMA 1 enclosure.
 - k. Hinged cover w/lock down screws.
 - l. High voltage protective cover.

2.07 CYLINDERS

- 1. Manufacturers and Products:
 - a. Scheduled Manufacturer and Product:
 - 1)** Schlage Everest 29 S
 - b. Acceptable Manufacturers and Products:
 - 1) No Substitute
- 2. Requirements:
 - a. Provide cylinders/cores compliant with ANSI/BHMA A156.5; latest revision; cylinder face finished to match lockset; manufacturer's series as indicated. Refer to "KEYING" article, herein.
 - b. Provide cylinders in the below-listed configuration(s), distributed throughout the Project as indicated.

- c. Patent Protection: Cylinders/cores requiring use of restricted, patented keys, patent protected.
- d. Nickel silver bottom pins.

2.08 KEYING

A. Scheduled System:

- a. Provide cylinders/cores keyed into Owner's existing Schlage Everest 29 key system
- 2. Provide permanent cylinders/cores keyed by the manufacturer according to the following key system.
 - a. Master Keying system as directed by the Owner.
- 3. Forward bitting list and keys separately from cylinders, by means as directed by Owner. Failure to comply with forwarding requirements will be cause for replacement of cylinders/cores involved at no additional cost to Owner.
- 4. Provide keys with the following features:
 - a. Material: Nickel silver; minimum thickness of .107-inch (2.3mm)
 - b. Patent Protection: Keys and blanks protected by one or more utility patent(s).
- 5. Identification:
 - a. Mark permanent cylinders/cores and keys with applicable blind code for identification. Do not provide blind code marks with actual key cuts.
 - b. Identification stamping provisions must be approved by the Architect and Owner.
 - c. Stamp cylinders/cores and keys with Owner's unique key system facility code as established by the manufacturer; key symbol and embossed or stamped with "DO NOT DUPLICATE" along with the "PATENTED" or patent number to enforce the patent protection.
 - d. Failure to comply with stamping requirements will be cause for replacement of keys involved at no additional cost to Owner.
 - e. Forward permanent cylinders/cores to Owner, separately from keys, by means as directed by Owner.
- 6. Quantity: Furnish in the following quantities.
 - a. Change (Day) Keys: 3 per cylinder/core.
 - b. Master Keys: 6.

2.09 DOOR CLOSERS

A. Manufacturers and Products:

- 1. Scheduled Manufacturer and Product:
 - a. LCN 4050A series
- 2. Acceptable Manufacturers and Products:
 - a. Falcon SC70A series
 - b. Norton 7500 series
- 3. Provide door closers conforming to ANSI/BHMA A156.4 Grade 1 requirements by BHMA certified independent testing laboratory. ISO 9000 certify closers. Stamp units with date of manufacture code.
- 4. Provide door closers with fully hydraulic, full rack and pinion action with cast aluminum cylinder.

5. Closer Body: 1-1/2-inch (38 mm) diameter with 11/16-inch (17 mm) diameter heat-treated pinion journal and full complement bearings.
6. Hydraulic Fluid: Fireproof, passing requirements of UL10C, and all weather requiring no seasonal closer adjustment for temperatures ranging from 120 degrees F to -30 degrees F.
7. Spring Power: Continuously adjustable over full range of closer sizes, and providing reduced opening force as required by accessibility codes and standards.
8. Hydraulic Regulation: By tamper-proof, non-critical valves, with separate adjustment for latch speed, general speed, and back check.
9. Pressure Relief Valve (PRV) Technology: Not permitted.
10. Provide stick on templates, special templates, drop plates, mounting brackets, or adapters for arms as required for details, overhead stops, and other door hardware items interfering with closer mounting.

1.01 DOOR TRIM

B. Manufacturers:

1. Scheduled Manufacturer:
 - a. Ives.
2. Acceptable Manufacturers:
 - a. Elmes
 - b. Trimco
 - c. Burns
 - d. Rockwood

C. Requirements:

1. Provide push plates, push bars, pull plates, pulls, and hands-free reversible door pulls with diameter and length as scheduled.

2.10 PROTECTION PLATES

A. Manufacturers:

1. Scheduled Manufacturer:
 - a. Ives
2. Acceptable Manufacturers:
 - a. Burns
 - b. Trimco
 - c. Rockwood

B. Requirements:

1. Provide protection plates with a minimum of 0.050 inch (1 mm) thick, beveled four edges as scheduled. Furnish with sheet metal or wood screws, finished to match plates.
2. Sizes 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.
3. At fire rated doors, provide protection plates over 16 inches high with UL label.

2.11 OVERHEAD STOPS AND OVERHEAD STOP/HOLDERS

- A. Manufacturers:
 - 1. Scheduled Manufacturers:
 - a. Glynn-Johnson
 - 2. Acceptable Manufacturers:
 - a. Rixson
 - b. Sargent
 - c. ABH

- B. Requirements:
 - 1. Provide overhead stop at any door where conditions do not allow for a wall stop or floor stop presents tripping hazard.
 - 2. Provide friction type at doors without closer and positive type at doors with closer.

2.12 DOOR STOPS AND HOLDERS

- A. Manufacturers:
 - 1. Scheduled Manufacturer:
 - a. Ives
 - 2. Acceptable Manufacturers:
 - a. Trimco
 - b. Burns
 - c. Rockwood

- B. Provide door stops at each door leaf:
 - 1. Provide wall stops wherever possible. Provide concave type where lockset has a push button of thumbturn.
 - 2. Where a wall stop cannot be used, provide universal floor stops.
 - 3. Where wall or floor stop cannot be used, provide overhead stop.
 - 4. Provide roller bumper where doors open into each other and overhead stop cannot be used.

2.13 THRESHOLDS, SEALS, DOOR SWEEPS, AUTOMATIC DOOR BOTTOMS, AND GASKETING

- A. Manufacturers:
 - 1. Scheduled Manufacturer:
 - a. Zero International
 - 2. Acceptable Manufacturers:
 - a. National Guard
 - b. Reese
 - c. Legacy
 - d. Pemko

- B. Requirements:
 - 1. Provide thresholds, weather-stripping, and gasketing systems as specified and per architectural details. Match finish of other items.

2. Smoke- and Draft-Control Door Assemblies: 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.
3. Provide door sweeps, seals, astragals, and auto door bottoms only of type where resilient or flexible seal strip is easily replaceable and readily available.
4. Size thresholds 1/2 inch (13 mm) high by 5 inches (127 mm) wide by door width unless otherwise specified in the hardware sets or detailed in the drawings.

2.14 SILENCERS

A. Manufacturers:

1. Scheduled Manufacturer:
 - a. Ives
2. Acceptable Manufacturers:
 - a. Burns
 - b. Rockwood
 - c. Trimco

B. Requirements:

1. Provide "push-in" type silencers for hollow metal or wood frames.
2. Provide one silencer per 30 inches (762 mm) of height on each single frame, and two for each pair frame.
3. Omit where gasketing is specified.

2.15 DOOR VIEWERS

A. Manufacturers:

1. Scheduled Manufacturer:
 - a. Ives
2. Acceptable Manufacturers:
 - a. Auth Chimes
 - b. Burns
 - c. Rockwood

- ##### B. Provide appropriate door viewer for door type and rating with minimum of 180-degree view area.

PART 3 - EXECUTION

3.01 EXAMINATION

- ##### A. 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.

- B. Field verify existing doors and frames receiving new hardware and existing conditions receiving new openings. Verify that new hardware is compatible with existing door and frame preparation and existing conditions.
- C. Examine roughing-in for electrical power systems to verify actual locations of wiring connections before electrified door hardware installation.
- D. Submit a list of deficiencies in writing and proceed with installation only after unsatisfactory conditions have been corrected.

3.02 PREPARATION

- A. Where on-site modification of doors and frames is required:
 - 1. Carefully remove existing door hardware and components being reused. Clean, protect, tag, and store in accordance with storage and handling requirements specified herein.
 - 2. Field modify and prepare existing doors and frames for new hardware being installed.
 - 3. When modifications are exposed to view, use concealed fasteners, when possible.
 - 4. Prepare hardware locations and reinstall in accordance with installation requirements for new door hardware and with:
 - a. Steel Doors and Frames: For surface applied door hardware, drill and tap doors and frames according to ANSI/SDI A250.6.
 - b. Wood Doors: DHI WDHS.5 "Recommended Hardware Reinforcement Locations for Mineral Core Wood Flush Doors."
 - c. Doors in rated assemblies: NFPA 80 for restrictions on on-site door hardware preparation.

3.03 INSTALLATION

- A. 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
- B. Install each hardware item in compliance with manufacturer's instructions and recommendations, using only fasteners provided by manufacturer.
- C. Do not install surface mounted items until finishes have been completed on substrate. Protect all installed hardware during painting.
- D. Set units level, plumb and true to line and location. Adjust and reinforce attachment substrate as necessary for proper installation and operation.
- E. Drill and countersink units that are not factory prepared for anchorage fasteners. Space fasteners and anchors according to industry standards.

- F. Install operating parts so they move freely and smoothly without binding, sticking, or excessive clearance.
 - G. Hinges: Install types and in quantities indicated in door hardware schedule but not fewer than quantity recommended by manufacturer for application indicated.
 - H. Wiring: Coordinate with Division 26, ELECTRICAL and Division 28 ELECTRONIC SAFETY AND SECURITY sections for:
 - 1. Conduit, junction boxes and wire pulls.
 - 2. Connections to and from power supplies to electrified hardware.
 - 3. Connections to fire/smoke alarm system and smoke evacuation system.
 - 4. Connection of wire to door position switches and wire runs to central room or area, as directed by Architect.
 - 5. Connections to panel interface modules, controllers, and gateways.
 - 6. Testing and labeling wires with Architect's opening number.
 - I. Key Control System: Tag keys and place them on markers and hooks in key control system cabinet, as determined by final keying schedule.
 - J. 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.
 - K. Closer/holders: Mount closer/holders on room side of corridor doors, inside of exterior doors, and stair side of stairway doors.
 - L. Power Supplies: Locate power supplies as indicated or, if not indicated, above accessible ceilings or in equipment room, or alternate location as directed by Architect.
 - M. Thresholds: Set thresholds in full bed of sealant complying with requirements specified in Division 07 Section "Joint Sealants."
 - N. Stops: Provide floor stops for doors unless wall or other type stops are indicated in door hardware schedule. Do not mount floor stops where they may impede traffic or present tripping hazard.
 - O. Perimeter Gasketing: Apply to head and jamb, forming seal between door and frame.
 - P. Meeting Stile Gasketing: Fasten to meeting stiles, forming seal when doors are closed.
 - Q. Door Bottoms and Sweeps: Apply to bottom of door, forming seal with threshold when door is closed.
- 3.04 FIELD QUALITY CONTROL
- A. Inspection and Testing:
 - 1. Provide functional testing and inspection of fire door assemblies by a qualified person in accordance with NFPA 80.

- a. Schedule fire door assembly inspection within 90 days of Substantial Completion of the Project.
 - b. Submit a signed, written final report as specified in Paragraph 1.03.E.1.
 - c. Correct all deficiencies and schedule a reinspection of fire door assemblies noted as deficient on the inspection report.
 - d. Inspector to reinspect fire door assemblies after repairs are made.
2. Provide inspection of required egress door assemblies by a qualified person in accordance with NFPA 101.
- a. Schedule egress door assembly inspection within 90 days of Substantial Completion of the Project for the required openings.
 - b. Submit a signed, written final report as specified in Paragraph 1.03.E.2.
 - c. Correct all deficiencies and schedule a reinspection of egress door assemblies noted as deficient on the inspection report.
 - d. Inspector to reinspect required egress door assemblies after repairs are made.

3.05 ADJUSTING

- A. Initial Adjustment: 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.
1. Spring Hinges: Adjust to achieve positive latching when door can close freely from an open position of 30 degrees.
 2. Electric Strikes: Adjust horizontal and vertical alignment of keeper to properly engage lock bolt.
 3. Door Closers: Adjust sweep period to comply with accessibility requirements and requirements of authorities having jurisdiction.
- B. Occupancy Adjustment: Approximately three to six months after date of Substantial Completion, examine and readjust each item of door hardware, including adjusting operating forces, as necessary to ensure function of doors and door hardware.

3.06 CLEANING AND PROTECTION

- A. Clean adjacent surfaces soiled by door hardware installation.
- B. Clean operating items per manufacturer's instructions to restore proper function and finish.
- C. Provide final protection and maintain conditions that ensure door hardware is without damage or deterioration at time of Substantial Completion.

3.07 DOOR HARDWARE SCHEDULE

- A. 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.

- B. Discrepancies, conflicting hardware, and missing items are to be brought to the attention of the architect with corrections made prior to the bidding process. Omitted items not included in a hardware set should be scheduled with the appropriate additional hardware required for proper application.
- C. Hardware items are referenced in the following hardware schedule. Refer to the above specifications for special features, options, cylinders/keying, and other requirements.

Abbreviation	Name
B/O	By Others
GLY	Glynn-Johnson Corp
IVE	H.B. Ives
LCN	Lcn Commercial Division
SCE	Schlage Electronic Security
SCH	Schlage Lock Company
UNK	Unknown
VON	Von Duprin
ZER	Zero International Inc

D. Hardware Sets:

Hardware Group No. 01

For use on Door #(s):

109D 109E 109F 109G

Provide each RU door(s) with the following:

QTY	DESCRIPTION	CATALOG NUMBER	FINISH	MFR
	HARDWARE	BY DOOR MFG		B/O

Hardware Group No. 02

For use on Door #(s):

100A 100B 109A

Provide each SGL door(s) with the following:

QTY	DESCRIPTION	CATALOG NUMBER	FINISH	MFR
3	EA HINGE	5BB1HW 4.5 X 4.5 NRP	630	IVE
1	EA PANIC HARDWARE	98-NL	626	VON
1	EA RIM CYLINDER	20-057 EV29 T145	626	SCH
1	EA ELECTRIC STRIKE	6300 FSE 12/24 VAC/VDC	630	VON
1	EA SURFACE CLOSER	4050A SCUSH	689	LCN
1	EA 5TH SCREW SUPPORT	4050-30	689	LCN
1	EA KICK PLATE	8400 10" X 2" LDW B-CS	630	IVE
1	EA FLOOR STOP	FS18S	BLK	IVE
1	EA SEAL	429A	AL	ZER
1	EA DOOR SWEEP	39A	AL	ZER
1	EA THRESHOLD	655A MSLA-10	AL	ZER
1	EA CREDENTIAL READER	BY DIV 28		B/O
1	EA DOOR CONTACT	679-05HM	BLK	SCE
	POWER SUPPLY	BY DIV 28		B/O






CARD IN. USER PRESENTS CREDENTIAL, ELECTRIC STRIKE KEEPER RELEASES, USER OPENS DOOR TO ENTER.

Hardware Group No. 03

For use on Door #(s):

104 105

Provide each SGL door(s) with the following:





QTY		DESCRIPTION	CATALOG NUMBER		FINISH	MFR
3	EA	HINGE	5BB1 4.5 X 4.5 NRP		652	IVE
1	EA	PRIVACY W/ INDICATOR	L9040 06A L583-363 L283-722		626	SCH
1	EA	SURFACE CLOSER	4050A RW/PA		689	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS		630	IVE
1	EA	WALL STOP	WS406/407CCV		630	IVE
1	SET	SEAL	488S-BK			ZER

Hardware Group No. 04

For use on Door #(s):

103A 103B

Provide each SGL door(s) with the following:








QTY		DESCRIPTION	CATALOG NUMBER		FINISH	MFR
3	EA	HINGE	5BB1 4.5 X 4.5 NRP		630	IVE
1	EA	CLASSROOM LOCK	ND70P6D RHO		626	SCH
1	EA	WALL STOP	WS406/407CCV		630	IVE
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS		630	IVE
3	EA	SILENCER	SR64		GRY	IVE

Hardware Group No. 05

For use on Door #(s):

100C

Provide each SGL door(s) with the following:





QTY		DESCRIPTION	CATALOG NUMBER		FINISH	MFR
3	EA	HINGE	5BB1 4.5 X 4.5 NRP		652	IVE
1	EA	PUSH PLATE	8200 4" X 16"		630	IVE
1	EA	PULL PLATE	8305 10" 4" X 16"		630	IVE
1	EA	SURFACE CLOSER	4050A HW/PA		689	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS		630	IVE
1	EA	WALL STOP	WS406/407CCV		630	IVE
3	EA	SILENCER	SR64		GRY	IVE

Hardware Group No. 06

For use on Door #(s):

102

Provide each SGL door(s) with the following:








QTY		DESCRIPTION	CATALOG NUMBER		FINISH	MFR
3	EA	HINGE	5BB1 4.5 X 4.5 NRP		652	IVE
1	EA	ENTRANCE LOCK	ND53PD RHO EV29 T145		626	SCH
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS		630	IVE
1	EA	WALL STOP	WS406/407CCV		630	IVE
1	SET	SEAL	488S-BK			ZER

Hardware Group No. 07

For use on Door #(s):

107

Provide each SGL door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER		FINISH	MFR
3	EA	HINGE	5BB1 4.5 X 4.5 NRP		652	IVE
1	EA	STOREROOM LOCK	ND80PD RHO EV29 T145		626	SCH
1	EA	ELECTRIC STRIKE	5100-3FP FSE		689	VON
1	EA	SURFACE CLOSER	4050A RW/PA		689	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS		630	IVE
1	EA	WALL STOP	WS406/407CCV		630	IVE
3	EA	SILENCER	SR64		GRY	IVE
1	EA	CREDENTIAL READER	BY DIV 28			B/O
		POWER SUPPLY	BY DIV 28			B/O

CARD IN. USER PRESENTS CREDENTIAL, ELECTRIC STRIKE KEEPER RELEASES, USER OPENS DOOR TO ENTER.

Pivot North Architecture
100% Construction Set
March 17, 2023






TWIN FALLS TRAINING FACILITY
SECTION 08 7100
DOOR HARDWARE

Hardware Group No. 08

For use on Door #(s):

108 110

Provide each SGL door(s) with the following:





QTY		DESCRIPTION	CATALOG NUMBER		FINISH	MFR
3	EA	HINGE	5BB1 4.5 X 4.5 NRP		652	IVE
1	EA	STOREROOM LOCK	ND80PD RHO EV29 T145		626	SCH
1	EA	SURFACE CLOSER	4050A RW/PA		689	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS		630	IVE
1	EA	WALL STOP	WS406/407CCV		630	IVE
1	SET	SEAL	488S-BK			ZER

Hardware Group No. 09

For use on Door #(s):

106

Provide each SGL door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER		FINISH	MFR
3	EA	HINGE	5BB1 4.5 X 4.5 NRP		652	IVE
1	EA	STOREROOM LOCK	ND80PD RHO EV29 T145		626	SCH
1	EA	WALL STOP	WS406/407CCV		630	IVE
3	EA	SILENCER	SR64		GRY	IVE

END OF SECTION 08 7100

SECTION 08 8000 - GLAZING

PART 1 - GENERAL

1.01 SUMMARY

- A. Section includes glazing for the following products and applications, including those specified in other Sections where glazing requirements are specified by reference to this Section:
 - 1. Doors and Windows.

1.02 DEFINITIONS

- A. Glass Manufacturers: Firms that produce primary glass, fabricated glass, or both, as defined in referenced glazing publications.
- B. Glass Thicknesses: Indicated by thickness designations in millimeters according to ASTM C 1036.
- C. Interspace: Space between lites of an insulating-glass unit.

1.03 SUBMITTALS

- A. Product Data: For each glass product and glazing material indicated.
 - 1. Weatherproofing system, including printed statement of VOC content.
- B. Sustainable Design Submittals:
 - 1. Product Data: For sealants, indicating VOC content.
- C. Glass Samples: For each type of glass product other than clear monolithic vision glass; 12 inches square.
 - 1. Coated glass.
 - 2. Insulating glass.
- D. Glazing Accessory Samples: For gaskets, in 12-inch lengths.
- E. Glazing Schedule: List glass types and thicknesses for each size opening and location. Use same designations indicated on Drawings.
- F. Qualification Data: For installers and manufacturers of insulating-glass units with sputter-coated, low-e coatings.
- G. Product Certificates: For glass and glazing products, from manufacturer.
- H. Warranties: Sample of special warranties.

1.04 QUALITY ASSURANCE

- A. Installer Qualifications: A qualified installer who employs glass installers for this Project who are certified under the National Glass Association's Certified Glass Installer Program.
- B. Manufacturer Qualifications for Insulating-Glass Units with Sputter-Coated, Low-E Coatings: A qualified insulating-glass manufacturer who is approved and certified by coated-glass manufacturer.
- C. Source Limitations for Glazing Accessories: Obtain from single source from single manufacturer for each product and installation method.
- D. Preinstallation Conference: Conduct conference at Project site.
 - 1. Review and finalize construction schedule and verify availability of materials, Installer's personnel, equipment, and facilities needed to make progress and avoid delays.
 - 2. Review temporary protection requirements for glazing during and after installation.

1.05 DELIVERY, STORAGE, AND HANDLING

- A. Protect glazing materials according to manufacturer's written instructions. Prevent damage to glass and glazing materials from condensation, temperature changes, direct exposure to sun, or other causes.
- B. Comply with insulating-glass manufacturer's written recommendations for venting and sealing units to avoid hermetic seal ruptures due to altitude change.

1.06 PROJECT CONDITIONS

- A. Environmental Limitations: Do not proceed with glazing when ambient and substrate temperature conditions are outside limits permitted by glazing material manufacturers and when glazing channel substrates are wet from rain, frost, condensation, or other causes.
 - 1. Do not install glazing sealants when ambient and substrate temperature conditions are outside limits permitted by sealant manufacturer or below 40 deg F.

1.07 WARRANTY

- A. Manufacturer's Special Warranty for Coated-Glass Products: Manufacturer's standard form in which coated-glass manufacturer agrees to replace coated-glass units that deteriorate within specified warranty period. Deterioration of coated glass is defined as defects developed from normal use that are not attributed to glass breakage or to maintaining and cleaning coated glass contrary to manufacturer's written instructions. Defects include peeling, cracking, and other indications of deterioration in coating.
 - 1. Warranty Period: 10 years from date of Substantial Completion.
- B. Manufacturer's Special Warranty on Laminated Glass: Manufacturer's standard form in which laminated-glass manufacturer agrees to replace laminated-glass units that deteriorate within specified warranty period. Deterioration of laminated glass is defined as defects developed from normal use that are not attributed to glass breakage or to maintaining and cleaning

laminated glass contrary to manufacturer's written instructions. Defects include edge separation, delamination materially obstructing vision through glass, and blemishes exceeding those allowed by referenced laminated-glass standard.

1. Warranty Period: 5 years from date of Substantial Completion.

- C. Manufacturer's Special Warranty on Insulating Glass: Manufacturer's standard form in which insulating-glass manufacturer agrees to replace insulating-glass units that deteriorate within specified warranty period. Deterioration of insulating glass is defined as failure of hermetic seal under normal use that is not attributed to glass breakage or to maintaining and cleaning insulating glass contrary to manufacturer's written instructions. Evidence of failure is the obstruction of vision by dust, moisture, or film on interior surfaces of glass.

1. Warranty Period: 10 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.01 PERFORMANCE REQUIREMENTS

- A. General: Installed glazing systems shall withstand normal thermal movement and wind and impact loads (where applicable) without failure, including loss or glass breakage attributable to the following: defective manufacture, fabrication, or installation; failure of sealants or gaskets to remain watertight and airtight; deterioration of glazing materials; or other defects in construction.
- B. Structural Performance: Engage a qualified engineer to design glazing, including comprehensive engineering analysis, to withstand the following design loads within the limits and under conditions indicated determined according to the IBC and ASTM E 1300:
1. Design Wind Pressures: Determine design wind pressures applicable to Project according to ASCE/SEI 7, based on heights above grade indicated on Drawings.
 - a. Wind Design Data: As indicated on the Structural Drawings.
 - b. Interior Conditions: Design glass at interior locations to comply with the following:
 - 1) Lites at Level Floor Conditions Each Side: Uniform load of 10 psf.
 - 2) Lites at 30 Inches or Greater Offset Floor Condition: Concentrated load of 50 lbf applied horizontally on an area of 1 sq. ft.
 2. Maximum Lateral Deflection: For glass supported on all four edges, limit center-of-glass deflection at design wind pressure to not more than 1/50 times the short-side length or 1 inch, whichever is less.
 3. Differential Shading: Design glass to resist thermal stresses induced by differential shading within individual glass lites.
- C. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes acting on glass framing members and glazing components.
1. Temperature Change: 120 deg F, ambient; 180 deg F, material surfaces.
- D. Safety Glazing: Where safety glazing is indicated, provide glazing that complies with 16 CFR 1201, Category II.

1. Provide safety glazing at all locations noted below:
 - a. Within 36 inches of finished floor.
 - b. Immediately adjacent to any swinging door opening.
 - c. At a lite within a door.
 - d. Any location specifically indicated in this section or on the Drawings to be safety glazing.

- E. Thermal and Optical Performance Properties: Provide glass with performance properties specified, as indicated in manufacturer's published test data, based on procedures indicated below:
 1. For monolithic-glass lites, properties are based on units with lites 6 mm thick.
 2. For laminated-glass lites, properties are based on products of construction indicated.
 3. For insulating-glass units, properties are based on units of thickness indicated for overall unit and for each lite.
 4. U-Factors: Center-of-glazing values, according to NFRC 100 and based on LBL's WINDOW 5.2 computer program, expressed as Btu/sq. ft. x h x deg F (W/sq. m x K).
 5. Solar Heat-Gain Coefficient and Visible Transmittance: Center-of-glazing values, according to NFRC 200 and based on LBL's WINDOW 5.2 computer program.
 6. Visible Reflectance: Center-of-glazing values, according to NFRC 300.

2.02 GLASS PRODUCTS, GENERAL

- A. Glazing Publications: Comply with published recommendations of glass product manufacturers and organizations below, unless more stringent requirements are indicated. Refer to these publications for glazing terms not otherwise defined in this Section or in referenced standards.
 1. GANA Publications: GANA's "Laminated Glazing Reference Manual" and GANA's "Glazing Manual."
 2. IGMA Publication for Insulating Glass: SIGMA TM-3000, "North American Glazing Guidelines for Sealed Insulating Glass Units for Commercial and Residential Use."
 3. AAMA Publications: AAMA GDSG-1, "Glass Design for Sloped Glazing," and AAMA TIR A7, "Sloped Glazing Guidelines."
 4. IGMA Publication for Sloped Glazing: IGMA TB-3001, "Guidelines for Sloped Glazing."

- B. Safety Glazing Labeling: Where safety glazing labeling is indicated, permanently mark glazing with certification label of the SGCC or another certification agency acceptable to authorities having jurisdiction. Label shall indicate manufacturer's name, type of glass, thickness, and safety glazing standard with which glass complies.
 1. Provide heat-strengthened laminated safety glass where required for compliance with CPSC 16CFR 1201 and where otherwise indicated on the Drawings.

- C. Insulating-Glass Certification Program: Permanently marked either on spacers or on at least one component lite of units with appropriate certification label of IGCC.

- D. Thickness: Where glass thickness is indicated, it is a minimum. Provide glass lites in thicknesses as needed to comply with requirements indicated.
 1. Minimum Glass Thickness for Exterior Lites: Not less than 6.0 mm.

- E. Strength: Where float glass is indicated, provide annealed float glass, Kind HS heat-treated float glass, or Kind FT heat-treated float glass as needed to comply with "Performance Requirements" Article. Where heat-strengthened glass is indicated, provide Kind HS heat-treated float glass or Kind FT heat-treated float glass as needed to comply with "Performance Requirements" Article.

2.03 GLASS PRODUCTS

- A. Float Glass: ASTM C 1036, Type I, Quality-Q3, Class I (clear) unless otherwise indicated.
- B. Heat-Strengthened Float Glass: ASTM C 1048; Kind HS (heat strengthened), Type I, Condition A (uncoated) unless otherwise indicated; Type I, Class I (clear) unless otherwise indicated; Quality-Q3.
 - 1. Fabrication Process: By horizontal (roller-hearth) process with roll-wave distortion parallel to bottom edge of glass as installed unless otherwise indicated.
 - 2. For coated vision glass, comply with requirements for Condition C (other coated glass).

2.04 INSULATING GLASS

- A. Insulating-Glass Units: Factory-assembled units consisting of sealed lites of glass separated by a dehydrated interspace, qualified according to ASTM E 2190, and complying with other requirements specified.
 - 1. Sealing System: Dual seal, with manufacturer's standard primary and secondary.
 - 2. Perimeter Spacer: Manufacturer's standard spacer material and construction.
 - a.
 - 3. Desiccant: Molecular sieve or silica gel, or blend of both.
- B. Glass: Comply with applicable requirements in "Glass Products" Article as indicated by designations in "Insulating-Glass Types" Article.
- C. Pyrolytic-Coated Glass: ASTM C 1376, float glass with metallic-oxide or nitride coating applied by pyrolytic deposition process during initial manufacture and complying with other requirements specified.

2.05 GLAZING GASKETS

- A. Dense Compression Gaskets: Molded or extruded gaskets of profile and hardness required to maintain watertight seal, made from one of the following:
 - 1. Neoprene complying with ASTM C 864.
 - 2. EPDM complying with ASTM C 864.
- B. Soft Compression Gaskets: Extruded or molded, closed-cell, integral-skinned neoprene gaskets complying with ASTM C 509, Type II, black; of profile and hardness required to maintain watertight seal.
 - 1. Application: Use where soft compression gaskets will be compressed by inserting dense compression gaskets on opposite side of glazing or pressure applied by means of pressure-glazing stops on opposite side of glazing.

- C. Glass Stops: Provide glass stops with integral, neoprene, bulb-type weather-stripping glazing gaskets.

2.06 GLAZING SEALANTS

A. General:

1. Compatibility: Provide glazing sealants that are compatible with one another and with other materials they will contact, including glass products, seals of insulating-glass units, and glazing channel substrates, under conditions of service and application, as demonstrated by sealant manufacturer based on testing and field experience.
2. Suitability: Comply with sealant and glass manufacturers' written instructions for selecting glazing sealants suitable for applications indicated and for conditions existing at time of installation.
3. Sealants used inside the weatherproofing system, shall have a VOC content of not more than 250 g/L.
4. Colors of Exposed Glazing Sealants: As selected by Architect from manufacturer's full range.

B. Glazing Sealant: Neutral-curing silicone glazing sealant complying with ASTM C 920, Type S, Grade NS, Class 100/50, Use NT, G, and A.

1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Dow Corning Corporation; 790.
 - b. GE Advanced Materials - Silicones; SilPruf LM SCS2700.
 - c. May National Associates, Inc.; Bondaflex Sil 290.
 - d. Sika Corporation U.S.; Sikasil WS-290.
 - e. Tremco Incorporated; Spectrem 1.
2. Applications: Wet glazing for other than structural-sealant-glazed curtainwall systems.

C. Glazing Sealant: Neutral-curing silicone glazing sealant complying with ASTM C 920, Type S, Grade NS, Class 25, Use NT, G, and A as related to exposure and joint substrates.

1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Dow Corning Corporation; 799.
2. Joint Sealant Color: As selected by Architect from Manufacturer's full range for exposed glazing sealants.

D. Back-Bedding Mastic Glazing Tapes: Preformed, butyl-based, 100 percent solids elastomeric tape; nonstaining and nonmigrating in contact with nonporous surfaces; with or without spacer rod as recommended in writing by tape and glass manufacturers for application indicated; and complying with ASTM C 1281 and AAMA 800 for products indicated below:

1. AAMA 804.3 tape, where indicated.
2. AAMA 806.3 tape, for glazing applications in which tape is subject to continuous pressure.
3. AAMA 807.3 tape, for glazing applications in which tape is not subject to continuous pressure.

2.07 MISCELLANEOUS GLAZING MATERIALS

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

2.08 ACCESSORIES

- A. Fasteners: Fabricated of same basic metal and alloy as fastened metal and matching it in finished color and texture where fasteners are exposed.
- B. Anchors and Inserts: Provide devices as required for hardware installation. Provide toothed or lead-shield expansion-bolt devices for drilled-in-place anchors. Provide stainless-steel anchors and inserts for applications on inside face of exterior walls and where indicated.

2.09 FABRICATION OF GLAZING UNITS

- A. Fabricate glazing units in sizes required to fit openings indicated for Project, with edge and face clearances, edge and surface conditions, and bite complying with written instructions of product manufacturer and referenced glazing publications, to comply with system performance requirements.
- B. Grind smooth and polish exposed glass edges and corners.

2.10 INSULATING-GLASS (IGU) TYPES

- A. Basis-of-Design Products: Subject to compliance with requirements, provide specific products listed by manufacturer's product or products by one of the following manufacturers:
 - 1. Guardian Industries.
 - 2. Vitro Americas, Inc.
 - 3. Viracon, Inc.
- B. Glass Types: Low-e-coated, clear insulating glass: As shown on Drawings.
 - 1. Basis-of-Design Products: Subject to compliance with requirements, provide "Solarban 70XL" as fabricated by Vitro Americas, Inc. or comparable approved product.
 - 2. Overall Unit Thickness: 1 inch.
 - 3. Outboard Lite: 1/4 inch (clear) float, Kind HS (heat-strengthened) safety glazing.
 - 4. Low-E Coating: No. 2 surface.

5. Interspace Content: Air.
6. Tint Color: Bronze.
7. Indoor Lite: 1/4 inch, Class 1 (clear) float, Kind HS (heat-strengthened) safety glazing.
8. Performance Requirements:
 - a. Visible Light Transmittance: 38 percent minimum/60 percent maximum.
 - b. Solar Heat Gain Coefficient: 0.26 maximum.
 - c. U-Value: 0.29 maximum.
9. Label as glazing complying with certification label of IGCC.

PART 3 - EXECUTION

3.01 EXAMINATION

- A. Examine framing, glazing channels, and stops, with Installer present, for compliance with the following:
 1. Manufacturing and installation tolerances, including those for size, squareness, and offsets at corners.
 2. Presence and functioning of weep systems.
 3. Minimum required face and edge clearances.
 4. Effective sealing between joints of glass-framing members.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 PREPARATION

- A. Clean glazing channels and other framing members receiving glass immediately before glazing. Remove coatings not firmly bonded to substrates.
- B. Examine glazing units to locate exterior and interior surfaces. Label or mark units as needed so that exterior and interior surfaces are readily identifiable. Do not use materials that will leave visible marks in the completed work.

3.03 GLAZING, GENERAL

- A. Comply with combined written instructions of manufacturers of glass, sealants, gaskets, and other glazing materials, unless more stringent requirements are indicated, including those in referenced glazing publications.
- B. Adjust glazing channel dimensions as required by Project conditions during installation to provide necessary bite on glass, minimum edge and face clearances, and adequate sealant thicknesses, with reasonable tolerances.
- C. Protect glass edges from damage during handling and installation. Remove damaged glass from Project site and legally dispose of off Project site. Damaged glass is glass with edge damage or other imperfections that, when installed, could weaken glass and impair performance and appearance.

- D. Apply primers to joint surfaces where required for adhesion of sealants, as determined by preconstruction testing.
 - E. Install setting blocks in sill rabbets, sized and located to comply with referenced glazing publications, unless otherwise required by glass manufacturer. Set blocks in thin course of compatible sealant suitable for heel bead.
 - F. Do not exceed edge pressures stipulated by glass manufacturers for installing glass lites.
 - G. Provide spacers for glass lites where length plus width is larger than 50 inches.
 - 1. Locate spacers directly opposite each other on both inside and outside faces of glass. Install correct size and spacing to preserve required face clearances, unless gaskets and glazing tapes are used that have demonstrated ability to maintain required face clearances and to comply with system performance requirements.
 - 2. Provide 1/8-inch minimum bite of spacers on glass and use thickness equal to sealant width. With glazing tape, use thickness slightly less than final compressed thickness of tape. Keep tape at 1/8 inch to 3/16 inch below the sight line. A bead of clear silicone sealant shall be applied to the outer face.
 - H. Provide edge blocking where indicated or needed to prevent glass lites from moving sideways in glazing channel, as recommended in writing by glass manufacturer and according to requirements in referenced glazing publications.
 - I. Set glass lites in each series with uniform pattern, draw, bow, and similar characteristics.
 - J. Set glass lites with proper orientation so that coatings face exterior or interior as specified.
 - K. Where wedge-shaped gaskets are driven into one side of channel to pressurize sealant or gasket on opposite side, provide adequate anchorage so gasket cannot walk out when installation is subjected to movement.
 - L. Square cut wedge-shaped gaskets at corners and install gaskets in a manner recommended by gasket manufacturer to prevent corners from pulling away; seal corner joints and butt joints with sealant recommended by gasket manufacturer.
- 3.04 GASKET GLAZING (DRY)
- A. Cut compression gaskets to lengths recommended by gasket manufacturer to fit openings exactly, with allowance for stretch during installation.
 - B. Insert soft compression gasket between glass and frame or fixed stop so it is securely in place with joints miter cut and bonded together at corners.
 - C. Installation with Drive-in Wedge Gaskets: Center glass lites in openings on setting blocks and press firmly against soft compression gasket by inserting dense compression gaskets formed and installed to lock in place against faces of removable stops. Start gasket applications at corners and work toward centers of openings. Compress gaskets to produce a weathertight

seal without developing bending stresses in glass. Seal gasket joints with sealant recommended by gasket manufacturer.

- D. Install gaskets so they protrude past face of glazing stops.

3.05 SEALANT GLAZING (WET)

- A. Install continuous spacers, or spacers combined with cylindrical sealant backing, between glass lites and glazing stops to maintain glass face clearances and to prevent sealant from extruding into glass channel and blocking weep systems until sealants cure. Secure spacers or spacers and backings in place and in position to control depth of installed sealant relative to edge clearance for optimum sealant performance.
- B. Where sealant of butt-glazed joints are indicated on the Drawings, force sealants between glass-to-glass joints to eliminate voids and to ensure complete wetting or bond of sealant to glass and channel surfaces.
- C. Tool exposed surfaces of sealants smooth.

3.06 CLEANING AND PROTECTION

- A. Protect exterior glass from damage immediately after installation by attaching crossed streamers to framing held away from glass. Do not apply markers to glass surface. Remove nonpermanent labels and clean surfaces.
- B. Protect glass from contact with contaminating substances resulting from construction operations. If, despite such protection, contaminating substances do come into contact with glass, remove substances immediately as recommended in writing by glass manufacturer.
- C. Examine glass surfaces adjacent to or below exterior concrete and other masonry surfaces at frequent intervals during construction, but not less than once a month, for buildup of dirt, scum, alkaline deposits, or stains; remove as recommended in writing by glass manufacturer.
- D. Remove and replace glass that is broken, chipped, cracked, or abraded or that is damaged from natural causes, accidents, and vandalism, during construction period.
- E. Wash glass on both exposed surfaces in each area of Project not more than four days before date scheduled for inspections that establish date of Substantial Completion. Wash glass as recommended in writing by glass manufacturer.

END OF SECTION 08 8000

SECTION 09 2216 – NON-STRUCTURAL METAL FRAMING

PART 1 - GENERAL

1.01 SUMMARY

- A. Section Includes:
 - 1. Non-load-bearing steel framing systems for interior partitions.
 - 2. Suspension systems for interior ceilings and soffits.
 - 3. Grid suspension systems for gypsum board ceilings.
 - 4. Firestop top and bottom track seals.
 - 5. Stud assemblies at rated walls.

1.02 SUBMITTALS

- A. Product Data: Submit manufacturer's data for each type of product indicated.
 - 1. Include fire-stop top and bottom track seal manufacturer's printed installation instructions.
- B. Testing Data: Submit manufacturer's independent laboratory test data certifying compliance with specified performance requirements.
- C. Certification - Studs and Runners: Provide documentation that framing members' certification is according to SIFA's "Code Compliance Certification Program for Cold-Formed Steel Structural and Non-Structural Framing Members."
- D. Evaluation Reports: For [embossed steel studs and runners firestop tracks, from ICC-ES or other qualified testing agency acceptable to authorities having jurisdiction.

1.03 QUALITY ASSURANCE

- A. Fire-Test-Response Characteristics: Provide materials and construction identical to those tested in assembly indicated according to ASTM E 119 by an independent testing and inspecting agency acceptable to authorities having jurisdiction.
- B. Sound Transmission Characteristics: Provide materials and construction identical to those tested in assembly indicated according to ASTM E 90 and classified according to ASTM E 413 by a qualified independent testing agency.

1.04 DELIVERY, STORAGE, AND HANDLING

- A. Deliver materials in original packages, containers, or bundles bearing brand name and identification of manufacturer or supplier.

- B. Store materials inside under cover and keep them dry and protected against damage from weather, direct sunlight, surface contamination, corrosion, construction traffic, and other causes.

PART 2 - PRODUCTS

2.01 PERFORMANCE REQUIREMENTS

- A. Structural Performance:
 - 1. Provide gypsum board assemblies capable of meeting the deflection limits for maximum heights of partitions without failing. Evidence of failure includes deflections exceeding limits indicated, bending stresses causing studs to distort and gypsum board to crack.
- B. Fire-Test-Response Characteristics: For fire-resistance-rated assemblies that incorporate non-load-bearing steel framing, provide materials and construction identical to those tested in assembly indicated, according to ASTM E119 by an independent testing agency.
- C. STC-Rated Assemblies: For STC-rated assemblies, provide materials and construction identical to those tested in assembly indicated on Drawings, according to ASTM E90 and classified according to ASTM E413 by an independent testing agency.

2.02 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Steel Framing and Furring: Furnish products as manufactured by a manufacturing member of the Steel Stud Manufacturers Association (SSMA) or Steel Framing Industry Association (SFIA), subject to compliance with Specification requirements.

2.03 PARTITION AND FRAMING COMPONENTS

- A. Partition Framing Components:
 - 1. General:
 - a. Comply with ASTM C 754 for conditions indicated.
 - b. Steel Sheet Components: Complying with ASTM C 645 requirements for metal
 - c. Protective coating: ASTM A 653, G60, hot-dip galvanized zinc coating.
 - 2. Steel Studs and Runners: ASTM C 645, depth as indicated on Drawings, gauge as indicated on Structural drawings. At locations not indicated, as recommended by Steel Stud Manufacturer Associations Manual for height and length of spans.
 - 3. Hat-Shaped, Rigid Furring Channels: ASTM C 645, 0.018 inch, 0.0179 inch, 18 mils (20 gauge minimum uncoated thickness, depth as indicated on Drawings.
 - 4. Cold-Rolled Furring Channels: 0.054 inches, 54 mil, (16 gauge) bare steel thickness, with minimum 1/2-inch- wide flange.
- B. Slip-Type Head Joints: Where indicated, provide one of the following:
 - 1. Single Long-Leg Runner System: ASTM C 645 top runner with 2-inch- deep flanges in thickness not less than indicated for studs, installed with studs friction fit into top runner

- and with continuous bridging located within 12 inches of the top of studs to provide lateral bracing.
- a. Acceptable Products: Subject to compliance with requirements, provide one of the following products, or comparable as approved by Architect:
 - 1) BlazeFrame DL Deflection Track; ClarkDietrich Metal Framing.
 2. Deflection Track: Steel sheet top runner manufactured to prevent cracking of finishes applied to interior partition framing resulting from deflection of structure above; in thickness not less than indicated for studs and in width to accommodate depth of studs.
 - a. Acceptable Products: Subject to compliance with requirements, provide one of the following products, or comparable as approved by Architect:
 - 1) SLP-TRK Slotted Deflection Track; ClarkDietrich Metal Framing;
 - 2) VertiClip SLD or VertiTrack VTD Series; Steel Network Inc. (The);
 - 3) Superior Flex Track System (SFT); Superior Metal Trim;
 3. Deep-Leg Deflection Track: ASTM C 645 top runner with 2-inch- deep flanges.
- C. Flat Strap and Backing Plate: Steel sheet for blocking and bracing in length and width indicated.
1. Minimum Base-Metal Thickness: 0.0312 inch.
 2. Coordinate blocking type, locations, size and gauge with corresponding items to be supported.
 3. Acceptable Products: Subject to compliance with requirements, provide one of the following products, or comparable as approved by Architect:
 - a. Backing Plate; ClarkDietrich.
 - b. Flush-Mount; Perfect Wall, Inc.
 - c. 20 gauge galvanized sheet metal.
- D. Cold-Rolled Channel Bridging: Steel, 0.053-inch minimum base-metal thickness, with minimum 1/2-inch- wide flanges.
1. Depth: As indicated on Drawings.
 2. Clip Angle: Not less than 1-1/2 by 1-1/2 inches, 0.068-inch- thick, galvanized steel.
- E. Shaft Wall Studs and Accessories: ASTM C645; galvanized sheet steel, of size and properties necessary to comply with ASTM C754 and specified performance requirements and meet rated assembly listing.
1. Studs: "H" or "T" shaped paired with "C" Studs and "J" track, 20 gauge, 0.032 inch minimum, unless otherwise indicated.
- F. Resilient Furring Channels: 1/2 inch deep, steel sheet members designed to reduce sound transmission.
1. Configuration: Asymmetrical.
- G. Z-Shaped Furring: With slotted or nonslotted web, face flange of 1-1/4 inches, wall attachment flange of 7/8 inch, minimum uncoated-metal thickness of 0.018 inch, and depth required to fit insulation thickness indicated.
- H. Fasteners for Metal Framing: Of type, material, size, corrosion resistance, holding power and other properties required to fasten steel members to substrates. Comply with gypsum board manufacturer's recommendations for applications indicated.

- I. Control Joint Backer: Metal profile which supports intumescent materials located inside and spanning gap between opposing drywall edge at control joint locations.
 1. Acceptable Products: Subject to compliance with requirements, provide one of the following products, or comparable as approved by Architect:
 - a. BlazeFrame Control Joint Backer (CJB); ClarkDieterich.
 2. Minimum Base-Steel Thickness: 0.018 inch.
 3. Width: 3-1/4 inch.

2.04 SUSPENSION SYSTEM COMPONENTS

- A. General:
 1. Comply with ASTM C 754 for conditions indicated.
 2. Steel Sheet Components: Complying with ASTM C 645 requirements for metal and with ASTM A 653, G40, hot-dip galvanized zinc coating.
 - a. Provide G60 minimum hot-dip galvanized zinc coating at areas subject to high moisture or wet areas.
 - b. Provide G90 minimum hot-dip galvanized zinc coating at exterior locations.
- B. Basis of Design (ADWC-1): USG Ensemble Acoustical Drywall Ceiling – Suspended System.
- C. Ceiling and Soffit Support Materials and Systems:
 1. Tie Wire: ASTM A 641, Class 1 zinc coating, soft temper, 0.0625-inch- diameter wire, or double strand of 0.0475-inch- diameter wire.
 2. Hangers:
 - a. Wire Hangers: ASTM A 641, Class 1 zinc coating, soft temper, 0.162-inch diameter.
 - b. Rod Hangers: ASTM A 510, mild carbon steel, galvanized.
 3. Drywall Edge Trim: Provide USG Compasso Elite Edge Trim, or approved manufacturer's comparable product.

2.05 ACCESSORIES

- A. General: Provide auxiliary materials that comply with referenced installation standards and manufacturer's written recommendations.

PART 3 - EXECUTION

3.01 EXAMINATION

- A. Examine areas and substrates, with Installer present, and including welded hollow-metal frames, cast-in anchors, and structural framing, for compliance with requirements and other conditions affecting performance. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 PREPARATION

- A. Suspended Ceilings: Coordinate installation of ceiling suspension systems with installation of overhead structure to ensure that inserts and other provisions for anchorages to building

structure have been installed to receive ceiling hangers at spacing required to support ceilings and that hangers will develop their full strength.

3.03 METAL STUD INSTALLATION - GENERAL

- A. Installation Standards: ASTM C 754, and ASTM C 840 requirements that apply to framing installation.
- B. Install supplementary framing, blocking, and bracing at terminations in gypsum board assemblies to support fixtures, equipment services, and heavy trim, grab bars, toilet accessories, furnishings, or similar construction. Comply with details indicated and with gypsum board manufacturer's written recommendations.
- C. Isolate steel framing from building structure at locations indicated to prevent transfer of loading imposed by structural movement.
 - 1. Isolate ceiling assemblies where they abut or are penetrated by building structure.
 - 2. Isolate partition framing and wall furring where it abuts structure, except at floor. Install slip-type joints at head of assemblies that avoid axial loading of assembly and laterally support assembly.
 - a. Use deflection track where indicated.
- D. Do not bridge building control and expansion joints with steel framing or furring members. Frame both sides of joints independently.

3.04 INSTALLATION - STEEL SUSPENDED CEILING

- A. Suspend ceiling hangers from building structure as follows:
 - 1. Install hangers plumb and free from contact with insulation or other objects within ceiling plenum that are not part of supporting structural or ceiling suspension system. Splay hangers only where required to miss obstructions and offset resulting horizontal forces by bracing, counters playing, or other equally effective means.
 - 2. Where width of ducts and other construction within ceiling plenum produces hanger spacings that interfere with the location of hangers required to support standard suspension system members, install supplemental suspension members and hangers in form of trapezes or equivalent devices. Size supplemental suspension members and hangers to support ceiling loads within performance limits established by referenced standards.
 - 3. Wire Hangers: Secure by looping and wire tying, either directly to structures or to inserts, eye screws, or other devices and fasteners that are secure and appropriate for substrate, and in a manner that will not cause hangers to deteriorate or otherwise fail.
 - 4. Do not attach hangers to steel roof deck.
 - 5. Do not attach hangers to permanent metal forms. Furnish cast-in-place hanger inserts that extend through forms.
 - 6. Do not attach hangers to rolled-in hanger tabs of composite steel floor deck.
 - 7. Do not connect or suspend steel framing from ducts, pipes, or conduit.

- B. Install suspended steel framing components in sizes and spacings indicated, but not less than that required by the referenced steel framing and installation standards.
- C. Grid Suspension System: Attach perimeter wall track or angle where grid suspension system meets vertical surfaces. Mechanically join main beam and cross-furring members to each other and butt-cut to fit into wall track.
 - 1. Where light fixtures occur, provide hanger wires at each corner and intermediates as necessary, anchored to structure to carry weight of light fixture. Frame around openings and install additional cross-reinforcing to restore lateral stability of ceiling framing. Light fixtures shall be independent of ceiling framing.
- D. Fire-Resistance-Rated Assemblies: Wire tie furring channels to supports.
- E. Seismic Bracing: Sway-brace suspension systems with hangers used for support.
- F. Installation Tolerances: Install steel framing components for suspended ceilings so members for panel attachment are level to within 1/8 inch in 12 feet measured lengthwise on each member and transversely between parallel members.

3.05 INSTALLATION – FRAMED ASSEMBLIES

- A. Where studs are installed directly against exterior masonry walls or dissimilar metals at exterior walls, install isolation strip between studs and exterior wall.
- B. Install steel studs so flanges point in the same direction and leading edge or end of each panel can be attached to open (unsupported) edges of stud flanges first.
 - 1. Space studs as follows: As indicated on Drawings.
- C. Install tracks (runners) at floors, ceilings, and structural walls and columns where gypsum board assemblies abut other construction.
- D. Extend partition framing full height to structural supports or substrates above suspended ceilings, except where partitions are indicated to terminate at suspended ceilings. Continue framing over frames for doors and openings and frame around ducts penetrating partitions above ceiling to provide support for gypsum board.
 - 1. Slip-Type Head Joints: Where framing extends to overhead structural supports, install to produce joints at tops of framing systems that prevent axial loading of finished assemblies. Provide nested extended leg ceiling runners, deflection clips or proprietary slip track. Install fire rated proprietary slip track at fire rated partitions in accordance with applicable UL assembly and coordinate installation of additional gypsum board strips to comply with assembly requirements.
 - 2. Cut studs 1/2 inch short of full height to provide perimeter relief. Do not fasten studs to top track to allow independent movement of studs and track.
- E. Fire-Resistance-Rated Partitions: Install framing to comply with fire-resistance-rated assembly indicated and support closures and to make partitions continuous from floor to underside of solid structure.

1. For fire-resistance-rated partitions that extend to the underside of floor/roof slabs and decks or other continuous solid-structure surfaces, install framing around structural and other members extending below floor/roof slabs and decks, as needed to support gypsum board closures and to make partitions continuous from floor to underside of solid structure.
 2. Install shaft wall framing assemblies in accordance with manufacturers installation instructions. Install studs at spacing required to meet performance requirements and applicable fire rated assembly.
- F. Direct Furring:
1. Screw to wood framing.
 2. Attach to concrete or masonry with stub nails, screws designed for masonry attachment, or powder-driven fasteners spaced 24 inches o.c.
- G. Hat-Shaped Furring Channels on Walls:
1. Space 16 inches o.c. vertically or horizontally.
 2. For horizontal application install first channels 4 inches from floor and ceiling lines.
 3. Attach to substrate with suitable fasteners spaces 16 inches o.c. in alternate flanges.
 4. Install asphalt felt isolation strip between furring channel and exterior wall surfaces.
- H. Z-Furring Members:
1. Erect insulation vertically and hold in place with Z-furring member's spaced 24 inches o.c. unless otherwise indicated on Drawings.
 2. Except at exterior corners, securely attach narrow flanges of furring members to wall with concrete stub nails, screws designed for masonry attachment, or powder-driven fasteners spaced 24 inches o.c.
 3. At exterior corners, attach wide flange of furring members to wall with short flange extending beyond corner; on adjacent wall surface, screw-attach short flange of furring channel to web of attached channel. At interior corners, space second member no more than 12 inches from corner and cut insulation to fit.
- I. Door Openings: Frame door openings to comply with GA-600 and with gypsum board manufacturer's applicable written recommendations, unless otherwise indicated. Screw vertical studs at jambs to jamb anchor clips on door frames; install runner track section (for cripple studs) at head and secure to jamb studs.
1. Install two studs at each jamb, unless otherwise indicated.
 2. If control joint is utilized at door opening, install cripple studs at head adjacent to each jamb stud, with a minimum 1/2-inch clearance from jamb stud to allow for installation of control joint.
 3. Extend jamb studs through suspended ceilings and attach to underside of overhead structure.
- J. Installation Tolerance: Install each steel framing and furring member so fastening surfaces vary not more than 1/8 inch from the plane formed by the faces of adjacent framing.

3.06 FIELD QUALITY CONTROL

- A. Testing: At Owner's request, Contractor shall provide spot testing of actual properties of steel framing to verify compliance with specifications.

END OF SECTION 09 2216

SECTION 09 29 00 - GYPSUM BOARD

PART 1 - GENERAL

1.01 SUMMARY

- A. Section Includes:
 - 1. Gypsum board panels for ceilings and walls.
 - 2. Tile Backer Board.
 - 3. Resilient Isolation Clips.
 - 4. Texture Finishes.

1.02 SUBMITTALS

- A. Product Data: For each type of product.
- B. Samples: For the following products:
 - 1. Trim Accessories: Full-size Sample in 12-inch- long length for each trim accessory indicated.
 - 2. Textured Finishes: Manufacturer's standard size for each textured finish indicated and on same backing indicated for Work.

1.03 QUALITY ASSURANCE

- A. Mockups: Build mockups of at least 100 sq. ft. in surface area to demonstrate aesthetic effects and to set quality standards for materials and execution.
 - 1. Build mockups for the following:
 - a. Each level of gypsum board finish indicated for use in exposed locations.
 - b. Each texture finish indicated.
 - 2. Apply or install final decoration indicated, including painting and wallcoverings, on exposed surfaces for review of mockups.
 - 3. Simulate finished lighting conditions for review of mockups.
 - 4. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.04 DELIVERY, STORAGE AND HANDLING

- A. Store materials inside under cover and keep them dry and protected against weather, condensation, direct sunlight, construction traffic, and other potential causes of damage. Stack panels flat and supported on risers on a flat platform to prevent sagging.

1.05 FIELD CONDITIONS

- A. Environmental Limitations: Comply with ASTM C 840 requirements or gypsum board manufacturer's written recommendations, whichever are more stringent.

- B. Do not install paper-faced gypsum panels until installation areas are enclosed and conditioned.
- C. Do not install panels that are wet, those that are moisture damaged, and those that are mold damaged.
 - 1. Indications that panels are wet or moisture damaged include, but are not limited to, discoloration, sagging, or irregular shape.
 - 2. Indications that panels are mold damaged include, but are not limited to, fuzzy or splotchy surface contamination and discoloration.

PART 2 - PRODUCTS

2.01 PERFORMANCE REQUIREMENTS

- A. Fire-Resistance-Rated Assemblies: For fire-resistance-rated assemblies, provide materials and construction identical to those tested in assembly indicated according to ASTM E 119 by an independent testing agency.
- B. STC-Rated Assemblies: For STC-rated assemblies, provide materials and construction identical to those tested in assembly indicated according to ASTM E 90 and classified according to ASTM E 413 by an independent testing agency.

2.02 GYPSUM BOARD, GENERAL

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

2.03 INTERIOR GYPSUM BOARD

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. CertainTeed Corp.
 - 2. Georgia-Pacific Gypsum LLC.
 - 3. National Gypsum Company.
 - 4. Temple-Inland.
 - 5. USG Corporation.
- B. Gypsum Board, Type X: ASTM C 1396.
 - 1. Thickness: 5/8 inch.
 - 2. Long Edges: Tapered.
- C. Gypsum Ceiling Board: ASTM C 1396.
 - 1. Thickness: 5/8 inch.
 - 2. Long Edges: Tapered.
- D. Moisture and Mold-Resistant Gypsum Board: Abuse-resistant, with moisture and mold resistant core and paper surfaces.
 - 1. Core: 5/8 inch, Type X.

2. Long Edges: Tapered.

- E. Shaftwall and Coreboard: Type X; 1 inch thick by 24 inches wide, beveled long edges, ends square cut.
1. Paper Faced Type: Gypsum shaftliner board or gypsum coreboard as defined ASTM C1396; water-resistant faces.
 2. Mold Resistance: Score of 10, when tested in accordance with ASTM D3273.
 3. Products:
 - a. American Gypsum Company; M-Bloc Shaft Liner.
 - b. Georgia-Pacific Gypsum; ToughRock Shaftliner.
 - c. Certaineed Corporation; ProRoc Brand Shaftliner.
 - d. USG Corporation; Sheetrock Gypsum Liner Panels.
 - e. Substitutions: See Section 01 6000 – Product Requirements.
- F. Glass-Mat Shaft Liner Panel: Type X; 1 inch by 24 inches.
1. Proprietary: GlasRoc Shaftliner Panel by Certaineed

2.04 TILE BACKING PANELS

- A. Glass Mat faced Board: Coated glass mat water-resistant gypsum backing panel as defined in ASTM C1178.
1. Application: Surfaces behind tile in restrooms.
 2. Fire Resistant Type: Type X core, thickness 5/8 inch.
 3. Products:
 - a. Georgia-Pacific Gypsum; DensShield Tile Backer.
 - b. National Gypsum Company; Gold Bond eXP Tile Backer.
 - c. Certaineed Corporation; GlasRoc Tile Backer.
 - d. Substitutions: See Section 01 6000 – Product Requirements.
 4. Thickness (Walls): 5/8-inch.
 5. Mold Resistance: ASTM D 3273, score of 10.

2.05 TRIM ACCESSORIES

- A. Interior Trim: ASTM C 1047.
1. Material: Galvanized or aluminum-coated steel sheet or rolled zinc.
 2. Shapes:
 - a. Cornerbead: Bullnose use at outside corners.
 - b. Bullnose bead.
 - c. LC-Bead: J-shaped; exposed long flange receives joint compound.
 - d. U-Bead: J-shaped; exposed short flange does not receive joint compound.
 - e. Expansion (control) joint: One piece formed with V shaped slot, with removable strip covering slot opening, use where indicated.
 - f. Curved-Edge Cornerbead: With notched or flexible flanges.
 3. Tear Away L Bead:
 - a. Basis of Design Product: Subject to the requirements provide Trim-Tex Tear Away L Bead or a comparable product of an approved manufacturer.
 - b. Application: Gypsum board walls to ceilings requiring independent movement.

- B. Aluminum Trim: Extruded accessories of profiles and dimensions indicated; ASTM B 221, Alloy 6063-T5.
 - 1. Basis of Specification Manufacturer: Provide the following products as manufactured by the listed manufacturer, as identified by their model number and description. Trim of the following manufacturers matching the style, size, and construction of the specified product, as determined by the Architect, is acceptable:
 - a. Fry Reglet Corp.
 - b. Gordon, Inc.
 - c. Pittcon Industries.
 - 2. U-shaped expansion (control) non-vented reveal joint where indicated:
 - a. Product: Fry Reglet, Series "DRM." Refer to drawings for size.
 - 3. F-shaped perimeter control non-vented reveal joint where indicated:
 - a. Product: Fry Reglet, Series "DRMF." Refer to drawings for size.
 - 4. X-shaped corner trim where indicated:
 - a. Product: Fry Reglet, Series "XDM." Refer to drawings for size.
 - 5. Z-shaped reveal where indicated:
 - a. Product: Fry Reglet, Series "DRMZ-625-375." Refer to drawings for size.
 - 6. Provide partition L-shaped trim at both outside corners of vertical edges of walls that terminate at exterior window framing system:
 - a. Product: Fry Reglet, Series "DRML." Provide two such at each wall termination, using trim depths that extend across face of end of wall from each corner, leaving no more than 1-inch gap centered behind the window frame.
 - 7. Finish: Clear anodized aluminum, unless otherwise indicated above.

2.06 JOINT TREATMENT MATERIALS

- A. General: Comply with ASTM C 475/C 475M.
- B. Joint Tape:
 - 1. Interior Gypsum Board: Paper.
 - 2. Cementitious Ceiling Board: As recommended by panel manufacturer.
- C. Joint Compound for Interior Gypsum Wallboard: For each coat use formulation that is compatible with other compounds applied on previous or for successive coats.
 - 1. Prefilling: At open joints, rounded or beveled panel edges, and damaged surface areas, use setting-type taping compound.
 - 2. Embedding and First Coat: For embedding tape and first coat on joints, fasteners, and trim flanges, use drying-type, all-purpose compound.
 - 3. Fill Coat: For second coat, use drying-type, all-purpose compound.
 - 4. Finish Coat: For third coat, use drying-type, all-purpose compound.

2.07 AUXILIARY MATERIALS

- A. General: Provide auxiliary materials that comply with referenced installation standards and manufacturer's written recommendations.
- B. Steel Drill Screws: ASTM C 1002, unless otherwise indicated.

1. Use screws complying with ASTM C 954 for fastening panels to steel members from 0.033 to 0.112 inch thick.
 2. For fastening cementitious backer units, use screws of type and size recommended by panel manufacturer.
- C. Sound Attenuation Blankets: As specified in Section 09 81 00 – Acoustical Insulation.
1. Fire-Resistance-Rated Assemblies: Comply with mineral-fiber requirements of assembly.
- D. Acoustical Joint Sealant: As specified in Section 07 9200 – Joint Sealants.

PART 3 - EXECUTION

3.01 EXAMINATION

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

3.02 APPLYING AND FINISHING PANELS, GENERAL

- A. Comply with ASTM C 840.
- B. Install ceiling panels across framing to minimize the number of abutting end joints and to avoid abutting end joints in central area of each ceiling. Stagger abutting end joints of adjacent panels not less than one framing member.
- C. Install panels with face side out. Butt panels together for a light contact at edges and ends with not more than 1/16 inch of open space between panels. Do not force into place.
- D. Locate edge and end joints over supports, except in ceiling applications where intermediate supports or gypsum board back-blocking is provided behind end joints. Do not place tapered edges against cut edges or ends. Stagger vertical joints on opposite sides of partitions. Do not make joints other than control joints at corners of framed openings.
- E. Form control and expansion joints with space between edges of adjoining gypsum panels.
- F. Cover both faces of support framing with gypsum panels in concealed spaces (above ceilings, etc.), except in chases braced internally.
 1. Unless concealed application is indicated or required for sound, fire, air, or smoke ratings, coverage may be accomplished with scraps of not less than 8 sq. ft. in area.
 2. Fit gypsum panels around ducts, pipes, and conduits.

3. Where partitions intersect structural members projecting below underside of floor/roof slabs and decks, cut gypsum panels to fit profile formed by structural members; allow 1/4- to 3/8-inch- wide joints to install sealant.
- G. Isolate perimeter of gypsum board applied to non-load-bearing partitions at structural abutments, except floors. Provide 1/4- to 1/2-inch- wide spaces at these locations and trim edges with edge trim where edges of panels are exposed. Seal joints between edges and abutting structural surfaces with acoustical sealant.
- H. Attachment to Steel Framing: Attach panels so leading edge or end of each panel is attached to open (unsupported) edges of stud flanges first.
- I. STC-Rated Assemblies: Seal construction at perimeters, behind control joints, and at openings and penetrations with a continuous bead of acoustical sealant. Install acoustical sealant at both faces of partitions at perimeters and through penetrations. Comply with ASTM C 919 and with manufacturer's written recommendations for locating edge trim and closing off sound-flanking paths around or through assemblies, including sealing partitions above acoustical ceilings.
- J. Install sound attenuation blankets before installing gypsum panels unless blankets are readily installed after panels have been installed on one side.

3.03 APPLYING INTERIOR GYPSUM BOARD

- A. Install interior gypsum board in the following locations:
 1. Type X: Vertical surfaces unless otherwise indicated.
 2. Ceiling Type: Ceiling surfaces.
 3. Abuse-Resistant Type: At all corridors, stairways, and where otherwise indicated.
 4. Mold-Resistant (Abuse-Resistant) Type: All toilet room surfaces not covered by tile and tile backing panels to receive paint or other finishes, janitor closets, and all similar areas subject to wetting, steam, or high humidity, and as indicated on Drawings.
- B. Single-Layer Application:
 1. On ceilings, apply gypsum panels before wall/partition board application to greatest extent possible and at right angles to framing unless otherwise indicated.
 2. On partitions/walls, apply gypsum panels vertically (parallel to framing) except horizontally (perpendicular to framing) where required for abuse resistant wainscot application unless otherwise indicated or required by fire-resistance-rated assembly, and minimize end joints.
 - a. Stagger abutting end joints not less than one framing member in alternate courses of panels.
 - b. At stairwells and other high walls, install panels horizontally unless otherwise indicated or required by fire-resistance-rated assembly.
 3. Fastening Methods: Apply gypsum panels to supports with steel drill screws.
 4. Shaft Wall Liner: Cut panels to accurate dimensions and install sequentially between special friction studs.
 - a. Seal perimeter of shaft wall and penetrations with fire rated sealant.

C. Multilayer Application:

1. On ceilings, apply gypsum board indicated for base layers before applying base layers on walls/partitions; apply face layers in same sequence. Apply base layers at right angles to framing members and offset face-layer joints one framing member, 16 inches minimum, from parallel base-layer joints, unless otherwise indicated or required by fire-resistance-rated assembly.
2. On partitions/walls, apply gypsum board indicated for base layers and face layers vertically (parallel to framing) with joints of base layers located over stud or furring member and face-layer joints offset at least one stud or furring member with base-layer joints, unless otherwise indicated or required by fire-resistance-rated assembly. Stagger joints on opposite sides of partitions.
3. Fastening Methods: Fasten base layers and face layers separately to supports with screws.
 - a. Comply with fasteners size and spacing requirements of listed rated assemblies.

3.04 INSTALLING TRIM ACCESSORIES

- A. General: For trim with back flanges intended for fasteners, attach to framing with same fasteners used for panels. Otherwise, attach trim according to manufacturer's written instructions.
- B. Control Joints: Install control joints according to ASTM C 840 and as indicated on the Drawings. If not indicated, do not exceed the following spacing limitations:
 1. Walls: Not greater than 30 feet on center.
 2. Ceilings (Restrained at Edges): Not greater than 30 feet in either direction, and not greater than 900 square feet in total area.
 3. Ceilings (Unrestrained at Edges): Not greater than 50 feet in either direction, and not greater than 2,500 square feet in total area.
 4. Review locations of all control joints not indicated on the Drawings with the Architect prior to installation.
- C. Interior Trim: Install in the following locations:
 1. Cornerbead: Use at outside corners unless otherwise indicated.
 2. LC-Bead: Use at exposed panel edges.
 3. U-Bead: Use where indicated.
 4. Curved-Edge Cornerbead: Use at curved openings.

3.05 FINISHING GYPSUM BOARD

- A. General: Treat gypsum board joints, interior angles, edge trim, control joints, penetrations, fastener heads, surface defects, and elsewhere as required to prepare gypsum board surfaces for decoration. Promptly remove residual joint compound from adjacent surfaces.
- B. Prefill open joints and damaged surface areas.
- C. Apply joint tape over gypsum board joints, except for trim products specifically indicated as not intended to receive tape.

- D. Gypsum Board Finish Levels: Finish panels to levels indicated below and according to ASTM C 840:
1. Level 1: As indicated.
 2. Level 2: At concealed spaces such as shafts or spaces above the ceiling areas and areas where gypsum board is used as a substrate for tile. Provide GA Level 2 finish.
 3. Level 3: At unoccupied spaces, such as storage and mechanical rooms. Provide medium texture finish over GA Level 3 finish.
 4. Level 4: At occupied spaces that will be exposed to public view, unless other finish level is specifically indicated. Provide a lightly textured finish over GA Level 4 finish.
 5. Level 5: Where indicated on Drawings, including surfaces designated to receive special wall graphics. Provide smooth finish over GA level 5 finish.
- E. Tile Backer Units: Finish according to manufacturer's written instructions.

3.06 PROTECTION

- A. Protect installed products from damage from weather, condensation, direct sunlight, construction, and other causes during remainder of the construction period.
- B. Remove and replace panels that are wet, moisture damaged, and mold damaged.
1. Indications that panels are wet or moisture damaged include, but are not limited to, discoloration, sagging, or irregular shape.
 2. Indications that panels are mold damaged include, but are not limited to, fuzzy or splotchy surface contamination and discoloration.

END OF SECTION 09 2900

SECTION 09 3000 - TILING

PART 1 - GENERAL

1.01 SUMMARY

- A. Section Includes:
 - 1. Ceramic Tile.
 - 2. Porcelain Tile.
 - 3. Metal edge strips.

1.02 DEFINITIONS

- A. General: Definitions in the ANSI A108 series of tile installation standards and in ANSI A137.1 apply to Work of this Section unless otherwise specified.
- B. ANSI A108 Series: ANSI A108.01, ANSI A108.02, ANSI A108.1A, ANSI A108.1B, ANSI A108.1C, ANSI A108.4, ANSI A108.5, ANSI A108.6, ANSI A108.8, ANSI A108.9, ANSI A108.10, ANSI A108.11, ANSI A108.12, ANSI A108.13, ANSI A108.14, ANSI A108.15, ANSI A108.16, and ANSI A108.17, which are contained in its "Specifications for Installation of Ceramic Tile."
- C. Module Size: Actual tile size plus joint width indicated.
- D. Face Size: Actual tile size, excluding spacer lugs.

1.03 SUBMITTALS

- A. Product Data: For each type of product.
- B. Shop Drawings: Show locations of each type of tile and tile pattern. Show widths, details, and locations of expansion, contraction, control, and isolation joints in tile substrates and finished tile surfaces.
 - 1. Shop Drawings shall include the following:
 - a. Floor plans and other plan drawings at not less than 1/8"=1'-0".
 - b. Elevations and sections at no less than 1/4"=1'-0".
 - c. Details drawings at no less than 1-1/2"=1'-0".
 - 2. Verify field dimensions and document field conditions including cracks in substrate.
- C. Samples for Initial Selection: For tile, grout, and accessories involving color selection.
- D. Samples for Verification:
 - 1. Full-size units of each type and composition of tile and for each color and finish required.
 - 2. Assembled samples mounted on a rigid panel, with grouted joints, for each type and composition of tile and for each color and finish required. Make samples at least 12

inches square, but not fewer than four tiles. Use grout of type and in color or colors approved for completed Work.

- E. Qualification Data: For Installer. Include lists of completed projects with project names and addresses, names of architects and owners, and other information specified.
- F. Master Grade Certificates: For each shipment, type, and composition of tile, signed by tile manufacturer and Installer.
- G. Product Certificates: For each type of product.
- H. Product Test Reports: For tile-setting and -grouting products.
- I. Field Test Reports: Submit test data and reports evidencing compliance with requirements for subfloor moisture conditions, subfloor alkalinity conditions and adhesion and dryness characteristics.
- J. Installer's Certification: Submit certificate signed by Installer that certifies the following.
 - 1. Mixing: Setting and grouting products have been mixed and installed in accordance with manufacturer's instructions, reference standards, and specified requirements.
 - 2. Additives: Setting and grouting material additives have been added to the setting and grouting materials in accordance with manufacturer's instructions, and in manufacturer's recommended quantities and ratios for type of installation material specified.
- K. Acceptance of Substrate: Provide letter of substrate acceptance, signed by Contractor, material manufacturer, and installer as required in Part 3 - Execution.
- L. Tile Test Reports: Indicate and interpret test results for compliance of special-purpose tile with specified requirements.
- M. Setting Material Test Reports: Material test reports from independent testing laboratory indicating test results for compliance of tile-setting and -grouting products with specified requirements.
- N. Pre-Installation Job Meeting Report: Submit pre-installation job meeting report. Refer to Division 01, Project Meetings, for requirements. Include copy of manufacturer's inspection report, manufacturer's recommendations, and any statement of non-compliance as applicable.
- O. Maintenance Manual: Submit tile and grout manufacturers' instructions for daily and periodic maintenance of the Tile Work. Include cleaning and stain removal processes; recommended surface treatment or sealer, and related application and maintenance instructions.
- P. Furnish extra materials that match and are from same production runs as products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 - 1. Tile and Trim Units: Furnish quantity of full-size units equal to 3 percent of amount installed for each type, composition, color, pattern, and size indicated.

2. Grout: Furnish quantity of grout equal to 3 percent of amount installed for each type, composition, and color indicated.

1.04 QUALITY ASSURANCE

- A. Installers' Qualifications: Firm with at least 10 years of successful installation experience on projects with work in material, design and extent similar to that required for this project with a record of successful in-service performance.
 1. Installer is a Trowel of Excellence member of the Tile Contractors' Association of America.
 2. Installer's supervisor for Project holds the International Masonry Institute's Foreman Certification.
 3. Installer employs Ceramic Tile Education Foundation Certified Installers or installers recognized by the U.S. Department of Labor as Journeyman Tile Layers.
- B. Subfloor Moisture Conditions: Do not install tile over concrete slabs until slabs have cured and are sufficiently dry.
- C. Subfloor Alkalinity Conditions: A pH reading acceptable to materials manufacturers of setting materials, including but not limited to, grout, crack suppression membrane and/or waterproofing membrane, but in case not higher than pH9, when tested in accordance with ASTM F710.
- D. Mockups: Provide as specified in Section 01 4000 – Quality Requirements.
- E. Verification of Extent of Installation Systems: After pouring of new slab, the Setting Material Manufacturer's authorized Representative shall examine the tile flooring substrate. Setting Materials Manufacturer's Representative shall meet with the Contractor, Architect and Owner's Representative to verify installation systems as specified in Part 2.

1.05 PREINSTALLATION CONFERENCE

- A. Conduct conference at Project Site.
 1. Review requirements in ANSI A108.01 for substrates and for preparation by other trades.
 2. Prior to installation of work, conduct conference with Contractor's Project Manager, Superintendent and Foreman, Primary Materials Installer, Installer of each component of associated work, Representative(s) of Materials Fabricator and Proprietary Product Manufacturer(s), Installer of other work requiring coordination for the purpose of reviewing job conditions, project requirements and procedures to be followed in performing work.
 3. Examination: At pre-installation job meeting, examine areas and conditions under which work is to be performed. Report in writing of conditions detrimental to proper and timely completion of work. Do not proceed with work until unsatisfactory conditions have been corrected. Commencement of work signifies acceptance by the tile installer of substrate conditions and installation conditions.

4. Fabricator's Inspection: At pre-installation job meeting, Manufacturers and Fabricator's authorized Representative shall inspect storage of job site materials, establish scheduling of initial and final installation of products, and method of preparing written progress reports to Contractor (with copy to Architect and Owner's Representative) of job conditions installation.
5. Recommendations: At pre-installation job meeting, review Manufacturer's product data publication and other published instructions for material installation compliance.
 - a. Where Manufacturer's Representative offers recommendations (either oral or written) on material use, such recommendations shall be in writing and substantiated by dated, printed, published product data or material use statement which is complete, definite, and clear, and signed by authorized company official. Manufacturer's proposed warranties for all setting and grouting materials must be approved by Architect before proceeding with work.
6. Statement of Non-Compliance:
 - a. Prepare and submit a written statement indicating nature of non-compliance, including Contractor's plan to address and/or remediate non-conforming conditions. Proceeding under this condition of non-compliance does not relieve Contractor's responsibility for compliance of requirements specified herein or as may be indicated on the Drawings.

1.06 DELIVERY, STORAGE, AND HANDLING

- A. Deliver and store packaged materials in original containers with seals unbroken and labels intact until time of use. Comply with requirements in ANSI A137.1 for labeling tile packages.
- B. Store tile and cementitious materials on elevated platforms, under cover, and in a dry location.
- C. Store aggregates where grading and other required characteristics can be maintained and contamination can be avoided.
- D. Store liquid materials in unopened containers and protected from freezing.

1.07 FIELD CONDITIONS

- A. Environmental Limitations: Do not install tile until construction in spaces is complete and ambient temperature and humidity conditions are maintained at the levels indicated in referenced standards and manufacturer's written instructions.
 1. Provide lighting conditions during installation which will be of the same intensity as the building completed lighting system.

1.08 WARRANTY

- A. General Warranty: Special warranty specified in this Article shall not deprive Owner of other rights Owner may have under provisions of the Contract Documents and shall be in addition to, and non-concurrent with, other warranties under requirements of the Contract Documents.

- B. Special Warranty: Setting materials manufacturer to provide to the Owner a Special Warranty for this project as described below:
1. Where setting and grouting materials are bonded directly to slab:
 - a. Warranty will cover all materials including tile, mortar, grouts and labor for demolition and labor for reinstallation of floor system.
 2. Where setting and grouting materials are installed over crack suppression membrane:
 - a. Warranty will cover setting and grouting material's ability to adhere to and be compatible with crack suppression membrane.
 3. Where crack suppression membrane is used, manufacturer's supplemental warranty will cover all materials (including tile, mortar, and grouts).
 4. Duration of Warranty: The manufacturers of setting and grouting materials to provide to the Owner a (5) year warranty on all materials and labor as described above. The manufacturer of the crack suppression membrane to provide to the Owner a (5) year warranty on all materials as described above.
 5. Included in the warranty procedure, provide the following:
 - a. Periodic site visits by the manufacturer's technical representative during each phase of the tile installation process to observe, take photographs and produce written progress reports to the tile Subcontractor, Contractor, Owner and Architect. Quantity of site visits to be determined by manufacturer at their discretion to ensure work is being installed in compliance with manufacturer's instructions.
 - b. Manufacturer's technical representative to notify Architect in writing if work is not being installed in compliance with manufacturer's instructions, or concerning job site conditions and practices that are in violation of accepted stone industry standards.
 - c. Continuing consultation to stone installation subcontractor, general contractor, and Architect as required.
 - d. Final Inspection: Manufacturer's technical representative shall make a final inspection of the work and shall submit a written report of any work not in compliance with the manufacturer's installation requirements. The final inspection report shall be certified by the manufacturer, indicating that the warranty is in effect

PART 2 - PRODUCTS

2.01 PERFORMANCE REQUIREMENTS

- A. ANSI Ceramic Tile Standard: Provide tile that complies with ANSI A137.1 for types, compositions, and other characteristics indicated.
1. Provide tile complying with Standard grade requirements unless otherwise indicated.
- B. ANSI Standards for Tile Installation Materials: Provide materials complying with ANSI A108.02, ANSI standards referenced in other Part 2 articles, ANSI standards referenced by TCNA installation methods specified in tile installation schedules, and other requirements specified.

- C. Wet Dynamic Coefficient of Friction (DCOF): For tile installed on walkway surfaces, provide products with the following values as determined by testing identical products per ASTM A137.1, Section 9.6.1:
 - 1. For materials installed on walkway surfaces, provide products with the following values as determined by testing identical products per ANSI B101.3:
 - a. Level Surface: Minimum, wet DCOF of 0.42.
 - b. Ramp Surfaces: Minimum, wet DCOF of 0.45.
- D. Break Strength: ASTM C 648. 250 lbs. minimum.
- E. Bond Strength: ASTM C 482. 50 psi minimum.
- F. Scratch Resistance (Moh's Hardness):
 - 1. For Porcelain (dry pressed): 0.5% maximum.
- G. Load-Bearing Performance: For ceramic tile installed on walkway surfaces, provide installations rated for the following load-bearing performance level based on testing assemblies according to ASTM C 627 that are representative of those indicated for this Project:
 - 1. Extra Heavy: Passes cycles 1 through 14.
 - 2. Heavy: Passes cycles 1 through 12.

2.02 TILING, GENERAL

- A. Factory Blending: For tile exhibiting color variations within ranges, blend tile in factory and package so tile units taken from one package show same range in colors as those taken from other packages and match approved Samples.
- B. Mounting: For factory-mounted tile, provide back- or edge-mounted tile assemblies as standard with manufacturer unless otherwise indicated.
 - 1. Where tile is indicated for installation in wet areas, do not use back- or edge-mounted tile assemblies unless tile manufacturer specifies in writing that this type of mounting is suitable for installation indicated and has a record of successful in-service performance.
- C. Factory-Applied Temporary Protective Coating: Where indicated under tile type, protect exposed surfaces of tile against adherence of mortar and grout by precoating with continuous film of petroleum paraffin wax, applied hot. Do not coat unexposed tile surfaces.
- D. Jobsite Blending: Provide additional blending at jobsite to ensure matching of color, pattern, and texture. Verify that tile is within approved range and matches approved samples prior to installing.
- E. Tile Size Tolerance: Factory rectify all tiles and trim pieces. When tile products are the same nominal size, variances in actual size to be no more than 1 mm± maximum between tiles of the same color, between tiles of different colors, or between tile and trim pieces. Size variations greater than 1mm are not acceptable.

2.03 MANUFACTURERS

- A. Basis-of-Design Product: Subject to compliance with requirements, provide specific products listed by manufacturer and product on the Finish Schedule.
- B. In other Part 2 articles where titles below introduce lists, the following requirements apply for product selection:
 - 1. Basis-of-Design Product: The design for each tile type is based on the product named. Subject to compliance with requirements, provide either the named product or submit a comparable product by another manufacturer prior to Bid for written approval of the Architect.
- C. Source Limitations for Tile: Obtain tile of each color or finish from single source or producer.
 - 1. Obtain tile of each type and color or finish from same production run and of consistent quality in appearance and physical properties for each contiguous area.
 - 2. Installation Systems: Acceptable manufacturers are indicated for each type of setting and grouting indicated. Do not mix manufacturers for setting and grouting materials within an installation system product. Provide a single manufacturer's system of setting and grouting materials for each installation system.
 - 3. Provide tile complying with Standard grade requirements only unless otherwise indicated. Second grade tile will not be acceptable.
- D. Source Limitations for Setting and Grouting Materials: Obtain ingredients of a uniform quality for each mortar, adhesive, and grout component from single manufacturer and each aggregate from single source or producer.
 - 1. Obtain setting and grouting materials, except for unmodified Portland cement and aggregate, from single manufacturer.
 - 2. Obtain waterproof membrane and crack isolation membrane, except for sheet products, from manufacturer of setting and grouting materials.
- E. Source Limitations for Other Products: Obtain each of the following products specified in this Section from a single manufacturer:
 - 1. Metal edge strips.

2.04 TILE PRODUCTS

- A. General: All products provided for installation shall be the products specified by the Interior Designer and/or Architect, unless noted otherwise. If product is no longer available or if a substitution is required, refer to Section 01 2500 – Substitution Procedures.
- B. Floor and Wall Tile: See Drawing Finish Schedule for tile specification number designations and product information as follows:
 - 1. Composition.
 - 2. Size.
 - 3. Thickness.
 - 4. Color/Pattern.
 - 5. Grout Color.

6. Trim Units: Coordinated with sizes and coursing of adjoining flat tile where applicable and matching characteristics of adjoining flat tile unless otherwise indicated. Provide shapes as indicated, selected from manufacturer's standard shapes.
 - a. Bullnose.

2.05 SETTING MATERIALS

- A. Available Manufacturers:
 1. Custom Building Products.
 2. LATICRETE International Inc.
 3. MAPEI Corporation.
- B. Latex-Portland Cement Mortar (Thin Set): ANSI A118.4, consisting of the following:
 1. Prepackaged dry-mortar mix combined with acrylic resin or styrene-butadiene-rubber liquid-latex additive.
- C. Medium Thin-set Latex-Portland Cement Mortar: Comply with requirements in ANSI A118.4. Provide product that is approved by manufacturer for thin-set application.
 1. Basis of Design Product: Subject to compliance with requirements, provide Custom Building Products MegaLite Non-Sag Rapid Set Mortar or a comparable product from one of the following:
 - a. Laticrete International Inc.; 255 MultiMax.
 - b. MAPEI Corporation; Ultracontact RS.
 2. Application: Large format tile installations. Refer to the Drawing Finish Schedule and Materials Key for tile sizes.
- D. For wall applications, provide mortar that complies with requirements for non-sagging mortar in addition to the other requirements in ANSI A118.4.

2.06 GROUT MATERIALS

- A. Available Manufacturers:
 1. Custom Building Products.
 2. LATICRETE International Inc.
 3. MAPEI Corporation.
- B. Water-Cleanable Epoxy Grout: ANSI A118.3.
 1. Acceptable Products: Subject to compliance with requirements, provide on of the following:
 - a. CEG Lite; Custom Building Products.
 - b. SpecraLock Pro; Laticrete.
 - c. Kerapoxy; MAPEI.
 2. Provide product capable of withstanding continuous and intermittent exposure to temperatures of up to 140 and 212 deg F (60 and 100 deg C), respectively, and certified by manufacturer for intended use.
 3. Color: As shown on Finish Schedule or selected by Interior Designer.

2.07 MISCELLANEOUS MATERIALS

- A. Trowelable Underlayments and Patching Compounds: Latex-modified, portland cement-based formulation provided or approved by manufacturer of tile-setting materials for installations indicated.
- B. Tile Cleaner: A neutral cleaner capable of removing soil and residue without harming tile and grout surfaces, specifically approved for materials and installations indicated by tile and grout manufacturers.
- C. Grout Sealer: Manufacturer's standard product for sealing grout joints and that does not change color or appearance of grout.
 - 1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Custom Building Products; Surfaceguard Sealer.
 - b. Jamo Inc.; Penetrating Sealer.
 - c. MAPEI Corporation; KER 004, Keraseal Penetrating Sealer for Unglazed Grout and Tile.
 - d. Summitville Tiles, Inc.; SL-15, Invisible Seal Penetrating Grout and Tile Sealer.
- D. Metal Edge Strips (Where Indicated): Angle, radius or L-shape, height to match tile and setting-bed thickness, metallic or combination of metal and PVC, designed specifically for flooring applications; stainless-steel, ASTM A 666, 300 Series exposed-edge material.
 - 1. (MCB-1) Metal Cove Base: Dilex AHKA by Schluter Systems
 - a. Finish: Anodized aluminum.
- E. Sealant: As specified in Section 07 9200 –Joint Sealants.

2.08 MIXING MORTARS AND GROUT

- A. Mix mortars and grouts to comply with referenced standards and mortar and grout manufacturers' written instructions.
- B. Add materials, water, and additives in accurate proportions.
- C. Obtain and use type of mixing equipment, mixer speeds, mixing containers, mixing time, and other procedures to produce mortars and grouts of uniform quality with optimum performance characteristics for installations indicated.

PART 3 - EXECUTION

3.01 EXAMINATION

- A. Examine substrates, areas, and conditions where tile will be installed, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

1. Verify that substrates for setting tile are firm; dry; clean; free of coatings that are incompatible with tile-setting materials, including curing compounds and other substances that contain soap, wax, oil, or silicone; and comply with flatness tolerances required by ANSI A108.01 for installations indicated.
2. Verify that installation of grounds, anchors, recessed frames, electrical and mechanical units of work, and similar items located in or behind tile has been completed.
3. Verify that joints and cracks in tile substrates are coordinated with tile joint locations; if not coordinated, adjust joint locations in consultation with Architect.

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

3.02 PREPARATION

- A. Fill cracks, holes, and depressions in concrete substrates for tile floors installed with thinset mortar with trowelable leveling and patching compound specifically recommended by tile-setting material manufacturer.
- B. Blending: For tile exhibiting color variations, verify that tile has been factory blended and packaged so tile units taken from one package show same range of colors as those taken from other packages and match approved Samples. If not factory blended, either return to manufacturer or blend tiles at Project site before installing.
- C. Field-Applied Temporary Protective Coating: If indicated under tile type or needed to prevent grout from staining or adhering to exposed tile surfaces, precoat them with continuous film of temporary protective coating, taking care not to coat unexposed tile surfaces.

3.03 TILE INSTALLATION

- A. Comply with TCNA's "Handbook for Ceramic, Glass, and Stone Tile Installation" for TCNA installation methods specified in tile installation schedules. Comply with parts of the ANSI A108 series "Specifications for Installation of Ceramic Tile" that are referenced in TCNA installation methods, specified in tile installation schedules, and apply to types of setting and grouting materials used.
 1. For the following installations, follow procedures in the ANSI A108 series of tile installation standards for providing 95 percent mortar coverage:
 - a. Tile installations consisting of tiles 8 by 8 inches or larger.
 - b. Tiles installed with epoxy grout.
 2. Verification: The Architect reserves the right to pull up and examine tiles, up to a maximum of five (5) tiles per 100 s. f. of installed work, to verify that required coverage is being achieved and the work is in compliance with requirements indicated. If required coverage is not being achieved, the contractor is responsible for removing non-compliant work, and replacing the work to be in compliance with requirements.
- B. Material Cleaning: Clean tile surfaces, including faces and backs, as recommended by manufacturer, prior to setting. Remove soil, dust, stains, and foreign materials. Use only mild cleaning compounds that contain no caustic or harsh filler or abrasives.

- C. Extend tile work into recesses and under or behind equipment and fixtures to form complete covering without interruptions unless otherwise indicated. Terminate work neatly at obstructions, edges, and corners without disrupting pattern or joint alignments.
- D. Accurately form intersections and returns. Perform cutting and drilling of tile without marring visible surfaces. Carefully grind cut edges of tile abutting trim, finish, or built-in items for straight aligned joints. Fit tile closely to electrical outlets, piping, fixtures, and other penetrations so plates, collars, or covers overlap tile.
- E. Provide manufacturer's standard trim shapes where necessary to eliminate exposed tile edges.
- F. Where accent tile differs in thickness from field tile, vary setting-bed thickness so that tiles are flush.
- G. Jointing Pattern: Lay tile in grid pattern unless otherwise indicated. Lay out tile work and center tile fields in both directions in each space or on each wall area. Lay out tile work to minimize the use of pieces that are less than half of a tile. Provide uniform joint widths unless otherwise indicated.
 - 1. For tile mounted in sheets, make joints between tile sheets same width as joints within tile sheets so joints between sheets are not apparent in finished work.
 - 2. Where adjoining tiles on floor, base, walls, or trim are specified or indicated to be same size, align joints.
 - 3. Where tiles are specified or indicated to be whole integer multiples of adjoining tiles on floor, base, walls, or trim, align joints unless otherwise indicated.
- H. Joint Widths: Unless otherwise indicated, install tile with the following joint widths:
 - 1. Porcelain Tile Wall Base: 1/8 inch.
 - 2. Ceramic Wall Tile: 1/16 inch.
- I. Expansion Joints: Provide expansion joints and other sealant-filled joints, including control, contraction, and isolation joints, where indicated or if not indicated reference Tile Council of North America's Guidelines EJ-171 and the American National Standard Specifications for the Installation of Ceramic Tile A108.01 – 3.7 requirements for movement joints. Form joints during installation of setting materials, mortar beds, and tile. Do not saw-cut joints after installing tiles.
 - 1. In premium areas including clubs, suites and suite concourses, locate joints as follows:
 - a. Provide joints in tile surfaces where tile work abuts restraining surfaces such as walls, curbs, columns, thresholds, etc. Provide continuous joints around columns.
 - b. Control joints may be located a maximum of 6" from substrate control joints or cracks in the slab. Span the staggered control joint or crack with a continuous crack suppression membrane per manufacturer's recommendation. Lap membrane on each side of crack or control joint in substrate to assure it is wider than any tile spanning the control joint or crack.
 - c. Formation: Extend joint completely through tile system, including setting material, reinforcing, membranes, and leveling materials.
 - d. Width: Where sealant-filled joints occur over substrate joints, form joints in the tile work to be not less in width than the substrate below, unless otherwise

indicated. Where sealant-filled joints do not occur over substrate joints, form joints to be the same width as grout joints in the tile work, unless otherwise indicated.

- e. Keep joints open and free of setting and grouting materials and contaminants.
 - f. Jobsite Conditions Coordination: Notify Architect if jobsite conditions require additional joints other than those indicated on the drawings, or if joint locations must be adjusted to meet spacing and location recommendations in the TCNA "Handbook for Ceramic Tile Installation," or if conditions differ from those shown on drawings.
- 2. In all other areas where joints occur in concrete substrates, locate joints in tile surfaces directly above them.
 - 3. Prepare joints and apply sealants to comply with requirements in Section 07 9200 - Joint Sealants.

3.04 ADJUSTING AND CLEANING

- A. Remove and replace tile that is damaged or that does not match adjoining tile. Provide new matching units, installed as specified and in a manner to eliminate evidence of replacement.
- B. Cleaning: On completion of placement and grouting, clean all ceramic tile surfaces so they are free of foreign matter.
 - 1. Remove grout residue from tile as soon as possible.
 - 2. Clean grout smears and haze from tile according to tile and grout manufacturer's written instructions but no sooner than 10 days after installation. Use only cleaners recommended by tile and grout manufacturers and only after determining that cleaners are safe to use by testing on samples of tile and other surfaces to be cleaned. Protect metal surfaces and plumbing fixtures from effects of cleaning. Flush surfaces with clean water before and after cleaning.
 - 3. Remove temporary protective coating by method recommended by coating manufacturer and that is acceptable to tile and grout manufacturer. Trap and remove coating to prevent drain clogging.

3.05 PROTECTION

- A. Protect installed tile work with kraft paper or other heavy covering during construction period to prevent staining, damage, and wear. If recommended by tile manufacturer, apply coat of neutral protective cleaner to completed tile walls and floors.
- B. Before final inspection, remove protective coverings and rinse neutral protective cleaner from tile surfaces. Clean tile surfaces in accordance with manufacturer's recommendation. Polish bright-glazed and polished-surface tiles.

3.06 WALL TILE INSTALLATION SCHEDULE

- A. Tile Installation: Interior wall installation over backer board; thin-set mortar; TCNA W244C (wet conditions) with cementitious backer board and waterproof membrane; W243 (dry conditions) with Type X gypsum board; ANSI A108.5.
1. Tile Type: As indicated in Drawings.
 2. Thin-Set Mortar: Latex-Portland cement mortar.
 3. Medium Thin-set Latex-Portland Cement Mortar for Large Format Tiles: Mortar indicated or manufacturer's recommended mortar.
 4. Grout: Water-Cleanable Epoxy Grout

END OF SECTION 09 3000

SECTION 09 5113 – ACOUSTICAL PANEL CEILINGS

PART 1 - GENERAL

1.01 SUMMARY

- A. Section includes acoustical panels and exposed suspension systems for ceilings.
- B. Products furnished, but not installed under this Section, include anchors, clips, and other ceiling attachment devices to be cast in concrete.

1.02 SUBMITTALS

- A. Product Data: For each type of product.
- B. Qualification Data: For testing agency.
- C. Product Test Reports: For each acoustical panel ceiling, for tests performed by manufacturer and witnessed by a qualified testing agency.
- D. Maintenance Data: For finishes to include in maintenance manuals.
- E. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 - 1. Acoustical Ceiling Panels: Full-size panels equal to 2 percent of quantity installed.
 - 2. Suspension-System Components: Quantity of each exposed component equal to 2 percent of quantity installed.

1.03 DELIVERY, STORAGE, AND HANDLING

- A. Deliver acoustical panels, suspension-system components, and accessories to Project site in original, unopened packages and store them in a fully enclosed, conditioned space where they will be protected against damage from moisture, humidity, temperature extremes, direct sunlight, surface contamination, and other causes.
- B. Before installing acoustical panels, permit them to reach room temperature and stabilized moisture content.
- C. Handle acoustical panels carefully to avoid chipping edges or damaging units in any way.

1.04 FIELD CONDITIONS

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

1. Pressurized Plenums: Operate ventilation system for not less than 48 hours before beginning acoustical panel ceiling installation.

PART 2 - PRODUCTS

2.01 PERFORMANCE REQUIREMENTS

- A. Seismic Performance: Acoustical ceiling shall withstand the effects of earthquake motions determined according to ASCE/SEI 7.
- B. 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-Spread Index: Comply with ASTM E 1264 for Class A materials.
 2. Smoke-Developed Index: 50 or less.

2.02 ACOUSTICAL PANELS, GENERAL

- A. Source Limitations:
 1. Acoustical Ceiling Panel: Obtain each type from single source from single manufacturer.
 2. Suspension System: Obtain each type from single source from single manufacturer.
- B. Acoustical Panel Standard: Provide manufacturer's standard panels of configuration indicated that comply with ASTM E 1264 classifications as designated by types, patterns, acoustical ratings, and light reflectance unless otherwise indicated.
 1. Mounting Method for Measuring NRC: Type E-400; plenum mounting in which face of test specimen is 15-3/4 inches away from test surface according to ASTM E 795.

2.03 ACOUSTICAL PANELS

- A. Basis-of-Design Products: Subject to compliance with requirements, provide Ultima High NRC by Armstrong World Industries, Inc.; or products approved by one of the following:
 1. Armstrong World Industries, Inc.
 2. CertainTeed Corp.
 3. USG Interiors, Inc.; Subsidiary of USG Corporation.
- B. Acoustical Panel Ceilings: Ultima High NRC (Item No. 1940) by Armstrong World Industries, Inc.
 1. Classification: ASTM E1264, Type IV, Form 2, Pattern E, Fire Class A.
 2. Description: Wet formed mineral fiber.
 - a. Grid: 15/16 inch.
 - b. Size: 24 inches x 24 inches x 7/8 inch thick.
 - c. Edge: Square Lay-In.
 - d. Light Reflectance: 0.87 percent.
 - e. NRC: 0.80.
 - f. Ceiling Attenuation Class (CAC): 35.
 - g. Fire Class A: ASTM E84 surface burning characteristics. Flame Spread Index of 25 or less. Smoke Developed Index of 50 or less (UL Labeled).

3. Antimicrobial Treatment: Broad spectrum fungicide and bactericide based.
4. Sag resistant.
5. Color: White; as shown on Finish Schedule.
6. Installation: Exposed tee system.

- C. Broad Spectrum Antimicrobial Fungicide and Bactericide Treatment: Provide acoustical panels treated with manufacturer's standard antimicrobial formulation that inhibits fungus, mold, mildew, and gram-positive and gram-negative bacteria and showing no mold, mildew, or bacterial growth when tested according to ASTM D3273 and evaluated according to ASTM D3274 or ASTM G21.

2.04 METAL SUSPENSION SYSTEMS, GENERAL

- A. Metal Suspension-System Standard: Provide manufacturer's standard direct-hung metal suspension systems of types, structural classifications, and finishes indicated that comply with applicable requirements in ASTM C 635/C 635M.
- B. Attachment Devices: Size for five times the design load indicated in ASTM C635, Table 1, "Direct Hung," unless otherwise indicated. Comply with seismic design requirements.
- C. Wire Hangers, Braces, and Ties: Provide wires complying with the following requirements:
1. Zinc-Coated, Carbon-Steel Wire: ASTM A 641/A 641M, Class 1 zinc coating, soft temper.
 2. Size: Select wire diameter so its stress at three times hanger design load (ASTM C 635/C 635M, Table 1, "Direct Hung") will be less than yield stress of wire, but provide not less than 0.106-inch- diameter wire.
- D. Seismic Stabilizer Bars: Manufacturer's standard perimeter stabilizers designed to accommodate seismic forces.
- E. Seismic Struts: Manufacturer's standard compression struts designed to accommodate seismic forces.
- F. Seismic Clips: Manufacturer's standard seismic clips designed and spaced to secure acoustical panels in place.

2.05 METAL SUSPENSION SYSTEM

- A. Basis-of-Design Product: Subject to compliance with requirements, provide products by one of the following:
- a. Armstrong World Industries, Inc
 - b. CertainTeed Corp.
 - c. Chicago Metallic Corporation.
 - d. USG Interiors, Inc.; Subsidiary of USG Corporation.
- B. Wide-Face, Capped, Double-Web, Steel Suspension System: Main and cross runners roll formed from cold-rolled steel sheet; prepainted, electrolytically zinc coated, or hot-dip galvanized according to ASTM A 653, not less than G30 coating designation; with prefinished 15/16-inch-wide metal caps on flanges.

1. Basis of Design Product: Prelude XL by Armstrong World Industries, Inc.
 - a. Finish: White; as indicated on Finish Schedule.
2. Structural Classification: Heavy-duty system.
3. End Condition of Cross Runners: Override (stepped) type.
4. Face Design: Flat, Flush.
5. Cap Material: Steel cold-rolled sheet.
6. Cap Finish: Painted white.

2.06 METAL EDGE MOLDINGS AND TRIM

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 1. Armstrong World Industries, Inc.
 2. CertainTeed Corp.
 3. Chicago Metallic Corporation.
 4. Fry Reglet Corporation.
 5. Gordon, Inc.
 6. USG Interiors, Inc.; Subsidiary of USG Corporation.
- B. Roll-Formed, Sheet-Metal Edge Moldings and Trim: Type and profile indicated or, if not indicated, manufacturer's standard moldings for edges and penetrations that comply with seismic design requirements; formed from sheet metal of same material, finish, and color as that used for exposed flanges of suspension-system runners.
 1. Provide manufacturer's standard edge moldings that fit acoustical panel edge details and suspension systems indicated and that match width and configuration of exposed runners unless otherwise indicated.
 2. For lay-in panels with reveal edge details, provide edge moldings that match profile of face of suspension grid.
 3. For circular penetrations of ceiling, provide edge moldings fabricated to diameter required to fit penetration exactly.

2.07 ACOUSTICAL SEALANT

- A. Acoustical Sealant: Manufacturer's standard sealant complying with ASTM C 834 and effective in reducing airborne sound transmission through perimeter joints and openings in building construction as demonstrated by testing representative assemblies according to ASTM E 90.
 1. Exposed and Concealed Joints: Non-sag, paintable, non-staining latex sealant.
 2. Concealed Joints: Nondrying, non-hardening, non-skinning, non-staining, gunnable, synthetic-rubber sealant.

PART 3 - EXECUTION

3.01 EXAMINATION

- A. Examine substrates, areas, and conditions, including structural framing to which acoustical panel ceilings attach or abut, with Installer present, for compliance with requirements

specified in this and other Sections that affect ceiling installation and anchorage and with requirements for installation tolerances and other conditions affecting performance of acoustical panel ceilings.

- B. Examine acoustical panels before installation. Reject acoustical panels that are wet, moisture damaged, or mold damaged.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 PREPARATION

- A. Measure each ceiling area and establish layout of acoustical panels to balance border widths at opposite edges of each ceiling. Avoid using less-than-half-width panels at borders, and comply with layout shown on reflected ceiling plans.

3.03 SUSPENDED PANEL INSTALLATION

- A. General: Install acoustical panel ceilings to comply with ASTM C 636/C 636M and seismic design requirements indicated, according to manufacturer's written instructions and CISCA's "Ceiling Systems Handbook."
- B. Suspend ceiling hangers from building's structural members and as follows:
 - 1. Install hangers plumb and free from contact with insulation or other objects within ceiling plenum that are not part of supporting structure or of ceiling suspension system.
 - 2. Splay hangers only where required to miss obstructions; offset resulting horizontal forces by bracing, countersplaying, or other equally effective means.
 - 3. Where width of ducts and other construction within ceiling plenum produces hanger spacings that interfere with location of hangers at spacings required to support standard suspension-system members, install supplemental suspension members and hangers in form of trapezes or equivalent devices.
 - 4. Secure wire hangers to ceiling-suspension members and to supports above with a minimum of three tight turns. Connect hangers directly either to structures or to inserts, eye screws, or other devices that are secure and appropriate for substrate and that will not deteriorate or otherwise fail due to age, corrosion, or elevated temperatures.
 - 5. Do not support ceilings directly from permanent metal forms or floor deck. Fasten hangers to cast-in-place hanger inserts, post-installed mechanical or adhesive anchors, or power-actuated fasteners that extend through forms into concrete.
 - 6. When steel framing does not permit installation of hanger wires at spacing required, install carrying channels or other supplemental support for attachment of hanger wires.
 - 7. Do not attach hangers to steel deck tabs.
 - 8. Do not attach hangers to steel roof deck. Attach hangers to structural members.
 - 9. Space hangers not more than 48 inches o.c. along each member supported directly from hangers unless otherwise indicated; provide hangers not more than 8 inches from ends of each member.
 - 10. Size supplemental suspension members and hangers to support ceiling loads within performance limits established by referenced standards and publications.

- C. Secure bracing wires to ceiling suspension members and to supports with a minimum of four tight turns. Suspend bracing from building's structural members as required for hangers, without attaching to permanent metal forms, steel deck, or steel deck tabs. Fasten bracing wires into concrete with cast-in-place or post-installed anchors.
- D. Install edge moldings and trim of type indicated at perimeter of acoustical ceiling area and where necessary to conceal edges of acoustical panels.
 - 1. Apply acoustical sealant in a continuous ribbon concealed on back of vertical legs of moldings before they are installed.
 - 2. Screw attach moldings to substrate at intervals not more than 16 inches o.c. and not more than 3 inches from ends, leveling with ceiling suspension system to a tolerance of 1/8 inch in 12 feet. Miter corners accurately and connect securely.
 - 3. Do not use exposed fasteners, including pop rivets, on moldings and trim.
- E. Install suspension-system runners so they are square and securely interlocked with one another. Remove and replace dented, bent, or kinked members.
- F. Install acoustical panels with undamaged edges and fit accurately into suspension-system runners and edge moldings. Scribe and cut panels at borders and penetrations to provide a neat, precise fit.
 - 1. For reveal-edged panels on suspension-system runners, install panels with bottom of reveal in firm contact with top surface of runner flanges.
 - 2. Paint cut edges of panel remaining exposed after installation; match color of exposed panel surfaces using coating recommended in writing for this purpose by acoustical panel manufacturer.

3.04 FIELD QUALITY CONTROL

- A. Testing Agency: Engage a qualified testing agency to perform tests and inspections and prepare test reports.
- B. Perform the following tests and inspections of completed installations of acoustical panel ceiling hangers and anchors and fasteners in successive stages. Do not proceed with installations of acoustical panel ceiling hangers for the next area until test results for previously completed installations show compliance with requirements.
 - 1. Extent of Each Test Area: When installation of ceiling suspension systems on each floor has reached 20 percent completion but no panels have been installed.
 - a. Within each test area, testing agency will select one of every 10 power-actuated fasteners and postinstalled anchors used to attach hangers to concrete and will test them for 200 lbf of tension; it will also select one of every two postinstalled anchors used to attach bracing wires to concrete and will test them for 440 lbf of tension.
 - b. When testing discovers fasteners and anchors that do not comply with requirements, testing agency will test those anchors not previously tested until 20 pass consecutively and then will resume initial testing frequency.

- C. Acoustical panel ceiling hangers and anchors and fasteners will be considered defective if they do not pass tests and inspections.
- D. Prepare test and inspection reports.

3.05 CLEANING

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

END OF SECTION 09 5113

SECTION 09 6500 - RESILIENT FLOORING

PART 1 - GENERAL

1.01 SUMMARY

- A. Section Includes:
 - 1. Resilient Base.
 - 2. Resilient Stair Covering.

1.02 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Samples for Verification: For each type of product indicated, in manufacturer's standard-size Samples but not less than 12 inches long, of each resilient product color, texture, and pattern required.
- C. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 - 1. Furnish not less than 10 linear feet for every 500 linear feet or fraction thereof, of each type, color, pattern, and size of resilient product installed.

1.03 QUALITY ASSURANCE

- A. Flooring products shall comply with the requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."
- B. Adhesives:
 - 1. Aerosol adhesives shall not exceed the VOC limits specified in the Green Seal Standard GS-36.
 - 2. Non-aerosol adhesives and primers shall not exceed the VOC limits specified in the South Coast Air Quality District Rule 1168.

1.04 DELIVERY, STORAGE, AND HANDLING

- A. Store resilient products and installation materials in dry spaces protected from the weather, with ambient temperatures maintained within range recommended by manufacturer, but not less than 50 deg F or more than 90 deg F.

1.05 PROJECT CONDITIONS

- A. Maintain ambient temperatures within range recommended by manufacturer, but not less than 70 deg F or more than 95 deg F, in spaces to receive resilient products during the following time periods:

1. 48 hours before installation.
 2. During installation.
 3. 48 hours after installation.
- B. Until Final Completion, maintain ambient temperatures within range recommended by manufacturer, but not less than 55 deg F or more than 95 deg F.
- C. Install resilient products after other finishing operations, including painting, have been completed.

PART 2 - PRODUCTS

2.01 PERFORMANCE REQUIREMENTS

- A. Fire-Test-Response Characteristics: As determined by testing identical products according to ASTM E 648 or NFPA 253 by a qualified testing agency.
1. Critical Radiant Flux Classification: Class I, not less than 0.45 W/sq. cm.

2.02 RESILIENT BASE (RB-1)

- A. Basis of Design Product: Subject to compliance with requirements, provide Pinnacle Resilient Wall Base by Roppe Corporation; or a comparable approved product by one of the following:
1. Johnsonite; A Tarkett Company.
 2. Roppe Corporation, USA.
- B. Resilient Base: ASTM F 1861.
1. Material Requirement: Type TV
 2. Manufacturing Method: Group I (solid, homogeneous).
 3. Style: Cove, unless otherwise indicated on the Finish Schedule.
 4. Minimum Thickness: 0.125 inch.
 5. Height: 4 inches, as indicated on the Finish Schedule.
 6. Lengths: Coils in manufacturer's standard length.
 7. Outside Corners: Pre formed.
 8. Inside Corners: Pre formed.
 9. Colors and Patterns: Black/Brown, as indicated on the Finish Schedule.

2.03 RESILIENT STAIR COVERING (RSC-1)

- A. Basis of Design Product: Subject to compliance with requirements, provide Renew Resilient Stair Covering by Roppe Corporation; or a comparable approved product by one of the following:
1. Johnsonite; A Tarkett Company.
 2. Roppe Corporation, USA.
- B. Resilient Stair Covering: ASTM F1344; Class 1 A, Grade 1.
1. Style: Hammered Design, unless otherwise indicated on the Finish Schedule.
 2. Minimum Thickness: 0.125 inch.

3. Size: As indicated on the Finish Schedule.
4. Colors and Patterns: Smoke-R174, as indicated on the Finish Schedule.
5. Tread: Contrasting vinyl insert.
6. Landing: Tiles to match tread.

2.04 INSTALLATION MATERIALS

- A. Trowelable Leveling and Patching Compounds: Latex-modified, portland cement based or blended hydraulic-cement-based formulation provided or approved by manufacturer for applications indicated.
- B. Adhesives: Water-resistant type recommended by manufacturer to suit resilient products and substrate conditions indicated.
 1. Adhesives shall have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
- C. Floor Polish: Provide protective, liquid floor-polish products recommended by resilient flooring manufacturer.

PART 3 - EXECUTION

3.01 EXAMINATION

- A. Examine substrates, with Installer present, for compliance with requirements for maximum moisture content and other conditions affecting performance of the Work.
- B. Verify that finishes of substrates comply with tolerances and other requirements specified in other Sections and that substrates are free of cracks, ridges, depressions, scale, and foreign deposits that might interfere with adhesion of resilient products.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 PREPARATION

- A. Prepare substrates according to manufacturer's written instructions to ensure adhesion of resilient products.
- B. Fill cracks, holes, and depressions in substrates with trowelable leveling and patching compound and remove bumps and ridges to produce a uniform and smooth substrate.
- C. Concrete Substrates: Prepare according to ASTM F710.
 1. Verify that substrates are dry and free of curing compounds, sealers, and hardeners.
 2. Remove substrate coatings and other substances that are incompatible with adhesives and that contain soap, wax, oil, or silicone, using mechanical methods recommended by resilient sheet flooring manufacturer. Do not use solvents.
 3. Alkalinity and Adhesion Testing: Perform tests recommended by resilient sheet flooring manufacturer. Proceed with installation only after substrate alkalinity falls within range

on pH scale recommended by manufacturer in writing, but not less than 5 or more than 9 pH.

4. Moisture Testing: Perform tests so that each test area does not exceed 200 sq. ft. and perform no fewer than three tests in each installation area and with test areas evenly spaced in installation areas.

- D. Do not install resilient products until they are same temperature as the space where they are to be installed.
 1. Move resilient products and installation materials into spaces where they will be installed at least 48 hours in advance of installation.
- E. Sweep and vacuum clean substrates to be covered by resilient products immediately before installation.

3.03 RESILIENT BASE INSTALLATION

- A. Comply with manufacturer's written instructions for installing resilient base.
- B. Apply resilient base to walls, columns, pilasters, casework and cabinets in toe spaces, and other permanent fixtures in rooms and areas where base is required.
- C. Install resilient base in lengths as long as practicable without gaps at seams and with tops of adjacent pieces aligned.
- D. Tightly adhere resilient base to substrate throughout length of each piece, with base in continuous contact with horizontal and vertical substrates.
- E. Do not stretch resilient base during installation.
- F. On masonry surfaces or other similar irregular substrates, fill voids along top edge of resilient base with manufacturer's recommended adhesive filler material.

3.04 CLEANING AND PROTECTION

- A. Comply with manufacturer's written instructions for cleaning and protection of resilient products.
- B. Perform the following operations immediately after completing resilient product installation:
 1. Remove adhesive and other blemishes from exposed surfaces.
 2. Sweep and vacuum surfaces thoroughly.
 3. Damp-mop surfaces to remove marks and soil.
- C. Protect resilient products from mars, marks, indentations, and other damage from construction operations and placement of equipment and fixtures during remainder of construction period.
- D. Cover resilient products until Final Completion.

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TWIN FALLS TRAINING FACILITY
SECTION 09 6500
RESILIENT FLOORING

END OF SECTION 09 6500

SECTION 09 81 00 - ACOUSTICAL INSULATION

PART 1 - GENERAL

1.01 SUMMARY

- A. Section Includes: Acoustical insulation as shown on Drawings and as specified.

1.02 SUBMITTALS

- A. Product Data: Manufacturer's data sheets on each product to be used, including:
 1. Test data showing compliance of products with specified requirements.
 2. Preparation instructions and recommendations.
 3. Storage and handling requirements and recommendations.
 4. Installation methods.

1.03 QUALITY ASSURANCE

- A. Surface-Burning Characteristics: As determined by testing identical products according to ASTM E 84 by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.
 1. Surface Burning Characteristics:
 - a. Maximum flame spread: 25
 - b. Maximum smoke developed: 50.

1.04 DELIVERY, STORAGE AND HANDLING

- A. Protect insulation from physical damage and from becoming wet, soiled, or covered with ice or snow. Comply with manufacturer's recommendations for handling, storage and protection during installation.

Label insulation packages to include material name, production date and/or product code.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

- A. Subject to compliance with requirements, provide products as manufactured by one of the following:
 1. Manville Building Products Group
 2. Owens Corning Fiberglas
 3. U.S. Gypsum Company

2.02 MATERIALS

- A. Sound Attenuation Blankets: ASTM C 665, Type I (blankets without membrane facing) produced by combining thermosetting resins with mineral fibers manufactured from glass, slag wool, or rock wool.
 - 1. Product Description: Glass fibers bonded with an acrylic thermosetting binder.
 - 2. Thickness: As indicated on Drawings or as required by wall thickness.
 - 3. Products shall be formaldehyde free.

PART 3 - EXECUTION

3.01 EXAMINATION

- A. Examine substrates and conditions under which insulation work is to be performed. A satisfactory substrate is one that complies with requirements of the section in which substrate and related work is specified.
- B. Obtain installer's written report listing conditions detrimental to performance of work in this section. Do not proceed with installation of insulation until unsatisfactory conditions have been corrected.
- C. Clean substrates of substances harmful to insulation.

3.02 INSTALLATION

- A. General: Apply insulation units to substrates by method indicated, complying with manufacturer's written instructions. If no specific method is indicated, bond units to substrate with adhesive or use mechanical anchorage to provide permanent placement and support of units.
- B. Batts:
 - 1. Install acoustical insulation batts in sound-rated stud partition walls where indicated on Drawings. Size batts for a friction fit and install in accordance with Manufacturer's recommendations.
 - 2. Install acoustical insulation batts above lay-in ceilings, and other locations as shown on Drawings, in strict accordance with Manufacturer's printed instructions.
 - 3. Butt ends of batts closely together and fill all voids.
 - 4. Where insulation must extend higher than 8 feet, temporary support can be provided to hold product in place until the finish material is applied.

3.03 PROTECTION

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

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TWIN FALLS TRAINING FACILITY
SECTION 09 8100
ACOUSTICAL INSULATION

END OF SECTION 09 8100

SECTION 09 9100 – PAINTING

PART 1 - GENERAL

1.01 SUMMARY

- A. Section Includes: Surface preparation and field painting of exposed interior items and surfaces.

1.02 DEFINITIONS

- A. General: Standard coating terms defined in ASTM D 16 , Standard Terminology for Paint, Related Coatings, Materials, and Applications and ASTM D523 Standard Test Method for Specular Gloss apply to this Section.
1. Flat: Lusterless or matte finish with a gloss range below 15 when measured at an 85-degree meter.
 2. Eggshell: Low-sheen finish with a gloss range between 20 and 35 when measured at a 60-degree meter.
 3. Semigloss: Medium-sheen finish with a gloss range between 35 and 70 when measured at a 60-degree meter.
 4. Full gloss: High-sheen finish with a gloss range more than 70 when measured at a 60-degree meter.
- B. PDCA: Painting and Decorating Contractors of America.

1.03 SUBMITTALS

- A. Product Data: Submit manufacturer's data for each paint system indicated, including primers. Data shall include label analysis and instructions for handling, storing, and applying each coating material.
- B. Material List: Submit an inclusive list of required coating materials. Indicate each material and cross-reference specific coating, finish system, and application. Identify each material by manufacturer's catalog number and general classification.
- C. Samples:
1. Architect will furnish Contractor a color schedule, color chips or selected colors prior to commencing work.
 2. Submit samples a minimum of 30 days prior to commencing painting work.
 3. Label and identify each sample as to location and application.
 4. Resubmit as requested by Architect until required sheen, color, and texture are achieved.
 5. Samples shall define each separate coat, including primer.
 6. Submit two 8 inch x 10 inch samples of each color and material specified, including the correct sheen and texture. Samples shall be on heavy cardboard.
- D. Coating Maintenance Manual: Submit a coating maintenance manual including an Area Summary with finish schedule, Area Detail designating where each product/color/finish was

used, product data pages, Material Safety Data Sheets, care and cleaning instructions, touch-up procedures, and color samples of each color and finish used.

1.04 QUALITY ASSURANCE

- A. Regulatory Requirements:
 - 1. ASTM Standards listed in paint manufacturer's technical literature.
 - 2. Local and Federal regulations regarding toxicity and air quality regulations.
- B. Source Limitations: Obtain primers for each coating system from the same manufacturer as the finish coats.
- C. Applicator Qualifications: A firm or individual with a minimum 5 years experience in applying paints and coatings similar in material, design, and scope to this project.
- D. Mockups: Provide as specified in Section 01 4000 – Quality Requirements.

1.05 DELIVERY, STORAGE, AND HANDLING

- A. Deliver materials to Project site in manufacturer's original, unopened packages and containers bearing manufacturer's name and label. Paint-material containers not displaying manufacturer's product identification will not be acceptable.
- B. Store materials not in use in tightly covered containers in a well-ventilated area at a minimum ambient temperature of 45 deg F. Maintain storage containers in a clean condition, free of foreign materials and residue.
 - 1. Protect materials from freezing. Keep storage area neat and orderly. Remove oily rags and waste daily.
 - 2. Store materials in manner and quantities that are in strict accordance with local ordinances, state laws, or fire underwriter regulations.

1.06 PROJECT CONDITIONS

- A. Environmental Requirements:
 - 1. Apply paints when ambient and surface temperature conforms to manufacturer's recommendations. Do not apply paint in the following conditions:
 - a. Snow, rain, fog, or mist
 - b. When relative humidity exceeds 85 percent
 - c. At temperatures less than 5 deg F above the dew point
 - d. To damp or wet surfaces.
 - e. In direct sunlight.

1.07 EXTRA MATERIALS

- A. Furnish extra paint materials from the same production run as the materials applied. Package with protective covering for storage and identify with labels describing contents. Deliver extra materials to location as instructed by Owner.

1. Quantity: Furnish Owner with an additional 3 percent, but not less than 1 gal., of each material and color applied.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products from one of the following manufacturers:
 1. BEHR
 2. Benjamin Moore
 3. Kelly-Moore
 4. PPG Paints
 5. Sherwin-Williams Co.
 6. Slip Doctors.
 7. Tnemec

2.02 PAINT MATERIALS

- A. All materials (primers, paints, coatings, varnishes, stains, lacquers, fillers, thinners, solvents, etc.) shall be in accordance with the MPI Architectural Painting Specification Manual "Approved Product" listing and shall be from a single manufacturer for each system used.
- B. Other paint materials such as linseed oil, shellac, etc. shall be the highest quality product of an approved manufacturer listed in the MPI Architectural Painting Specification Manual and shall be compatible with other coating materials as required.
- C. All materials and paints shall be lead and mercury free and shall have low VOC content where possible.
- D. Material Compatibility: Provide primers, and finish-coat materials that are compatible with one another, and with the substrates indicated, under conditions of service and application, as demonstrated by manufacturer based on testing and field experience.
- E. Material Quality: Provide manufacturer's best-quality paint materials, factory formulated and recommended by manufacturer for application indicated.
 1. Materials selected for coating systems for each type surface shall be the product of a single manufacturer.
- F. Colors:
 1. Manufacturer supplying paint shall match colors.
 2. Obtain clarification of intended color at locations where color is not indicated on schedule or drawings.
 3. Approval of final colors: Do not apply final coat of paint until colors have been approved by Architect.

- G. Schedule of Finishes: Refer to the "Finish Schedule" on the Drawing for designated finishes of areas.
- H. Paint Products: As indicated in Schedule of Paint Products at end of section.
- I. Chemical Components of Interior Paints and Coatings: Provide products that comply with the limits for VOC content contained in 2010 California Green Building Standards Code as indicated on the drawings. Note: VOC limits contained in California Code comply with, or are more restrictive than, LEED 2009 VOC requirements.

2.03 ACCESSORIES

- A. Concrete Floor Sealing Compound: Clear, chemically reactive, waterborne solution of inorganic silicate or silconate materials and proprietary components; odorless; that penetrates, hardens and densifies concrete surfaces. Subject to compliance with requirements, provide products as manufactured by one of the following:
 - 1. Ashford Formula by Curecrete Distribution Inc.
 - 2. Seal Hard by L&M Construction Chemicals.
- B. Application Materials:
 - 1. Brushes: Use brushes best suited for type of material applied. Use brush of appropriate size for surface or item being painted.
 - 2. Rollers: Use rollers of carpet, velvet-back, or high-pile sheep's wool as recommended by manufacturer for material and texture required.
 - 3. Spray Equipment: Use airless spray equipment with orifice size as recommended by manufacturer for material and texture required.

PART 3 - EXECUTION

3.01 EXAMINATION

- A. Examine substrates, areas, and conditions, with Applicator present, for compliance with requirements for paint application. Comply with procedures specified in PDCA P4.
 - 1. Proceed with paint application only after unsatisfactory conditions have been corrected and surfaces receiving paint are thoroughly dry.
 - 2. Commencement of painting will be construed as Applicator's acceptance of surfaces and conditions.
- B. Test shop applied primer to verify compatibility with cover materials.
- C. Verify moisture content of surfaces using an electronic moisture meter. Do not apply finishes unless moisture contents are at range acceptable to paint manufacturer.

3.02 PREPARATION

- A. General:

1. Prior to commencing painting work, remove and protect hardware, accessories, electrical plates, lighting fixtures and similar items.
 2. Mask permanent labels.
 3. Surfaces requiring painting or finishing shall be thoroughly dry and cured, free of dirt, dust, rust, stains, scale, mildew, wax, grease, oil, deteriorated substrates, bond-breakers, efflorescence and other foreign matter detrimental to the coating's adhesion and performance.
 4. Repair voids, cracks, nicks, and other surface defects, with appropriate patching material. Finish flush with surrounding surfaces and match adjacent finish texture.
 5. Determine moisture content of plaster, stucco, cementitious materials, wood, and other moisture-holding materials by use of a reliable electronic moisture meter.
- B. Surface Preparation: Clean and prepare surfaces to be painted according to manufacturer's written instructions for each particular substrate condition and as specified.
1. WOOD: Sand smooth and remove dust. Fill open joints, cracks, nail holes and other pits or depressions flush and smooth with putty or wood dough after priming. Use wood dough to match finish paint coat. Touch up knots or sap streaks with a stain-blocking sealer before priming.
 2. CONCRETE: Remove bond breaker and release agent residue, loose particles, efflorescence and encrustations from cured concrete substrates. Fill depressions and remove fins and projections not inherent in base material. Prime with an alkali-resistant primer.
 3. PRIMED FERROUS METAL: Remove contaminants and foreign matter. Touch up abrasions with a suitable ferrous metal primer.
 4. UNPRIMED FERROUS METAL: Remove rust, mill scale and foreign matter. Touch up abrasions with a suitable ferrous metal primer.
 5. GALVANIZED METAL: Remove oils, passivators and clean entire surface with an appropriate solvent. Pre-treat with a phosphoric acid etching solution. Apply primer same day as pretreatment is applied.
 6. PHOSPHATIZED METAL (shall not be chemically etched): Clean and apply suitable metal primer.
 7. GYPSUM BOARD: Remove dust and foreign matter. Fill pits flush and smooth with joint compound and where required skim coat to provide the specified level of finish before application of decoration.
 8. Surfaces, which cannot be prepared or painted as specified, shall be immediately brought to attention of Architect.
 - a. Starting of work without such notification will be considered acceptance of surfaces involved.
 - b. Replace unsatisfactory work caused by improper or defective surfaces as direct by Architect.
- C. Material Preparation: Mix and prepare paint materials according to manufacturer's written instructions.
1. Maintain containers used in mixing and applying paint in a clean condition, free of foreign materials and residue.

2. Stir material before application to produce a mixture of uniform density. Stir as required during application. Do not stir surface film into material. If necessary, remove surface film and strain material before using.
 3. Use only thinners approved by paint manufacturer and only within recommended limits.
- D. Tinting: Manufacturer shall shop tint each undercoat a lighter shade to simplify identification of each coat when multiple coats of same material are applied. Tint undercoats to match the color of the finish coat, but provide sufficient differences in shade of undercoats to distinguish each separate coat.

3.03 APPLICATION

- A. General: Apply paint according to manufacturer's written instructions.
1. Paint colors, surface treatments, and finishes as indicated in the paint schedules.
 2. Do not paint over dirt, rust, scale, grease, moisture, scuffed surfaces, or conditions detrimental to formation of a durable paint film.
 3. Sand lightly between each succeeding enamel or varnish coat.
 4. Paint back sides of access panels and removable or hinged covers to match exposed surfaces.
 5. Finish exterior doors on tops, bottoms, and side edges the same as exterior faces.
 6. Finish interior of wall and base cabinets and similar field-finished casework to match exterior.
 7. Leave parts of molding and ornaments clean and true to details with no undue amount of paint in corners and depressions.
- B. Scheduling Painting: Apply first coat to surfaces that have been cleaned, pretreated, or otherwise prepared for painting as soon as practical after preparation and before subsequent surface deterioration.
1. The number of coats and film thickness required are the same regardless of application method. Do not apply succeeding coats until previous coat has cured as recommended by manufacturer. If sanding is required to produce a smooth, even surface according to manufacturer's written instructions, sand between applications.
 2. Priming will not be required on items delivered with prime or shop coats, unless otherwise specified. Touch up prime coats applied by others as required to ensure an even primed surface before applying finish coat
 3. If undercoats, stains, or other conditions show through final coat of paint, apply additional coats until paint film is of uniform finish, color, and appearance. Give special attention to ensure that edges, corners, crevices, welds, and exposed fasteners receive a dry film thickness equivalent to that of flat surfaces.
 4. Allow sufficient time between successive coats to permit proper drying. Do not recoat surfaces until paint has dried to where it feels firm, and does not deform or feel sticky under moderate thumb pressure, and until application of another coat of paint does not cause undercoat to lift or lose adhesion.
 5. Number of coats scheduled is minimum. Apply additional coats at no additional cost if necessary to completely hide base materials, produce uniform color and provide satisfactory finish result.

- C. Application Procedures: Apply paints and coatings by brush, roller, spray, or other applicators according to manufacturer's written instructions.
- D. Coating Thickness: Apply paint materials no thinner than manufacturer's recommended spreading rate to achieve dry film thickness indicated. Provide total dry film thickness of the entire system as recommended by manufacturer.
- E. Exposed Surfaces: Paint exposed surfaces, except where indicated that the surface or material is not to be painted or is to remain natural. If a finish is not indicated, verify with Architect prior to painting that surface. If a color of finish is not indicated, Architect will select from standard colors and finishes available.
 - 1. The term "exposed surfaces" includes areas visible when permanent or built-in fixtures, grilles, convector covers, covers for finned-tube radiation, and similar components are in place. Extend coatings in these areas, as required, to maintain system integrity and provide desired protection.
 - 2. Paint surfaces behind movable equipment and furniture the same as similar exposed surfaces. Before final installation of equipment, paint surfaces behind permanently fixed equipment or furniture with prime coat only.
- F. Do not paint prefinished items, concealed surfaces, finished metal surfaces, operating parts, and labels.
- G. Labels: Do not paint over UL, FMG, or other code-required labels or equipment name, identification, performance rating, or nomenclature plates.
- H. Mechanical and Electrical Work: Painting of mechanical and electrical work is limited to items exposed in equipment rooms and occupied spaces. Items without factory finish such as conduits, pipes, access panels and items of similar nature shall be finished to match adjacent wall and ceiling surfaces unless otherwise directed.
- I. Prime Coats: Before applying finish coats, apply a prime coat, as recommended by manufacturer, to material that is required to be painted or finished and that has not been prime coated by others. Recoat primed and sealed surfaces where evidence of suction spots or unsealed areas in first coat appears, to ensure a finish coat with no burn-through or other defects due to insufficient sealing.
- J. Pigmented (Opaque) Finishes: Completely cover surfaces as necessary to provide a smooth, opaque surface of uniform finish, color, appearance, and coverage. Cloudiness, spotting, holidays, laps, brush marks, runs, sags, ropiness, or other surface imperfections will not be acceptable.
- K. Touch Up for Previously Coated Surfaces:
 - 1. Touch up marred, scraped, and blemished areas of surfaces which were factory primed or previously coated.
 - 2. Properly prepare and touch up scratched, abrasions, and blemishes and remove foreign matter before proceeding with succeeding coats.

3. Feather touch up coating overlapping minimum 2 inches onto adjacent unblemished areas producing smooth, uniform surface.
 4. Touch up fasteners, welded surfaces and surrounding, field connections and areas on which shop coat has been abraded or damaged with specified primer before corrosion or other damage occurs from exposure.
- L. Completed Work: Match approved samples for color, texture, and coverage. Remove, refinish, or repaint work not complying with requirements.

3.04 FIELD QUALITY CONTROL

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

3.05 CLEANING

- A. Cleanup:
1. At the end of each workday, remove empty cans, rags, rubbish, and other discarded paint materials from Project site. Take precautions to prevent fires.
 2. During the course of the Work, remove misplaced paint and stain spots or spills. Leave Work in clean condition acceptable to Architect.
 3. After completing painting, clean glass and paint-spattered surfaces. Remove spattered paint by washing and scraping without scratching or damaging adjacent finished surfaces.
- B. Set aside and protect surplus and uncontaminated finish materials not required by the Owner and deliver or arrange collection for verifiable re-use or re-manufacturing.

3.06 PROTECTION

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

3.07 SCHEDULE OF PAINT PRODUCTS

- A. The following schedule of paint products is intended to identify manufacturer's highest quality recommended systems. Recommended systems for substrates or applications that are not identified in the schedule shall be submitted by paint manufacturer for approval.
- B. Provide paint finishes of even uniform color, free from cloudy or mottled appearance. Properly correct non-complying work to satisfaction of Owner or Owner's Representative.
- C. Some Colors, especially accent colors may require multiple finish coats for adequate coverage and opacity.
- D. The specified number of primer and finish coats is minimum acceptable. If full coverage and opacity is not obtained with specified number of coats, apply additional coats as necessary to produce required finish.

3.08 INTERIOR PAINT PRODUCTS – LOW/ZERO VOC

- A. Gypsum Board – Walls:
 - 1. System: 2 coat finish over 1-coat primer.
 - 2. Paint: Latex paint.
 - 3. First Coat (Primer)
 - a. Benjamin Moore: Ultra Spec Latex Primer 534
 - b. Kelly-Moore: 970 Acry-Plex PVA Wall Sealer
 - c. PPG Paints: Speedhide Zero Interior Latex Sealer 6-4900XI
 - d. Sherwin-Williams Co.: ProMar 200 Zero VOC Primer B28W02600
 - 4. Second Coat and Finish Coat:
 - a. Low-Luster/Eggshell:
 - 1) Benjamin Moore: Ultra Spec 500 Low Sheen (Eggshell) 537
 - 2) Kelly-Moore: 1010 KM Premium Professional Eggshell
 - 3) PPG Paints: Speedhide Zero Interior Eggshell 6-4340
 - 4) Sherwin-Williams Co.: ProMar 200 Zero VOC Low Gloss Eggshell B41W02651
- B. Gypsum Board – Ceilings:
 - 1. System: 2 coat finish over 1-coat primer.
 - 2. Paint: Latex paint.
 - 3. First Coat (Primer)
 - a. Benjamin Moore: Ultra Spec Latex Primer 534
 - b. Kelly-Moore: 970 Acry-Plex PVA Wall Sealer
 - c. PPG Paints: Speedhide Zero Interior Latex Sealer 6-4900XI
 - d. Sherwin-Williams Co.: ProMar 200 Zero VOC Primer B28W02600
 - 4. Second Coat and Finish Coat:
 - a. Flat:
 - 1) Benjamin Moore: Ultra Spec 500 Flat 535
 - 2) Kelly-Moore: 1005 KM Premium Professional Flat
 - 3) PPG Paints: Speedhide Zero Interior Flat 6-4110
 - 4) Sherwin-Williams Co.: ProMar 200 Zero VOC Flat B30W12651.

- C. Interior Ferrous Metals: Metal Railing, Hollow Metal Doors and Frames (excludes prefinished items)
 - 1. System: 1 coat primer (not required on shop-primed items in sound condition) with 2 coat finish.
 - 2. Paint Type: 100 percent Acrylic. (latex system)
 - 3. First Coat (Primer): Kwall-Howells #180-11 Corobond DTM, Rust Inhibitive Metal Primer.
 - 4. Second Coat and Finish Coat:
 - a. Semi-Gloss:
 - 1) Benjamin Moore: Ultra Spec 500 Semi-Gloss 539
 - 2) Kelly-Moore: 1050 KM Professional Semi-Gloss
 - 3) PPG Paints: Speedhide Zero Interior Semi-Gloss 6-4510XI
 - 4) Sherwin-Williams Co.: ProMar 200 Zero VOC Semi-Gloss B31-2600

- D. Interior Wood Finishes – Mezzanine Plywood:
 - 1. System: 1 coat primer with 1 coat finish.
 - 2. Paint type: Solvent-based epoxy coating.
 - 3. Primer: Manufacturer’s recommended Primer.
 - 4. Basis of Design: Dura Grip by Slip Doctors.
 - 5. Color: To be selected from Manufacturer’s standard colors.

3.09 PAINT SCHEDULE

- A. Color Schedule: Color system based on Sherwin Williams.
 - 1. P-1: Paint-Field – Greek Villa – 7551.
 - a. Finish: Flat.
 - 2. P-2: Paint-Accent – Basil – 6194.
 - a. Finish: Eggshell.
 - 3. P-3: Paint – Interior Door Frames & Railings – Iron Ore – 7069.
 - a. Finish: Semi-Gloss.
 - 4. P-4: Paint – Ceiling – High Reflective White – 7757.
 - a. Finish: Flat.
 - 5. P-5: Paint – Exterior Face of Doors – TBD.
 - a. Finish: Semi-Gloss.

END OF SECTION 09 9100

SECTION 10 1100 - VISUAL DISPLAY UNITS

PART 1 - GENERAL

1.01 SECTION INCLUDES

- A. Porcelain enamel steel markerboards.

1.02 RELATED REQUIREMENTS

- A. Section 06 1000 - Rough Carpentry: Blocking and supports.
- B. Section 09 2216 – Non-Structural Metal Framing: Concealed supports in metal stud walls.

1.03 SUBMITTALS

- A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
- B. Product Data: Provide manufacturer's data on markerboard, , trim, and accessories.
- C. Shop Drawings: Indicate wall elevations, dimensions, joint locations, special anchor details.
- D. Samples: Submit color charts for selection of color and texture of markerboard, and trim.
- E. Test Reports: Show conformance to specified surface burning characteristics requirements.
- F. Manufacturer's printed installation instructions.
- G. Maintenance Data: Include data on regular cleaning, stain removal.

1.04 QUALITY ASSURANCE

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

1.05 WARRANTY

- A. See Section 01 7800 - Closeout Submittals, for additional warranty requirements.
- B. Provide five year warranty for markerboard to include warranty against discoloration due to cleaning, crazing or cracking, and staining.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

- A. Basis of Design: Claridge Products and Equipment, Inc: www.claridgeproducts.com.
1. Claridge products are specified for type, quality and construction required.
 2. Substitutions: See Section 01 6000 – Product Requirements.

2.02 VISUAL DISPLAY UNITS

- A. Markerboards: Porcelain enamel on steel, laminated to core, magnetic.
1. Color: White, porcelain.
 2. Steel Face Sheet Thickness: 24 gage, 0.0239 inch.
 3. Core: Hardboard, manufacturer's standard thickness, laminated to face sheet.
 4. Size: 4 feet by 6 feet.
 5. Frame: Extruded aluminum, with concealed fasteners.
 6. Frame Finish: Anodized, natural.
 7. Accessories: Provide chalk tray, map rail, and double flag holder.
- B. Combination Units and Units Made of More Than One Panel: Factory-assembled markerboards in a single frame, of materials specified above.
1. Join panels of different construction with H-shaped extruded aluminum molding finished to match frame.
 2. Configuration: As indicated on drawings.
 3. Units Too Large to Ship Assembled: Fully assembled in factory, then disassembled for shipping.

2.03 MATERIALS

- A. Porcelain Enameled Steel Sheet: ASTM A424/A424M, Type I, Commercial Steel, with fired-on vitreous finish.
- B. Hardboard for Cores: ANSI A135.4, Class 1 – Tempered, S25 (smooth two sides).
- C. Natural Cork Sheet: Seamless, single-layer, compressed fine-grain cork sheet; bulletin board quality; face sanded for natural finish with surface-burning characteristics indicated.
- D. Adhesives: Type used by manufacturer.

2.04 ACCESSORIES

- A. Map Rail: Extruded aluminum, manufacturer's standard profile, with cork insert with burlap backing and runners for accessories; 1 inch (25 mm) wide overall, full width of frame.
- B. Temporary Protective Cover: Sheet polyethylene, 8 mil (0.2 mm) thick.
- C. Marker Tray: Aluminum, manufacturer's standard profile, one piece full length of markerboard, molded ends, concealed fasteners, same finish as frame.

- D. Mounting Brackets: Concealed.

PART 3 - EXECUTION

3.01 EXAMINATION

- A. Verify that field measurements are as indicated.
- B. Verify that internal wall blocking is ready to receive work and positioning dimensions are as indicated on shop drawings.

3.02 PREPARATION

- A. 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 boards in accordance with manufacturer's instructions.
- B. Secure units level and plumb.

3.04 CLEANING

- A. Clean board surfaces in accordance with manufacturer's instructions.
- B. Cover with protective cover, taped to frame.
- C. Remove temporary protective cover at Date of Substantial Completion.

END OF SECTION 10 1100

Pivot North Architecture
100% Construction Set
March 17, 2023

TWIN FALLS TRAINING FACILITY
SECTION 10 1100
VISUAL DISPLAY UNITS

SECTION 10 1400 – SIGNAGE

PART 1 - GENERAL

1.01 SECTION INCLUDES

- A. Room signage.
- B. Dimensional Characters.

1.02 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.
- F. Verification Samples: Submit samples showing colors specified.
- G. Manufacturer's Installation Instructions: Include installation templates and attachment devices.
- H. Manufacturer's Qualification Statement.

1.03 QUALITY ASSURANCE

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

1.04 DELIVERY, STORAGE, AND HANDLING

- A. Package signs as required to prevent damage before installation.
- B. Maintain this minimum temperature during and after installation of signs.

PART 2 - PRODUCTS

2.01 GENERAL

- A. Accessibility Compliance: Signs are required to comply with ADA Standards and ICC A117.1 and applicable building codes, unless otherwise indicated; in the event of conflicting requirements, comply with the most comprehensive and specific requirements.

2.02 ROOM SIGNAGE

- A. Room Identification Sign: Sign with smooth, uniform surfaces; with message and characters having uniform faces, sharp corners, and precisely formed lines and profiles; and as follows:
 - 1. Solid-Sheet Sign, Returns, and Back: Aluminum with Acrylic sheet.
 - a. Acrylic Sheet: ASTM D 4802, Type UVF (UV filtering).
 - b. Raised Graphics: Color as selected by Architect.
 - 2. Frame: Horizontal retainers and Vertical retainers to hold changeable sign panel.
 - a. Material: Aluminum.
 - b. Profile: Rounded.
 - c. Corner Condition in Elevation: Rounded to radius indicated.
 - d. Finish and Color: Extruded Aluminum – Satin Finish.
 - 3. Mounting: As indicated Manufacturer's standard method for substrates indicated.
 - 4. Surface Finish:
 - a. Integral Acrylic Sheet Color: Removable clear acrylic sheet.
 - 5. Design: Refer to Drawings.

2.03 DIMENSIONAL CHARACTERS

- A. Letters:
 - 1. Material: Extruded Aluminum.
 - 2. Color: As selected by Architect.
 - 3. Mounting: Pin-mounted to exterior building façade. Coordinate blocking for mounting.
 - 4. Design and Font: As directed by the Architect.
 - a. Text/Height: Refer to Drawings for Text and Height.

2.04 ACCESSORIES

- A. Fasteners and Anchors: Manufacturer's standard as required for secure anchorage of signage, noncorrosive and compatible with each material joined, and complying with the following:
 - 1. Use concealed fasteners and anchors unless indicated to be exposed.
 - 2. Sign Mounting Fasteners:

- a. Through Fasteners: Exposed metal fasteners matching sign finish, with type of head indicated, installed in predrilled holes.
- B. Double-Sided Tape at Glass Surfaces: Manufacturer's standard high-bond, foam-core tape, 0.045 inch (1.14 mm) thick, with adhesive on both sides.

2.05 FABRICATION

- A. General: Provide manufacturer's standard sign assemblies according to requirements indicated.
 - 1. Mill joints to a tight, hairline fit. Form assemblies and joints exposed to weather to resist water penetration and retention.
 - 2. Provide welds and brazes behind finished surfaces without distorting or discoloring exposed side. Clean exposed welded and brazed connections of flux, and dress exposed and contact surfaces.
 - 3. Conceal connections if possible; otherwise, locate connections where they are inconspicuous.
 - 4. Internally brace signs for stability and for securing fasteners.
 - 5. Provide rebates, lugs, and brackets necessary to assemble components and to attach to existing work. Drill and tap for required fasteners. Use concealed fasteners where possible; use exposed fasteners that match sign finish.
- B. Subsurface-Applied Graphics: Apply graphics to back face of clear face-sheet material to produce precisely formed image. Image shall be free of rough edges.
- C. Shop- and Subsurface-Applied Vinyl: Align vinyl film in final position and apply to surface. Firmly press film from the middle outward to obtain good bond without blisters or fishmouths.

PART 3 - EXECUTION

3.01 EXAMINATION

- A. Verify that substrate surfaces are ready to receive work.

3.02 INSTALLATION

- A. General: Install signs using mounting methods indicated and according to manufacturer's written instructions.
 - 1. Locate signs and mount at heights indicated on drawings and in accordance with ADA Standards and ICC A117.1.
 - 2. Install signs level, plumb, true to line, and at locations and heights indicated, with sign surfaces free of distortion and other defects in appearance.
 - 3. Install signs so they do not protrude or obstruct according to the accessibility standard.
 - 4. Before installation, verify that sign surfaces are clean and free of materials or debris that would impair installation.

5. Corrosion Protection: Coat concealed surfaces of exterior aluminum in contact with grout, concrete, masonry, wood, or dissimilar metals, with a heavy coat of bituminous paint.
- B. Mounting Methods:
1. Masonry Substrates: Fill holes with adhesive. Leave recess space in hole for displaced adhesive. Place sign in position and push until flush to surface, embedding studs in holes. Temporarily support sign in position until adhesive fully sets.
 2. Thin or Hollow Surfaces: Place sign in position and flush to surface, install washers and nuts on studs projecting through opposite side of surface, and tighten.
 3. Through Fasteners: Drill holes in substrate using predrilled holes in sign as template. Countersink holes in sign if required. Place sign in position and flush to surface. Install through fasteners and tighten.
 4. Double-Side Tape – Glass Surfaces: Clean bond-breaking materials from substrate surface and remove loose debris. Apply tape strips symmetrically to back of sign and of suitable quantity to support weight of sign without slippage. Keep strips away from edges to prevent visibility at sign edges. Place sign in position, and push to engage tape adhesive.
- C. Remove temporary protective coverings and strippable films as signs are installed.

END OF SECTION 10 1400

SECTION 10 2600 – WALL AND DOOR PROTECTION

PART 1 - GENERAL

1.01 SECTION INCLUDES

- A. Corner guards.
- B. Impact Resistant Panel.

1.02 RELATED REQUIREMENTS

- A. Section 05 5000 – Metal Fabrications: Anchors for attachment of work of this Section, concealed in wall.
- B. Section 06 1000 – Rough Carpentry: Blocking for wall and corner guard anchors.

1.03 SUBMITTALS

- A. Product Data: Indicate physical dimensions, features, and anchorage details.
- B. Shop Drawings: Include plans, elevation, sections, and attachment details.
- C. Samples: Submit samples illustrating component design, configurations, joinery, color and finish.
 - 1. Submit two sections of corner guards, 24 inches long.
- D. Manufacturer's Instructions: Indicate special procedures, perimeter conditions requiring special attention.
- E. Warranty Documentation: Submit manufacturer warranty and ensure tat forms have been completed in Owner's name and registered with manufacturer.
- F. 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 Stock Materials: One package(s) of minimum 36 inches long unit of each kind of covers for corner guards.
- G. Maintenance Data: Manufacturer's instructions for care and cleaning of each type of product. Include information about both recommended and potentially detrimental cleaning materials and methods.

1.04 DELIVERY, STORAGE, AND HANDLING

- A. Deliver wall and door protection items in original, undamaged protective packaging. Label items to designate installation locations.

- B. Protect work from moisture damage.
- C. Protect work from UV light damage.
- D. Do not deliver products to project site until areas for storage and installation are fully enclosed, and interior temperature and humidity are in compliance with manufacturer's recommendations for each type of item.
- E. Store products in either horizontal or vertical position, in compliance with manufacturer's instructions.

1.05 WARRANTY

- A. Correct defective Work within a one year period after Date of Substantial Completion.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

- A. Corner Guards:
 - 1. Inpro: www.inprocorp.com.
 - 2. Substitutions: See Section 01 6000 – Product Requirements.
- B. Impact Resistant Panels:
 - 1. Formica Corporation; Hardstop Panel: www.formica.com/en/us.
 - 2. Substitutions: See Section 01 6000 – Product Requirements.

2.02 PRODUCT TYPES

- A. (CG-1) Corner Guards – Flush Mounted:
 - 1. Material: Anodized aluminum.
 - 2. Width of Wings: 1 1/2 inches.
 - 3. Color: As shown on Finish Schedule or as selected by Architect from manufacturer's full range of finishes.
 - 4. Length: Refer to drawings.
- B. (WP-1) Wall Protection Panel:
 - 1. Product: Hardstop Panels by Formica.
 - 2. Panel Size: 48 inch x 96 inch.
 - 3. Panel Thickness: 0.0677 – 0.0827 inch.
 - 4. Pattern: Beige Elm 5794-NG on wood backer.
 - a. Pattern Direction: Run Grain vertically as specified on Finish Schedule.
 - 5. Seams:
 - a. Vertical Joints: Standard metal trim.
 - b. Horizontal Edges: Manufacturer's standard metal trim.
- C. Adhesives and Primers: As recommended by manufacturer.

- D. Mounting Brackets and Attachment Hardware: Appropriate to component and substrate.
- E. See Section 06 1000 – Rough Carpentry for wood blocking for wall and corner guard anchors.
- F. See Section 05 5000 – Metal Fabrications for anchor devices to be installed as work of this Section.

2.03 FABRICATION

- A. Fabricate components with tight joints, corners and seams.
- B. Form end trim closure by capping and finishing smooth.

2.04 SOURCE QUALITY CONTROL

- A. See Section 01 4000 – Quality Requirements, for additional requirements.
- B. Provide wall and door protection systems of each type from a single source and manufacturer.

PART 3 - EXECUTION

3.01 EXAMINATION

- A. Verify that rough openings, concealed blocking, and anchors are correctly sized and located.
- B. Verify that field measurements are as indicated on drawings.
- C. Verify that substrate surfaces for adhered items are clean and smooth.
- D. Start of installation constitutes acceptance of project conditions.

3.02 INSTALLATION

- A. Install components in accordance with manufacturer's instructions, level and plumb, secured rigidly in position to supporting construction.
- B. Installation Wall Protection Panels: Install in accordance with manufacturer's instructions.
 - 1. Cut and drill panels with carbide tipped saw blades, drill bits, or snips.
 - 2. Apply adhesive to the back side of the panel using trowel as recommended by adhesive manufacturer.
 - 3. Apply panels to wall with seams plumb and pattern aligned with adjoining panels.
 - 4. Install panels with manufacturer's recommended gap for panel field and corner joints.
 - 5. Seal gaps at floor, ceiling and between panels with applicable sealant to prevent moisture intrusion.
 - 6. Remove excess sealant after paneling is installed and prior to curing.

3.03 TOLERANCES

- A. Maximum Variation From Required Height: 1/4 inch.
- B. Maximum Variation From Level or Plane For Visible Length: 1/4 inch.

3.04 CLEANING

- A. Clean wall and door protection items of excess adhesive, dust, dirt and other contaminants.

END OF SECTION 10 2600

SECTION 10 2800 - TOILET ACCESSORIES

PART 1 - GENERAL

1.01 SUMMARY

- A. Section Includes:
 - 1. Toilet Accessories.

1.02 SUBMITTALS

- A. Product Data: For each type of product indicated. Include the following:
 - 1. Construction details and dimensions.
 - 2. Anchoring and mounting requirements, including requirements for cutouts in other work and substrate preparation.
 - 3. Material and finish descriptions.
 - 4. Features that will be included for Project.
- B. Product Schedule: Indicating types, quantities, sizes, and installation locations by room of each accessory required.
 - 1. Identify locations using room designations indicated.
 - 2. Identify products using designations indicated.
- C. Maintenance Data: For toilet and bath accessories to include in maintenance manuals.

1.03 QUALITY ASSURANCE

- A. Source Limitations: For products listed together in the same Part 2 articles, obtain products from single source from single manufacturer.

1.04 REGULATORY REQUIREMENTS

- A. ANSI A117.1 "Making Buildings and Facilities Accessible to and Usable by Physically Handicapped People."
- B. Public Law 101-336 "The Americans with Disabilities Act (ADA)."
- C. ADA Accessibility Guidelines (ADAAG).

1.05 COORDINATION

- A. Coordinate accessory locations with other work to prevent interference with clearances required for access by people with disabilities, and for proper installation, adjustment, operation, cleaning, and servicing of accessories.

- B. Deliver inserts and anchoring devices set into concrete or masonry as required to prevent delaying the Work.

PART 2 - PRODUCTS

2.01 MATERIALS

- A. Stainless Steel: ASTM A 666, Type 304, 0.031-inch minimum nominal thickness unless otherwise indicated.
- B. Steel Sheet: ASTM A 1008/A 1008M, Designation CS (cold rolled, commercial steel), 0.036-inch minimum nominal thickness.
- C. Galvanized-Steel Sheet: ASTM A 653/A 653M, with G60 hot-dip zinc coating.
- D. Galvanized-Steel Mounting Devices: ASTM A 153/A 153M, hot-dip galvanized after fabrication.
- E. Fasteners: Screws, bolts, and other devices of same material as accessory unit and tamper-and-theft resistant where exposed, and of galvanized steel where concealed.
- F. Chrome Plating: ASTM B 456, Service Condition Number SC 2 (moderate service).
- G. Mirrors: ASTM C 1503, Mirror Glazing Quality, clear-glass mirrors, nominal 6.0 mm thick.
- H. ABS Plastic: Acrylonitrile-butadiene-styrene resin formulation.

2.02 PUBLIC-USE TOILET ACCESSORIES

- A. Basis-of-Design Product: The design for accessories is based on products indicated on the Drawings. Subject to compliance with requirements, provide the named product or a comparable product by one of the following:
 - 1. Bobrick Washroom Equipment, Inc.
 - 2. Bradley.
 - 3. American Specialties (ASI).
 - 4. As shown on Plumbing Accessories Schedule.
- B. Mirrors: RA-2.
 - 1. Basis of Design: ASI Style 0600.
 - 2. Size: 24 inches x 48 inches.
 - 3. Finish: Matte Black.
- C. Grab Bars: RA-1.
 - 1. Basis of Design: ASI Style 3800
 - 2. Standard grab bars at each ADA restroom.
 - 3. Sizes:
 - a. 36 inch horizontal.
 - b. 42 inch horizontal.

- c. 18 inch vertical.
 - 4. Finish: Matte Black.

 - D. Coat and Clothing Hooks: RA-3.
 - 1. Basis of Design: ASI Style 7340-41.
 - 2. Height: As shown on Drawings.
 - 3. Include second coat hook at ADA height in ADA restrooms.
 - 4. Finish: Matte Black.

 - E. Shower Curtain, Rod & Hooks:
 - 1. Basis of Design: Bobrick Washroom Equipment B-207 Series.
- 2.03 FABRICATION
- A. General: Fabricate units with tight seams and joints, and exposed edges rolled. Hang doors and access panels with full-length, continuous hinges. Equip units for concealed anchorage and with corrosion-resistant backing plates.

 - B. Keys: Provide universal keys for internal access to accessories for servicing and resupplying. Provide minimum of six keys to Owner's representative.

PART 3 - EXECUTION

3.01 INSTALLATION

- A. Install accessories according to manufacturers' written instructions, using fasteners appropriate to substrate indicated and recommended by unit manufacturer. Install units level, plumb, and firmly anchored in locations and at heights indicated.

- B. Grab Bars: Install to withstand a downward load of at least 250 lbf, when tested according to ASTM F 446.

3.02 ADJUSTING AND CLEANING

- A. Adjust accessories for unencumbered, smooth operation. Replace damaged or defective items.

- B. Remove temporary labels and protective coatings.

- C. Clean and polish exposed surfaces according to manufacturer's written recommendations.

END OF SECTION 10 2800

SECTION 10 4400 - FIRE PROTECTION SPECIALTIES

PART 1 - GENERAL

1.01 SUMMARY

- A. Section includes:
 - 1. Portable fire extinguishers.
 - 2. Fire extinguisher cabinets.

1.02 REFERENCES

- A. National Fire Protection Association:
 - 1. NFPA 10 - Standard for Portable Fire Extinguishers.
- B. Underwriters Laboratories Inc.:
 - 1. UL - Fire Protection Equipment Directory.

1.03 SUBMITTALS

- A. Product Data: Submit extinguisher operational features, color and finish, anchorage details.
- B. Manufacturer's Installation Instructions: Submit special criteria and wall opening coordination requirements.
- C. Maintenance and Operating Manuals: Submit test, refill or recharge schedules and re-certification requirements.

1.04 ENVIRONMENTAL REQUIREMENTS

- A. Do not install extinguishers when ambient temperature is capable of freezing extinguisher components.

PART 2 - PRODUCTS

2.01 PORTABLE, HAND-CARRIED FIRE EXTINGUISHERS

- A. Fire Extinguishers: Type, size, and capacity for each fire protection cabinet and mounting bracket indicated.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. J. L. Industries, Inc.; a division of Activar Construction Products Group.
 - b. Larsen's Manufacturing Company.
 - 2. Valves: Manufacturer's standard.
 - 3. Handles and Levers: Manufacturer's standard.

4. Instruction Labels: Include pictorial marking system complying with NFPA 10,
- B. Dry Chemical Type Fire Extinguisher (General): Carbon steel tank, with pressure gage. Multi-purpose UL rated 4-A:60-B:C; 5 lb capacity.
 1. Class: A:B:C
 2. Size:
 - a. 5 pound

2.02 CABINETS

- A. Fire-Protection Cabinets: Surface Mounted, Recessed or Semi-Recessed (depending on wall assembly) Mounted Cabinet.
 1. Manufacturers:
 - a. J.L. Industries, Inc.
 - b. Larsen's Manufacturing Company.
 2. Basis of Design: Ambassador Series 8115V10 by JL Industries
- B. Cabinet Construction: Provide manufacturer's standard box (tub), with trim, frame, door, and hardware to suit cabinet type, trim style, and door style indicated. Weld joints and grind smooth. Miter and weld perimeter door frames.
 1. Cabinet Metal: Steel.
 2. Shelf: Same metal and finish as cabinet.
- C. Cabinet Type: Suitable for the following:
 1. Fire extinguisher.
- D. Cabinet Mounting: Suitable for the following mounting conditions:
 1. Surface Mounted, Recessed or Semi-Recessed Mounted: Cabinet box mounted within walls, as shown on Drawings.
- E. Cabinet Trim Style: Fabricate cabinet trim in one piece with rolled edges.
 1. Exposed Trim: One-piece combination trim and perimeter door frame overlapping surrounding wall surface with exposed trim face and wall return at outer edge (backbend).
 - a. Rolled-Edge Trim: 2-1/2-inch backbend depth.
- F. Cabinet Trim Material: Manufacturer's standard, as follows: Steel.
- G. Door Material: Manufacturer's standard, as follows: Steel.
- H. Door Glazing: Manufacturer's standard, as follows:
 1. Polycarbonate Acrylic Sheet: ASTM D4802, Category A-1, 6 mm thick, with Finish 1 (smooth or polished). Clear.
- I. Door Style: Manufacturer's standard design, as follows:
 1. Vertical duo panel with frame.

- J. Door Construction: Fabricate doors according to manufacturer's standards, of materials indicated, and coordinated with cabinet types and trim styles selected.
 - 1. Provide minimum 1/2-inch thick door frames, fabricated with tubular stiles and rails, and hollow-metal design.
 - 2. Provide inside latch and lock for break-glass panels.
- K. Door Hardware: Provide manufacturer's standard door-operating hardware of proper type for cabinet type, trim style, and door material and style indicated. Provide either lever handle with cam-action latch, or exposed or concealed door pull and friction latch. Provide concealed or continuous-type hinge permitting door to open 180 degrees.

2.03 ACCESSORIES

- A. Extinguisher Brackets: Formed steel, chrome-plated.
- B. Door Locks: Provide emergency release cam-lock based design.
- C. Identification: Provide lettering to comply with authorities having jurisdiction for letter style, color, size, spacing, and location. Locate as indicated by Architect.
 - 1. Identify fire extinguisher in cabinet with the words "FIRE EXTINGUISHER" applied to door.
 - a. Application Process: Silk-screened.
 - b. Lettering Color: Red.
 - c. Orientation: Vertical.

2.04 FINISHES, GENERAL

- A. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.
- B. Appearance of Finished Work: Variations in appearance of abutting or adjacent pieces are acceptable if they are within one-half of the range of approved Samples. Noticeable variations in the same piece are not acceptable. Variations in appearance of other components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

2.05 ALUMINUM FINISHES

- A. Finish designations prefixed by AA comply with the system established by the Aluminum Association for designating aluminum finishes.
- B. Class II, Clear Anodic Finish: AA-M12C22A31 (Mechanical Finish: Nonspecular as fabricated; Chemical Finish: etched, medium matte; Anodic Coating: Architectural Class II, clear coating 0.010 mm or thicker) complying with AAMA 607.1.

PART 3 - EXECUTION

3.01 EXAMINATION

- A. Examine fire extinguishers for proper charging and tagging.
 - 1. Remove and replace damaged, defective, or undercharged fire extinguishers.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 INSTALLATION

- A. General: Install fire extinguishers and mounting brackets in locations indicated and in compliance with requirements of authorities having jurisdiction.
 - 1. Mounting Brackets: 54 inches above finished floor to top of fire extinguisher.
- B. Install fire extinguisher cabinets in locations and at mounting heights indicated or, if not indicated, at heights acceptable to authorities having jurisdiction.
 - 1. Fasten cabinets to structure, square and plumb.

3.03 ADJUSTING, CLEANING, AND PROTECTION

- A. Adjust cabinet doors that do not swing or operate freely.
- B. Refinish or replace cabinets and doors damaged during installation.
- C. Provide final protection and maintain conditions that ensure that cabinets and doors are without damage or deterioration at the time of Substantial Completion.

END OF SECTION 10 4400

SECTION 11 31 00 - RESIDENTIAL APPLIANCES

PART 1 - GENERAL

1.01 SUMMARY

- A. Section includes:
 - 1. Microwave ovens.
 - 2. Refrigerator/freezers.
 - 3. Ice Maker.

1.02 SUBMITTALS

- A. Appliance Schedule: Use same room designations shown on Drawings.

1.03 DELIVERY, STORAGE AND HANDLING

- A. Deliver appliances only after utility rough-in is complete and construction in spaces to receive appliances is substantially complete and ready for installation.
- B. Storage: Adequately protect against damage while stored at the site.

PART 2 - PRODUCTS

2.01 APPLIANCES

- A. Owner Furnished Contractor Installed (OFCI): Provide installation and connections for appliances that are Owner Furnished and Contractor Installed.
 - 1. Microwave.
 - 2. Refrigerator/Freezer.
 - 3. Ice Maker.

PART 3 - EXECUTION

3.01 EXAMINATION

- A. Verification of Conditions: Examine subsurface to receive Work and report detrimental conditions in writing to Architect. Commencement of Work will be construed as acceptance of subsurface.
 - 1. Coordinate appliance model numbers and selections meet the cabinet millwork clear openings prior to purchase.
- B. Coordination: Coordinate with other work which affects, connects with, or will be concealed by this Work. Verify utility rough-ins are present and correctly located.

3.02 INSTALLATION

- A. Built-in Appliances: Securely anchor to supporting cabinetry or countertops with concealed fasteners. Verify that clearances are adequate for proper functioning and rough openings are completely concealed.
- B. Freestanding Appliances: Place in final locations after finishes have been completed in each area. Verify that clearances are adequate to properly operate equipment.

3.03 FIELD QUALITY CONTROL

- A. Tests: Test each item for proper operation. Check and adjust oven thermostats for correct temperature.

3.04 CLEANING

- A. During the course of the Work and on completion, remove and dispose of excess materials, equipment and debris away from premises. Leave Work in clean condition, wash and clean equipment.

END OF SECTION 11 3100

SECTION 12 3600 – SOLID SURFACE COUNTERTOPS

PART 1 - GENERAL

1.01 SUMMARY

- A. Section Includes: Interior quartz slabs for the following:
 - 1. Countertops.
 - 2. Side and Back splashes.
 - 3. Countertop Support Brackets.

1.02 SUBMITTALS

- A. Product Data: For each variety of quartz, accessories, and other manufactured products indicated.
- B. Shop Drawings: Include plans, elevations, sections, details, and attachments to other Work.
- C. Samples:
 - 1. For each stone and quartz type. Interior Designer to hand select each slab. Contractor to coordinate previews for review and selections. Contractor to identify quantity required for project.
 - 2. Submit 2 samples, 6 inches in length, for each color of grout required.
- D. Maintenance data: Submit stone supplier's literature or instructions for preventive care and maintenance measures pertinent to the specific stone finishes for normal maintenance and special cleaning procedures.

1.03 QUALITY ASSURANCE

- A. Installer Qualifications: An installer who employs experienced stone masons and stone fitters, who are skilled in installing interior stone facing similar in material, design, and extent to that indicated for this Project and whose products have a record of successful in-service performance.

PART 2 - PRODUCTS

2.01 SOLID SURFACE

- A. General: Provide products of material, size, and shape required for application indicated, and with a proven record of compatibility with surfaces contacted in installation.
- B. Quartz Countertops: Non-porous with built-in antimicrobial protection, installed over continuous substrate.
 - 1. MSF approved for food contact.

2. Finish on Exposed surface: Polished.
3. Exposed Self Edge Treatment: Minimum 2 cm thick; edge profile as indicated on Drawings.
4. Back and End Splashes: Same sheet material, square top; minimum 4 inch high; 1 inch deep maximum. Install at all locations abutting walls, not adjacent to cabinets, and as shown on Drawings.
5. Product/Color: Wilsonart, Desert View (Q4043); as shown on Room Finish Schedule.

2.02 COUNTER SUPPORT BRACKET

- A. Countertop Support Brackets: Extruded aluminum support brackets, ASTM B221, 6063-T5 alloy and temper, L-shaped formed by TIG-welding, deburred and ground smooth; for support of plastic laminate and simulated stone countertops as indicated on Drawings, complying with the following:
1. Basis of Design Product: Subject to compliance with requirements, provide countertop support brackets as manufactured by Rakks/Rangine Corporation or comparable products by the following:
 - a. A&M Hardware Inc.
 2. Sizes:
 - a. Up to 36 inch Deep Countertop: Model EH-1230PS; 31 inches high (unless otherwise shown on Drawings) by 30 inch deep.
 3. Horizontal Bracket Section: Tee-shape, with 2 inch deep flange and 2 to 3 inch wide web by 3/16 to 1/4 inch thick.
 4. Vertical Bracket Section: Angle, 2 inches by 2 inches by 1/4 inch thick.
 5. Capacity: Not less than 300 lbs per bracket (typical).
 - a. Up to 36 inch Deep Countertop: 450 lbs per bracket.
 6. Finish: Black.
 7. Type: Concealed, in-wall.

2.03 ACCESSORIES

- A. Adhesives:
1. General: Use only adhesives formulated for stone and recommended by their manufacturer for the application indicated.
 2. Bonding to plywood subtop: Epoxy Adhesive: ANSI A118.3.
 - a. Manufacturers: Subject to compliance with specifications, provide products as manufactured by one of the following:
 - 1) Custom Building Products.
 - 2) Laticrete International, Inc.
 - 3) Mapei Corporation.
 3. Seam Adhesive: 2-part polyester-resin type adhesive designed for joining stone with hairline joints matching color of stone. "Akemi" stone adhesive as manufactured by Wood and Stone, Inc. Manassas, VA, or as recommended by stone manufacturer. Verify compatibility of adhesive with type of stone used.
- B. Setting Shims: Resilient, non-staining plastic.

- C. Cleaner: As recommended by manufacturer.
- D. Sealant for Countertops: Silicone sealant complying with requirements in Section 07 9200 - Joint Sealants.
 - 1. Color: Clear, unless otherwise selected by Architect or Interior Designer.
 - 2. Sealant at top edges shall match wall colors.

2.04 FABRICATION

- A. Quartz Countertops:
 - 1. Fabricate countertops in the shop to the largest extent possible according to quartz manufacturer's written instructions and the AWI "Architectural Woodwork Standards."
 - a. Grade: Per pattern as specified in Finish Schedule.
 - 2. Inspect material for defects prior to fabrication.
 - a. Materials used throughout the project shall be from the same batch and bear labels with the same batch numbers.
 - b. Visually inspect materials to be used for adjacent pieces to ensure acceptable color match.
 - c. Inspect in lighting conditions similar to those existing at the job site.
 - 3. Shop fabricate to the greatest extent possible.
 - 4. Fabricate solid surface countertops to designs, sizes and thicknesses indicated and to comply with indicated standards. Sizes, profiles and other characteristics are indicated on the drawings.
 - 5. Joints: Fabricate countertops without joints to the greatest extent possible. If joints are unavoidable, submit to Architect a Drawing indicating proposed location of joints for approval prior to commencing fabrication.
 - a. Form joints between components using manufacturer's standard joint adhesive without conspicuous joints.
 - 6. Cutouts and Holes:
 - a. Undercounter Fixtures: Make cutouts for undercounter fixtures in shop using template or pattern furnished by fixture manufacturer. Form cutouts to smooth, even curves.
 - 1) Verify shape of vertical edges with Architect prior to commencing cutouts.
 - b. Counter-Mounted Fixtures: Prepare countertops in shop for field cutting openings for counter-mounted fixtures. Mark tops for cutouts and drill holes at corners of cutout locations. Make corner holes of largest radius practical.
 - 7. Rout and finish component edges with clean, sharp returns.
 - a. Rout cutouts, radii and contours to template.
 - b. Smooth edges.
 - c. Repair or reject defective and inaccurate work.

PART 3 - EXECUTION

3.01 EXAMINATION

- A. Verification of Conditions:

1. Examine subsurfaces to receive Work and report detrimental conditions in writing to Architect.
2. Commencement of Work will be construed as acceptance of subsurfaces.
3. Verify, before proceeding with this Work that required inspections of existing conditions have been completed.

3.02 PREPARATION

- A. Coordinate erection of stone and quartz with work of other trades that adjoin or tie into work.
- B. Clean surfaces which have become soiled or stained prior to setting to remove soil, stains and foreign materials. Clean by thoroughly scrubbing with fiber brushes followed by thorough drenching with clear water. Use only mild cleaning compounds that contain no caustic or harsh filler or abrasive.

3.03 INSTALLATION

A. General

1. Temporarily place and fit units in position to assure accurate fit prior to final setting. Make adjustments as required for level and fit to adjacent construction.
2. Do not lay chipped, cracked, or otherwise defective units. Remove and replace units that are chipped, cracked, broken, or otherwise defective whether before or after setting.
3. Cutting: Avoid field cutting and fitting to the greatest extent possible and obtain approval prior to proceeding. When required and approved, exposed units shall be cut with a power driven Carborundum or diamond disc blade saw or other methods as approved by Architect by skilled stone fitters. When using "wet" cutting methods, clean water shall be used on exposed units.
4. Contiguous Work: Provide reveals and openings as required to accommodate contiguous work.
5. Set units to comply with requirements indicated on Drawings and Shop Drawings. Install anchors, supports, fasteners, and other attachments indicated or necessary to secure interior stone facing in place. Shim and adjust anchors, supports, and accessories to set stone accurately in locations indicated, with uniform joints of widths indicated and with edges and faces aligned according to established relationships and indicated tolerances.
6. Provide expansion, control, and pressure-relieving joints of widths and at locations indicated.
7. Seal expansion and other joints as specified in Section 07 9200 - Joint Sealants.
8. Keep expansion joints free of plaster, mortar, grout, and other rigid materials.

B. Countertops:

1. General: Install countertops over plywood subtops with full spread of water-cleanable epoxy adhesive.
2. Bond seams with stone seam adhesive and draw seam tight and level with clamps to assure tight, level hairline seams matching stone for color and finish. Protect area adjacent to seam by masking.

3. Complete cutouts not finished in shop. Mask areas of countertops adjacent to cutouts to prevent damage while cutting.
4. Secure backsplashes to tops with concealed metal brackets at 16 inches o.c. and to walls with adhesive.
5. Apply sealant to seams and to gap between countertops and splashes in accordance with Section 07 9200 - Joint Sealants.

3.04 CONSTRUCTION TOLERANCES

- A. Construction Tolerances: Set stone to comply with the following tolerances:
1. Variation from level: 1/8 inch in 5 feet maximum.
 2. Variation from plumb: 1/16 inch in 12 inches maximum.

3.05 ADJUSTING AND CLEANING

- A. Remove and replace stonework of the following description:
1. Broken, chipped, cracked, stained or otherwise damaged stones.
 2. Defective joints.
 3. Stonework not matching approved samples.
- B. Replace in manner which results in stonework showing no evidence of replacement.
- C. Cleaning: Do not use wire brushes, acid type cleaning agents, cleaning compounds with caustic or harsh fillers, or other materials or methods which could damage stone.
- D. Clean countertop not less than 6 days after completion of grouting and pointing, using clean water and soft rags or stiff-bristle fiber brushes. Do not use wire brushes, acid-type cleaning agents, cleaning compounds with caustic or harsh fillers, or other materials or methods that could damage stone.
- E. Clean up debris, refuse and surplus material and remove from premises.

3.06 PROTECTION

- A. Furnish temporary protection for exposed stone corners and surfaces subject to injury.

END OF SECTION 12 3600

SECTION 13 3419 - METAL BUILDING SYSTEMS

PART 1 - GENERAL

1.01 SUMMARY

- A. Section Includes: All elements associated with prefabricated metal building, including but not limited to:
 - 1. Structural-steel framing.
 - 2. Metal roof panels.
 - 3. Metal wall panels.
 - 4. Foamed-insulation-core metal wall panels.
 - 5. Thermal insulation.
 - 6. Accessories.

1.02 DEFINITIONS

- A. Terminology Standard: See MBMA's "Metal Building Systems Manual" for definitions of terms for metal building system construction not otherwise defined in this Section or in standards referenced by this Section.

1.03 COORDINATION

- A. Coordinate metal panel assemblies with rain drainage work, flashing, trim, and construction of supports and other adjoining work to provide a leakproof, secure, and noncorrosive installation.

1.04 PREINSTALLATION MEETINGS

- A. Preinstallation Conference: Conduct conference at Project site.
 - 1. Review methods and procedures related to metal building systems including, but not limited to, the following:
 - a. Condition of foundations and other preparatory work performed by other trades.
 - b. Structural load limitations.
 - c. Construction schedule. Verify availability of materials and erector's personnel, equipment, and facilities needed to make progress and avoid delays.
 - d. Required tests, inspections, and certifications.
 - e. Unfavorable weather and forecasted weather conditions and impact on construction schedule.

1.05 CLOSEOUT SUBMITTALS

- A. Maintenance Data: For metal panel finishes and door hardware to include in maintenance manuals.

1.06 FIELD CONDITIONS

- A. Weather Limitations: Proceed with panel installation only when weather conditions permit metal panels to be installed according to manufacturers' written instructions and warranty requirements.

PART 2 - PRODUCTS

2.01 SYSTEM DESCRIPTION

- A. This prefabricated building system has already been purchased and approved by the Owner. Coordinate with Building Manufacturer's written information for coordination of building and connection efforts.

PART 3 - EXECUTION

3.01 EXAMINATION

- A. Examine substrates, areas, and conditions, with erector present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
- B. Before erection proceeds, survey elevations and locations of concrete- and masonry-bearing surfaces and locations of anchor rods, bearing plates, and other embedments to receive structural framing, with erector present, for compliance with requirements and metal building system manufacturer's tolerances.
 - 1. Engage land surveyor to perform surveying.
- C. Proceed with erection only after unsatisfactory conditions have been corrected.

3.02 PREPARATION

- A. Clean and prepare surfaces to be painted according to manufacturer's written instructions for each particular substrate condition.
- B. Provide temporary shores, guys, braces, and other supports during erection to keep structural framing secure, plumb, and in alignment against temporary construction loads and loads equal in intensity to design loads. Remove temporary supports when permanent structural framing, connections, and bracing are in place unless otherwise indicated.

3.03 ERECTION OF STRUCTURAL FRAMING

- A. Erect metal building system according to manufacturer's written instructions and drawings.
- B. Do not field cut, drill, or alter structural members without written approval from metal building system manufacturer's professional engineer.

- C. Set structural framing accurately in locations and to elevations indicated, according to AISC specifications referenced in this Section. Maintain structural stability of frame during erection.
- D. Base and Bearing Plates: Clean concrete- and masonry-bearing surfaces of bond-reducing materials, and roughen surfaces prior to setting plates. Clean bottom surface of plates.
 - 1. Set plates for structural members on wedges, shims, or setting nuts as required.
 - 2. Tighten anchor rods after supported members have been positioned and plumbed. Do not remove wedges or shims but, if protruding, cut off flush with edge of plate before packing with grout.
 - 3. Promptly pack grout solidly between bearing surfaces and plates so no voids remain. Neatly finish exposed surfaces; protect grout and allow to cure. Comply with manufacturer's written installation instructions for shrinkage-resistant grouts.
- E. Align and adjust structural framing before permanently fastening. Before assembly, clean bearing surfaces and other surfaces that will be in permanent contact with framing. Perform necessary adjustments to compensate for discrepancies in elevations and alignment.
 - 1. Level and plumb individual members of structure.
 - 2. Make allowances for difference between temperature at time of erection and mean temperature when structure will be completed and in service.
- F. Primary Framing and End Walls: Erect framing level, plumb, rigid, secure, and true to line. Level baseplates to a true even plane with full bearing to supporting structures, set with double-nutted anchor bolts. Use grout to obtain uniform bearing and to maintain a level base-line elevation. Moist-cure grout for not less than seven days after placement.
 - 1. Make field connections using high-strength bolts installed according to RCSC's "Specification for Structural Joints Using High-Strength Bolts" for bolt type and joint type specified.
 - a. Joint Type: Snug tightened or pretensioned as required by manufacturer.
- G. Secondary Framing: Erect framing level, plumb, rigid, secure, and true to line. Field bolt secondary framing to clips attached to primary framing.
 - 1. Provide rake or gable purlins with tight-fitting closure channels and fasciae.
 - 2. Locate and space wall girts to suit openings such as doors and windows.
 - 3. Provide supplemental framing at entire perimeter of openings, including doors, windows, louvers, ventilators, and other penetrations of roof and walls.
- H. Steel Joists and Joist Girders: Install applicable joists, girders, struts, purlins and accessories plumb, square, and true to line; securely fasten to supporting construction according to SJI's "Standard Specifications and Load Tables for Steel Joists and Joist Girders," joist manufacturer's written instructions, and requirements in this Section.
 - 1. Before installation, splice joists delivered to Project site in more than one piece.
 - 2. Space, adjust, and align joists accurately in location before permanently fastening.
 - 3. Install temporary bracing and erection bridging, connections, and anchors to ensure that joists are stabilized during construction.
 - 4. Joist Installation: Bolt joists, rafters and struts to supporting steel framework using carbon-steel bolts unless otherwise indicated.

5. Joist Installation: Bolt joists to supporting steel framework using high-strength structural bolts unless otherwise indicated. Comply with RCSC's "Specification for Structural Joints Using High-Strength Bolts" for high-strength structural bolt installation and tightening requirements.
 6. Joist Installation: Weld joist seats to supporting steel framework.
 7. Install and connect bridging concurrently with joist erection, before construction loads are applied. Anchor ends of bridging lines at top and bottom chords if terminating at walls or beams.
- I. Bracing: Install bracing in roof and sidewalls where indicated on erection drawings.
 1. Tighten rod and cable bracing to avoid sag.
 2. Locate interior end-bay bracing only where indicated.
 - J. Framing for Openings: Provide shapes of proper design and size to reinforce openings and to carry loads and vibrations imposed, including equipment furnished under mechanical and electrical work. Securely attach to structural framing.
 - K. Erection Tolerances: Maintain erection tolerances of structural framing within AISC 303.
- 3.04 METAL PANEL INSTALLATION, GENERAL
- A. Fabricate and finish metal panels and accessories at the factory, by manufacturer's standard procedures and processes, as necessary to fulfill indicated performance requirements demonstrated by laboratory testing. Comply with indicated profiles and with dimensional and structural requirements.
 - B. On-Site Fabrication: Subject to compliance with requirements of this Section, metal panels may be fabricated on-site using UL-certified, portable roll-forming equipment if panels are of same profile and warranted by manufacturer to be equal to factory-formed panels. Fabricate according to equipment manufacturer's written instructions and to comply with details shown.
 - C. Examination: Examine primary and secondary framing to verify that structural-panel support members and anchorages have been installed within alignment tolerances required by manufacturer.
 1. Examine roughing-in for components and systems penetrating metal panels, to verify actual locations of penetrations relative to seams before metal panel installation.
 - D. General: Anchor metal panels and other components of the Work securely in place, with provisions for thermal and structural movement.
 1. Field cut metal panels as required for doors, windows, and other openings. Cut openings as small as possible, neatly to size required, and without damage to adjacent metal panel finishes.
 - a. Field cutting of metal panels by torch is not permitted unless approved in writing by manufacturer.
 2. Install metal panels perpendicular to structural supports unless otherwise indicated.

3. Flash and seal metal panels with weather closures at perimeter of openings and similar elements. Fasten with self-tapping screws.
 4. Locate and space fastenings in uniform vertical and horizontal alignment.
 5. Locate metal panel splices over structural supports with end laps in alignment.
 6. Lap metal flashing over metal panels to allow moisture to run over and off the material.
- E. Lap-Seam Metal Panels: Install screw fasteners using power tools with controlled torque adjusted to compress EPDM washers tightly without damage to washers, screw threads, or metal panels. Install screws in predrilled holes.
1. Arrange and nest side-lap joints so prevailing winds blow over, not into, lapped joints. Lap ribbed or fluted sheets one full rib corrugation. Apply metal panels and associated items for neat and weathertight enclosure. Avoid "panel creep" or application not true to line.
- F. Metal Protection: Where dissimilar metals contact each other or corrosive substrates, protect against galvanic action by painting contact surfaces with corrosion-resistant coating, by applying rubberized-asphalt underlayment to each contact surface, or by other permanent separation as recommended by metal roof panel manufacturer.
- G. Joint Sealers: Install gaskets, joint fillers, and sealants where indicated and where required for weatherproof performance of metal panel assemblies. Provide types of gaskets, fillers, and sealants indicated; or, if not indicated, provide types recommended by metal panel manufacturer.
1. Seal metal panel end laps with double beads of tape or sealant the full width of panel. Seal side joints where recommended by metal panel manufacturer.
 2. Prepare joints and apply sealants to comply with requirements in Section 07 9200 "Joint Sealants."

3.05 METAL ROOF PANEL INSTALLATION

- A. General: Provide metal roof panels of full length from eave to ridge unless otherwise indicated or restricted by shipping limitations.
1. Install ridge caps as metal roof panel work proceeds.
 2. Flash and seal metal roof panels with weather closures at eaves and rakes. Fasten with self-tapping screws.
- B. Standing-Seam Metal Roof Panels: Fasten metal roof panels to supports with concealed clips at each standing-seam joint, at location and spacing and with fasteners recommended by manufacturer.
1. Install clips to supports with self-drilling or self-tapping fasteners.
 2. Install pressure plates at locations indicated in manufacturer's written installation instructions.
 3. Snap Joint: Nest standing seams and fasten together by interlocking and completely engaging factory-applied sealant.
 4. Seamed Joint: Crimp standing seams with manufacturer-approved motorized seamer tool so that clip, metal roof panel, and factory-applied sealant are completely engaged.

5. Rigidly fasten eave end of metal roof panels and allow ridge end free movement for thermal expansion and contraction. Pre-drill panels for fasteners.
 6. Provide metal closures at peaks, rake edges, rake walls and each side of ridge caps.
- C. Lap-Seam Metal Roof Panels: Fasten metal roof panels to supports with exposed fasteners at each lapped joint, at location and spacing recommended by manufacturer.
1. Provide metal-backed sealing washers under heads of exposed fasteners bearing on weather side of metal roof panels.
 2. Provide sealant tape at lapped joints of metal roof panels and between panels and protruding equipment, vents, and accessories.
 3. Apply a continuous ribbon of sealant tape to weather-side surface of fastenings on end laps and on side laps of nesting-type metal panels, on side laps of ribbed or fluted metal panels, and elsewhere as needed to make metal panels weatherproof to driving rains.
 4. At metal panel splices, nest panels with minimum 6-inch (152-mm) end lap, sealed with butyl-rubber sealant and fastened together by interlocking clamping plates.
- D. Metal Fascia Panels: Align bottom of metal panels and fasten with blind rivets, bolts, or self-drilling or self-tapping screws. Flash and seal metal panels with weather closures where fasciae meet soffits, along lower panel edges, and at perimeter of all openings.
- E. Metal Roof Panel Installation Tolerances: Shim and align metal roof panels within installed tolerance of 1/4 inch in 20 feet (6 mm in 6 m) on slope and location lines and within 1/8-inch (3-mm) offset of adjoining faces and of alignment of matching profiles.

3.06 METAL WALL PANEL INSTALLATION

- A. General: Install metal wall panels in orientation, sizes, and locations indicated on Drawings. Install panels perpendicular to girts, extending full height of building, unless otherwise indicated. Anchor metal wall panels and other components of the Work securely in place, with provisions for thermal and structural movement.
1. Unless otherwise indicated, begin metal panel installation at corners with center of rib lined up with line of framing.
 2. Shim or otherwise plumb substrates receiving metal wall panels.
 3. When two rows of metal panels are required, lap panels 4 inches (102 mm) minimum.
 4. When building height requires two rows of metal panels at gable ends, align lap of gable panels over metal wall panels at eave height.
 5. Rigidly fasten base end of metal wall panels and allow eave end free movement for thermal expansion and contraction. Pre-drill panels.
 6. Flash and seal metal wall panels with weather closures at eaves and rakes, and at perimeter of all openings. Fasten with self-tapping screws.
 7. Install screw fasteners in pre-drilled holes.
 8. Install flashing and trim as metal wall panel work proceeds.
 9. Apply elastomeric sealant continuously between metal base channel (sill angle) and concrete, and elsewhere as indicated on Drawings; if not indicated, as necessary for waterproofing.
 10. Align bottom of metal wall panels and fasten with blind rivets, bolts, or self-drilling or self-tapping screws.

11. Provide weatherproof escutcheons for pipe and conduit penetrating exterior walls.
- B. Metal Wall Panels: Install metal wall panels on exterior side of girts. Attach metal wall panels to supports with fasteners as recommended by manufacturer.
- C. Insulated Metal Wall Panels: If required to meet building envelope criteria of building location, install insulated metal wall panels on exterior side of girts. Attach panels to supports at each panel joint using concealed clip and fasteners at maximum 42 inches (1067 mm) o.c., spaced not more than manufacturer's recommendation. Fully engage tongue and groove of adjacent insulated metal wall panels.
 1. Install clips to supports with self-tapping fasteners.
 2. Apply continuous ribbon of sealant to panel joint on concealed side of insulated metal wall panels as vapor seal; apply sealant to panel joint on exposed side of panels as weather seal.
- D. Installation Tolerances: Shim and align metal wall panels within installed tolerance of 1/4 inch in 20 feet (6 mm in 6 m), noncumulative; level, plumb, and on location lines; and within 1/8-inch (3-mm) offset of adjoining faces and of alignment of matching profiles.

3.07 THERMAL INSULATION INSTALLATION

- A. General: Install insulation concurrently with metal panel installation, in thickness indicated to cover entire surface, according to manufacturer's written instructions.
 1. Set vapor-retarder-faced units with vapor retarder toward warm side of construction unless otherwise indicated. Do not obstruct ventilation spaces except for firestopping.
 2. Tape joints and ruptures in vapor retarder, and seal each continuous area of insulation to the surrounding construction to ensure airtight installation.
 3. Install factory-laminated, vapor-retarder-faced blankets straight and true in one-piece lengths, with both sets of facing tabs sealed, to provide a complete vapor retarder.
 4. Install blankets straight and true in one-piece lengths. Install vapor retarder over insulation, with both sets of facing tabs sealed, to provide a complete vapor retarder.
- B. Blanket Roof Insulation: Comply with the following installation method:
 1. Over-Framing Installation: Extend insulation and vapor retarder over and perpendicular to top flange of secondary framing. Hold in place by metal roof panels fastened to secondary framing.
 2. Between-Purlin Installation: Extend insulation and vapor retarder between purlins. Carry vapor-retarder-facing tabs up and over purlin, overlapping adjoining facing of next insulation course and maintaining continuity of retarder. Hold in place with bands and crossbands below insulation.
 3. Over-Purlin-with-Spacer-Block Installation: Extend insulation and vapor retarder over and perpendicular to top flange of secondary framing. Install layer of filler insulation over first layer to fill space formed by metal roof panel standoffs. Hold in place by panels fastened to standoffs.
 - a. Thermal Spacer Blocks: Where metal roof panels attach directly to purlins, install thermal spacer blocks.

4. Two-Layers-between-Purlin-with-Spacer-Block Installation: Extend insulation and vapor retarder between purlins. Carry vapor-retarder-facing tabs up and over purlin, overlapping adjoining facing of next insulation course and maintaining continuity of retarder. Install layer of filler insulation over first layer to fill space between purlins formed by thermal spacer blocks. Hold in place with bands and crossbands below insulation.
 - a. Thermal Spacer Blocks: Where metal roof panels attach directly to purlins, install thermal spacer blocks.
 5. Retainer Strips: Install retainer strips at each longitudinal insulation joint, straight and taut, nesting with secondary framing to hold insulation in place.
- C. Blanket Wall Insulation: Extend insulation and vapor retarder over and perpendicular to top flange of secondary framing. Hold in place by metal wall panels fastened to secondary framing.
1. Retainer Strips: Install retainer strips at each longitudinal insulation joint, straight and taut, nesting with secondary framing to hold insulation in place.
 2. Sound-Absorption Insulation: Where sound-absorption requirement is indicated for metal liner panels, cover insulation with polyethylene film and provide inserts of wire mesh to form acoustical spacer grid.
 3. Comply with building envelope requirements of building location.
- D. Board Wall Insulation: Extend board insulation in thickness indicated or as required to meet energy envelope criteria of building location, to cover entire wall. Hold in place by metal wall panels fastened to secondary framing. Comply with manufacturers' written instructions.
1. Retainer Strips: Install retainer strips at each longitudinal insulation joint, straight and taut, nesting with secondary framing to hold insulation in place.
 2. Drip edge flashing to conceal and protect exposed bottom edge of insulation and to project water to the exterior assembly.

3.08 DOOR AND FRAME INSTALLATION

- A. General: Install doors and frames plumb, rigid, properly aligned, and securely fastened in place according to manufacturers' written instructions. Coordinate installation with wall flashings and other components. Seal perimeter of each door frame with elastomeric sealant used for metal wall panels.
- B. Personnel Doors and Frames: Install doors and frames according to NAAMM-HMMA 840. Fit non-fire-rated doors accurately in their respective frames, with the following clearances:
1. Between Doors and Frames at Jambs and Head: 1/8 inch (3 mm).
 2. Between Edges of Pairs of Doors: 1/8 inch (3 mm).
 3. At Door Sills with Threshold: 3/8 inch (9.5 mm).
 4. At Door Sills without Threshold: 3/4 inch (19.1 mm).
 5. At fire-rated openings, install frames according to, and doors with clearances specified in, NFPA 80.
- C. Sectional Service Doors: Bolt support angles to opening head members through factory-punched holes. Bolt door tracks to support angles at maximum 24 inches (610 mm) o.c. Set

doors and operating equipment with necessary hardware, jamb and head mold stops, continuous hood flashing, anchors, inserts, hangers, and equipment supports.

- D. Field Glazing: Comply with installation requirements in Section 08 8000 "Glazing."
- E. Door Hardware:
 - 1. Install surface-mounted items after finishes have been completed at heights indicated in DHI's "Recommended Locations for Architectural Hardware for Standard Steel Doors and Frames."
 - 2. Set units level, plumb, and true to line and location. Adjust and reinforce attachment substrates as necessary for proper installation and operation.
 - 3. Drill and countersink units that are not factory prepared for anchorage fasteners. Space fasteners and anchors according to industry standards.
 - 4. Set thresholds for exterior doors in full bed of sealant complying with requirements for concealed mastics specified in Section 07 9200 "Joint Sealants."

3.09 WINDOW INSTALLATION

- A. General: Install windows plumb, rigid, properly aligned, without warp or rack of frames or sash, and securely fasten in place according to manufacturer's written instructions. Coordinate installation with wall flashings and other components. Seal perimeter of each window frame with elastomeric sealant used for metal wall panels.
 - 1. Separate dissimilar materials from sources of corrosion or electrolytic action at points of contact with other materials by complying with requirements specified in AAMA/WDMA/CSA 101/I.S.2/A440.
- B. Set sill members in bed of sealant or with gaskets, for weathertight construction.
- C. Install windows and components to drain condensation, water penetrating joints, and moisture migrating within windows to the exterior.
 - 1. Install flashing dams at window sills. Turn up back and side interior dams 1/2 inch vertical and seal interior corners.

3.10 ACCESSORY INSTALLATION

- A. General: Install accessories with positive anchorage to building and weathertight mounting, and provide for thermal expansion. Coordinate installation with flashings and other components.
 - 1. Install components required for a complete metal roof panel assembly, including trim, copings, ridge closures, seam covers, flashings, sealants, gaskets, fillers, closure strips, and similar items.
 - 2. Install components for a complete metal wall panel assembly, including trim, copings, corners, seam covers, flashings, sealants, gaskets, fillers, closure strips, and similar items.
 - 3. Where dissimilar metals contact each other or corrosive substrates, protect against galvanic action by painting contact surfaces with corrosion-resistant coating, by applying

rubberized-asphalt underlayment to each contact surface, or by other permanent separation as recommended by manufacturer.

- B. Flashing and Trim: Comply with performance requirements, manufacturer's written installation instructions, and SMACNA's "Architectural Sheet Metal Manual." Provide concealed fasteners where possible, and set units true to line and level. Install work with laps, joints, and seams that will be permanently watertight and weather resistant.
 - 1. Install exposed flashing and trim that is without excessive oil-canning, buckling, and tool marks and that is true to line and levels indicated, with exposed edges folded back to form hems. Install sheet metal flashing and trim to fit substrates and to result in waterproof and weather-resistant performance.
 - 2. Expansion Provisions: Provide for thermal expansion of exposed flashing and trim. Space movement joints at a maximum of 10 feet (3 m) with no joints allowed within 24 inches (600 mm) of corner or intersection. Where lapped or bayonet-type expansion provisions cannot be used or would not be sufficiently weather resistant and waterproof, form expansion joints of intermeshing hooked flanges, not less than 1 inch (25 mm) deep, filled with mastic sealant (concealed within joints).
- C. Gutters: Join sections with riveted-and-soldered or lapped-and-sealed joints. Attach gutters to eave with gutter hangers spaced as required for gutter size, but not more than 36 inches (914 mm) o.c. using manufacturer's standard fasteners. Provide end closures and seal watertight with sealant. Provide for thermal expansion.
- D. Downspouts: Join sections with 1-1/2-inch (38-mm) telescoping joints. Provide fasteners designed to hold downspouts securely 1 inch (25 mm) away from walls; locate fasteners at top and bottom and at approximately 60 inches (1524 mm) o.c. in between.
 - 1. Provide elbows at base of downspouts to direct water away from building.
 - 2. Tie downspouts to underground drainage system indicated.
- E. Roof and Wall Vents: Set mechanical vents complete with necessary hardware, anchors, dampers, weather guards, rain caps, and equipment supports. Join sections with splice plates and end-cap skirt assemblies where required to achieve indicated length. Install preformed filler strips at base to seal ventilator to metal roof or wall panels.
- F. Louvers: Locate and place louver units level, plumb, and at indicated alignment with adjacent work.
 - 1. Use concealed anchorages where possible. Provide brass or lead washers fitted to screws where required to protect metal surfaces and to make a weathertight connection.
 - 2. Provide perimeter reveals and openings of uniform width for sealants and joint fillers.
 - 3. Protect galvanized- and nonferrous-metal surfaces from corrosion or galvanic action by applying a heavy coating of corrosion-resistant paint on surfaces that will be in contact with concrete, masonry, or dissimilar metals.
 - 4. Install concealed gaskets, flashings, joint fillers, and insulation as louver installation progresses, where weathertight louver joints are required. Comply with Section 07 9200 "Joint Sealants" for sealants applied during louver installation.

- G. Roof Curbs: Install curbs at locations indicated on Drawings. Install flashing around bases where they meet metal roof panels.
- H. Pipe Flashing: Form flashing around pipe penetration and metal roof panels. Fasten and seal to panel as recommended by manufacturer.

3.11 FIELD QUALITY CONTROL

- A. Special Inspections: Owner will engage a qualified special inspector to perform field quality control special inspections and to submit reports.
- B. Product will be considered defective if it does not pass tests and inspections.
- C. Prepare test and inspection reports.

3.12 ADJUSTING

- A. Doors: After completing installation, test and adjust doors to operate easily, free of warp, twist, or distortion.
- B. Door Hardware: Adjust and check each operating item of door hardware and each door to ensure proper operation and function of every unit. Replace units that cannot be adjusted to operate as intended.
- C. Windows: Adjust operating sashes and ventilators, screens, hardware, and accessories for a tight fit at contact points and at weather stripping to ensure smooth operation and weathertight closure. Lubricate hardware and moving parts.
- D. Roof and Wall Vents and Adjustable Louvers: After completing installation, including work by other trades, lubricate, test, and adjust units to operate easily, free of warp, twist, or distortion as needed to provide fully functioning units.
 - 1. Adjust louver blades to be weathertight when in closed position.

3.13 CLEANING AND PROTECTION

- A. Repair damaged galvanized coatings on galvanized items with galvanized repair paint according to ASTM A780/A780M and manufacturer's written instructions.
- B. Remove and replace glass that has been broken, chipped, cracked, abraded, or damaged during construction period.
- C. Touchup Painting: After erection, promptly clean, prepare, and prime or reprime field connections, rust spots, and abraded surfaces of prime-painted structural framing, bearing plates, and accessories.
 - 1. Clean and prepare surfaces by SSPC-SP 2, "Hand Tool Cleaning," or by SSPC-SP 3, "Power Tool Cleaning."
 - 2. Apply a compatible primer of same type as shop primer used on adjacent surfaces.

- D. Touchup Painting: Cleaning and touchup painting are specified in Section 09 9100 – Painting.
- E. Metal Panels: Remove temporary protective coverings and strippable films, if any, as metal panels are installed. On completion of metal panel installation, clean finished surfaces as recommended by metal panel manufacturer. Maintain in a clean condition during construction.
 - 1. Replace metal panels that have been damaged or have deteriorated beyond successful repair by finish touchup or similar minor repair procedures.
- F. Doors and Frames: Immediately after installation, sand rusted or damaged areas of prime coat until smooth and apply touchup of compatible air-drying primer.
 - 1. Immediately before final inspection, remove protective wrappings from doors and frames.
- G. Windows: Clean metal surfaces immediately after installing windows. Avoid damaging protective coatings and finishes. Remove excess sealants, glazing materials, dirt, and other substances. Clean factory-glazed glass immediately after installing windows.
- H. Louvers: Clean exposed surfaces that are not protected by temporary covering, to remove fingerprints and soil during construction period. Do not let soil accumulate until final cleaning.
 - 1. Restore louvers damaged during installation and construction period so no evidence remains of corrective work. If results of restoration are unsuccessful, as determined by Architect, remove damaged units and replace with new units.
 - a. Touch up minor abrasions in finishes with air-dried coating that matches color and gloss of, and is compatible with, factory-applied finish coating.

END OF SECTION 13 3419

SECTION 21 0500 - COMMON WORK RESULTS FOR FIRE PROTECTION

PART 1 - GENERAL

1.01 RELATED DOCUMENTS:

- A. All drawings associated with the entire project, including general provisions of the Contract, including The General Conditions of the Contract for Construction, General and Supplementary Conditions and Division-1 Conditions specification sections shall apply to the Division 21, 22, and 23 specifications and drawings. The Contractor shall be responsible for reviewing and becoming familiar with the aforementioned and all other Contract Documents associated with the project.
- B. Related Sections: Refer to all sections in Division 21, 22, and 23. Refer to Division 26 specification sections and Division 26 drawings.
- C. Where contradictions occur between this section and Division 1, the more stringent requirement shall apply.
- D. Contractor shall be defined as any and all entities involved with the construction of the project.

1.02 SUMMARY:

- A. This Section specifies the basic requirements for fire protection installations and includes requirements common to more than one section of Divisions 21, 22, and 23. It expands and supplements the requirements specified in Division 1.

1.03 FIRE PROTECTION INSTALLATIONS:

- A. The Contract Documents are diagrammatic, showing certain physical relationships which must be established within the mechanical work and its interface with all other work. Such establishment is the exclusive responsibility of the Contractor. Drawings shall not be scaled for the purpose of establishing material quantities.
- B. Drawings and specifications are complementary. Whatever is called for in either is binding as though called for in both. Report any discrepancies to the Engineer and obtain written instructions before proceeding. Where any contradictions occur between the specifications and the drawings the more stringent requirement shall apply. The contractor shall include pricing for the more stringent and expensive requirements.
- C. Drawings shall not be scaled for rough-in measurements or used as shop drawings. Where drawings are required for these purposes or have to be made from field measurement, Contractor shall take the necessary measurements and prepare the drawings.
- D. The exact location for some items in this specification may not be shown on the drawings. The location of such items may be established by the Engineer during the progress of the work.

- E. The contract documents indicate required size and points of terminations of pipes, and suggest proper routes to conform to structure, avoid obstructions and preserve clearances. It is not intended that drawings indicate necessary offsets. The contractor shall make the installation in such a manner as to conform to the structure, avoid obstructions, preserve headroom and keep openings and passageways clear, without further instructions or costs to the Owner. All equipment shall be installed so access is maintained for serviceability.
 - F. Before any work is installed, determine that pipe and equipment will properly fit the space; that required piping grades can be maintained and that piping can be run as intended without interferences between systems, structural elements or work of other trades.
 - G. Verify all dimensions by field measurements.
 - H. Coordinate installation in chases, slots and openings with all other building components to allow for proper mechanical installations.
 - I. Sequence, coordinate, and integrate installations of mechanical materials and equipment for efficient flow of the work. Give particular attention to large equipment requiring positioning prior to closing-in the building.
 - J. Where mounting heights are not detailed or dimensioned, install mechanical services and overhead equipment to provide the maximum headroom possible.
 - K. Install pipe and equipment to facilitate 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.
 - L. Make allowance for expansion and contraction for all building components and piping systems that are subject to such.
 - M.** The ceiling space shall not be "layered". It is the contractor's responsibility to offset the system as required to allow installation within the identified ceiling cavity. The contractor shall include labor and material in the base bid to accommodate such offsets.
 - N. In general, all "static" piping systems shall be routed as high as possible, i.e. fire protection systems. Keep all equipment in accessible areas such as corridors and coordinate with systems and equipment from other sections.
 - O. The Contractor shall provide all labor and material necessary but not limited to the starting/stopping of all equipment, and operating/verifying the operation of all systems controls as required to accomplish all work necessary to meet construction document requirements. Contractor shall submit records of such activities to engineer and include in the O & M manuals.
- 1.04 coordination:
- A. Work out all installation conditions in advance of installation. The Contractor shall be responsible for coordination of all work, in all areas. The Contractor shall be responsible for providing all labor and material, including but not limited to all fittings, offsets, hangers, devices,

etc., necessary to overcome congested conditions at no increase in contract sum. **The Contractors base bid shall include any and all time and manpower necessary to develop such coordination efforts and shop drawings. Increases to contract sum or schedule shall not be considered for such effort.**

- B. Provide proper documentation of equipment, product data and shop drawings to all entities involved in the project. Coordination shall include, but not be limited to the following:
 - 1. Fire Protection and Fire Alarm Contractor shall provide shop drawings to all other Contractors.
 - 2. Automatic Temperature Controls, and Testing, Adjusting and Balancing Contractors shall be provided with equipment product data and shop drawings.

1.05 coordination with other divisions:

- A. General:
 - 1. Coordinate all work to conform to the progress of the work of other trades.
 - 2. Complete the entire installation as soon as the condition of the building will permit. No extras will be allowed for corrections of ill-timed work, when such corrections are required for proper installation of other work.
- B. Coordinate ceiling cavity space carefully with all trades. In the event of conflict, install systems within the cavity space allocation in the following order of priority:
 - 1. Equipment and required clearances
 - 2. Plumbing waste, cooling coil drain piping and roof drain mains and leaders.
 - 3. Ductwork mains
 - 4. Plumbing vent piping
 - 5. Low pressure ductwork and air devices.
 - 6. Electrical and communication conduits, raceways and cabletray.
 - 7. Domestic hot and cold water
 - 8. Fire sprinkler mains, branch piping and drops (locate as tight to structure as possible).
 - 9. DDC control wiring and other low voltage systems.
 - 10. Fire alarm systems.
- C. Chases, Inserts and Openings:
 - 1. Provide measurements, drawings and layouts so that openings, inserts and chases in new construction can be built in as construction progresses.
 - 2. Check sizes and locations of openings provided. Including the access panels for equipment in hard lid ceilings and wall cavities.
 - 3. Any cutting and patching made necessary by failure to provide measurements, drawings and layouts at the proper time shall be done at no additional cost in contract sum.
- D. Support Dimensions: Provide dimensions and drawings so that concrete bases and other equipment supports to be provided under other sections of the specifications can be built at the proper time.
- E. 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.

- F. Modifications required as a result of failure to resolve interferences, provide correct shop drawings or call attentions to changes required in other work as result of modifications shall be paid for by responsible Contractor/Subcontractor.
- G. Coordination with Electrical Work: Refer to Division 1 and 26.

1.06 design work required by contractor:

- A. The construction of this project requires the Contractor to include the detailing and design of several systems and/or subsystems. All such design work associated with the development of shop drawings shall be the complete responsibility of the Contractor.
- B. The Contractor shall take the full responsibility to develop and complete routing strategies which will allow fully coordinated system to be installed in a fully functional manner. The Engineers contract drawings shall be for system design intent and general configurations.
- C. Systems or subsystems which require design responsibility by the contractor include but are not limited to:
 - 1. Final coordinated distribution of fire protection and other systems within the ceiling cavity.
 - 2. Any system not fully detailed
 - 3. Equipment supports, hangers, anchors and seismic systems not fully detailed nor specified in these documents, or catalogued by the manufacturer.
 - 4. Seismic restraint systems
- D. Design Limitations:
 - 1. The Contractor shall not modify the Engineers design intent in any way.
 - 2. The Contractor shall not change any pipe size or equipment size without prior written approval from the Engineer.
 - 3. The Contractor shall conform to the NFPA and IFC when design and installing fire protection systems.

1.07 PROJECT CONDITIONS:

- A. Protect all work against theft, injury or damage from all causes until it has been tested and accepted.
- B. Be responsible for all damage to the property of the Owner or to the work of other contractors during the construction and guarantee period. Repair or replace any part of the work which may show defect during one year from the final acceptance of all work, provided such defect is, in the opinion of the Architect, due to imperfect material or workmanship and not due to the Owner's carelessness or improper use.

1.08 SAFETY:

- A. Refer to Division 1.

1.09 EQUAL EMPLOYMENT OPPORTUNITY REQUIREMENTS:

- A. Refer to Division 1 and conform with the State and Owners requirements.

1.10 REQUIREMENTS OF REGULATORY AGENCIES:

- A. Refer to Division 1.
- B. Execute and inspect all work in accordance with all Underwriters, local and state codes, rules and regulations applicable to the trade affected as a minimum, but if the plans and/or specifications call for requirements that exceed these rules and regulations, the greater requirement shall be followed. Follow recommendations of NFPA, , EPA, and OSHA.
- C. Comply with the local and state codes adopted by the Authorities Having Jurisdictions at the time of permit application, including referenced standards, amendments and policies as outlined and adopted by State Fire Marshal.
- D. Comply with standards in effect at the date of these Contract Documents, except where a standard or specific date or edition is indicated.
- E. After entering into contract, Contractor will be held to complete all work necessary to meet these requirements without additional expense to the Owner.

1.11 REQUIREMENTS OF LOCAL UTILITY COMPANIES:

- A. Comply with rules and regulations of local utility companies. Include in bid the cost of all valves, valve boxes, meter boxes, meters and such accessory equipment which will be required but not provided by Local Utility Company for the project.
- B. Utility Connections:
 - 1. Coordinate connection of fire protection systems with exterior underground and overhead utilities and services. Comply with requirements of governing regulations, franchised service companies and controlling agencies. Provide required connection for each service.
 - 2. The contract documents indicate the available information on existing utilities and services and on new services (if any) to be provided to the project by utility companies and agencies. Notify Engineer immediately if discrepancies are found.

1.12 PERMITS AND FEES:

- A. Refer to Division 1.
- B. The Contractor shall pay all tap, development, meter, etc., fees required for connection to municipal and public utility facilities, unless directed otherwise by the General Contractor/Owner – IN WRITING.
- C. Contractor shall arrange for and pay for all inspections, licenses and certificates required in connection with the work.

1.13 PROJECT SEISMIC REQUIREMENTS:

- A. Installation shall comply with the local seismic requirements for the area of installation. Provide restraints, bracing, anchors, vibration isolation, seismic snubbers, and all other components required for the installation.
- B. All systems shall be installed to meet NFPA and IBC Seismic requirements.
 - 1. Where any conflicts arise the more stringent requirements shall be applicable.
 - 2. The design of the seismic requirements shall be the full responsibility of the Contractor.

1.14 PRODUCT OPTIONS AND SUBSTITUTIONS:

- A. Refer to the Instructions to Bidders and Division 1.
- B. The burden of proof that proposed equipment is equal in size, capacity, performance, and other pertinent criteria for this specific installation, or superior to that specified is up to the Contractor. If substitutions are not granted, the specified materials and equipment must be installed. Where substituted equipment is allowed, it shall be the Contractor's responsibility to notify all related trades of the accepted substitution and to assume full responsibility for all costs caused as a result of the substitution.
- C. Bidders opting to bid or propose comparable products (either a product by a listed acceptable manufacturer in the respective specification section or a substitution request) are responsible for:
 - 1. Confirming the equipment they are bidding will fit in the space available, incorporating equipment's clearance requirements.
 - 2. Coordination of any variance from basis-of-design in weight, electrical requirements, other utility requirements, etc. with other trades.
 - 3. Inclusion in the bid of any applicable costs for changes in prime bidder's and their sub bidders' work required to accommodate the utilization of the comparable product.
 - 4. The contractor shall bear any and all responsibility including any changes to mechanical, plumbing, electrical, structural or architectural design. These changes shall be clearly identified and presented to the Design Team.

1.15 SUBMITTALS:

- A. General
 - 1. Refer to the Conditions of the Contract (General and Supplementary), Division 1.
 - 2. Contractor shall provide a submittal schedule appropriate for the size and schedule of the project. Limit the number of large submittals being reviewed at one time and coordinate timing of sections that are dependent on each other.
 - 3. The Contractor shall identify any "long lead time" items which may impact the overall project schedule. If these submittal requirements affect the schedule, the Contractor shall identify the impacts and confer with the Engineer within two weeks of entering into the contract.
 - 4. The front of each submittal package shall be identified with the specification section number, job name, Owner's project number, date, Prime Contractor and Sub-Contractor's

- names, addresses, and contact information, etc. Each Specification Section shall be submitted individually and submittal shall be tabbed for the equipment/materials/etc. within the section. Submittals that are not complete with the required information will not be reviewed and will be sent back to be corrected.
5. Submittals shall be provided electronically. All electronic submittals need to be complete with all design information and stamped for conformity by the contractor. Submittals will be reviewed, marked appropriately and returned by the same means received.
 6. An index shall be provided which includes:
 - a. Product
 - b. Plan Code (if applicable)
 - c. Specification Section
 - d. Manufacturer and Model Number
 7. Submittal schedule shall be provided for review within four (4) working weeks from award of contract to successful bidder or as required by Division 1.
- B. Basis of Design: The manufacturer's material or equipment listed in the schedule or identified by name on the drawings are the basis of design and provided for the establishment of size, capacity, grade and quality. If the contractor proposes alternates or substitutions in lieu of the scheduled names, the cost of any changes in construction required by their use shall be borne by Contractor.
- C. Contractor Review: Submittal of shop drawings, product data and samples will be accepted only when submitted by and stamped by the General Contractor. Each submittal shall be reviewed by the State Fire Marshal and Authority having Jurisdiction and stamped by the respective Fire Marshall prior to submittal to the Architect/Engineer. Any submittal not stamped or complete will be sent back. Data submitted from Subcontractors and material suppliers directly to the Engineer will not be processed unless prior written approval is obtained by the Contractor.
- D. Submittal Review Process: Before starting work, prepare and submit to the Architect/Engineer shop drawings and descriptive equipment data required for the project. Continue to submit in the stated format after each Architect/Engineer's action until a "No Exception Taken" or "Make Correction Noted" action is received. When a "Make Corrections Noted" is received, make the required corrections for inclusion in the Operating and Maintenance Manual (O&M). Submittals marked "Make Corrections Noted" shall not be resubmitted during the submittal process. Unless each item is identified with specification section and sufficient data to identify its compliance with the specifications and drawings, the item will be returned "Revise and Resubmit". Where an entire submittal package is returned for action by the Contractor, the Engineer may summarize comments in letter format and return the entire set. Submittals shall be prepared per the SUBMITTAL CHECKLIST, at the end of this section.
- E. The Design Professional's review and appropriate action on all submittals and shop drawings is only for the limited purpose of checking for conformance with the design concept and the information expressed in the contract documents. This review shall not include:
1. Accuracy or completeness of details, such as quantities, dimensions, weights or gauges, fabrication processes
 2. Construction means or methods
 3. Coordination of the work with other trades

4. Construction safety precautions

- F. The Design Professional's review shall be conducted with reasonable promptness while allowing sufficient time in the Design Professional's judgment to permit adequate review. Review of a specific item shall not indicate that the Design Professional has reviewed the entire assembly of which the item is a component.
- G. The Design Professional shall not be responsible for any deviations from the contract documents not brought specifically to the attention of the Design Professional in writing by the Contractor. This shall clearly identify the design and the specific element which vary from the Design. The Contractor shall be responsible for all remedy for lack of strict conformance associated with this criteria.
- H. The Design Professional shall not be required to review partial submissions or those for which submissions of correlated items have not been received.
- I. If more than two submittals (either for product data, shop drawings, record drawings, or test and balance reports) are made by the Contractor, the Owner reserves the right to charge the Contractor for subsequent reviews by their consultants. Such extra fees shall be deducted from payments by the Owner to the Contractor.
- J. The contractor shall cloud all changes made on submittals that are marked "Revise and Resubmit."
- K. Required Submittals: Provide submittals for each item of equipment specified or scheduled in the contract documents. See table at the end of this section.

1.16 SPECIFIC CATEGORY SUBMITTAL REQUIREMENTS:

- A. Product Listing:
 - 1. Prepare listing of major I equipment and materials for the project, within (2) two weeks of signing the Contract Documents and transmit to the Architect. A sample schedule is included at the end of this section to complete this requirement.
 - a. Provide all information requested.
 - b. Submit this listing as a part of the submittal requirement specified in Division 1, "PRODUCTS AND SUBSTITUTION."
 - 2. Unless otherwise specified, all materials and equipment shall be of domestic (USA) manufacture and shall be of the best quality used for the purpose in commercial practice.
 - 3. When two or more items of same material or equipment are required (pipe, valves, sprinklers, fittings, etc.) they shall be of the same manufacturer. Product manufacturer uniformity does not apply to raw materials, bulk materials, pipe, tube, fittings (except flanged and grooved types), wire, steel bar stock, welding rods, fasteners, and similar items used in work, except as otherwise indicated.
 - a. Provide products which are compatible within systems and other connected items.
- B. Schedule of Values

1. Provide preliminary schedule of values with product data submittal, within three (3) weeks from award of contract to successful bidder. Provide according to the following descriptions:
 - a. Site Utilities
 - b. Fire Protection
 - 1) Equipment
 - 2) Piping rough in
 - 3) Piping finish
 - 4) Testing and training
 2. Provide a final Schedule of Values at close-out of project including updated values based on actual installation.
- C. Product Data:
1. Where pre-printed data covers more than one distinct product, size, type, material, trim, accessory group or other variation, mark submitted copy with black pen to indicate which of the variations is to be provided.
 2. Delete or mark-out portions of pre-printed data which are not applicable.
 3. Where operating ranges are shown, mark data to show portion of range required for project application.
 4. For each product, include the following:
 - a. Sizes.
 - b. Weights.
 - c. Speeds.
 - d. Capacities.
 - e. Piping and electrical connection sizes and locations.
 - f. Statements of compliance with the required standards and regulations.
 - g. Performance data.
 - h. Manufacturer's specifications.
- D. Shop Drawings:
1. Shop Drawings are defined as sprinkler system layout drawings prepared specifically for this project, or fabrication and assembly type drawings of system components to show more detail than typical pre-printed materials.
 2. Prepare Shop Drawings, except diagrams, to accurate scale, min 1/8"-1'-0", unless otherwise noted.
 - a. Show clearance dimensions at critical locations.
 - b. Show dimensions of spaces required for operation and maintenance.
 - c. Show interfaces with other work, including structural support.
- E. Test Reports:
1. Submit test reports which have been signed and dated by the accredited firm or testing agency performing the test.
 2. Prepare test reports in the manner specified in the standard or regulation governing the test procedure (if any) as indicated.
 3. Submit test reports as required for O & M manuals.
- F. Operation and Maintenance Data: See separate paragraph of this specification section.

- G. Record Drawings: See separate paragraph of this specification section.

1.17 DELIVERY, STORAGE, AND HANDLING:

- A. Refer to Division 1 Sections on Transportation and Handling and Storage and Protection.
- B. Deliver products to project properly identified with names, model numbers, types, grades, compliance labels and similar information needed for distinct identifications; adequately packaged and protected to prevent damage or contamination during shipment, storage, and handling.
- C. Check delivered equipment against contract documents and submittals.
- D. Store equipment and materials at the site, unless off-site storage is authorized in writing. Protect stored equipment and materials from damage, dirt, dust, freezing, heat and moisture.
- E. Coordinate deliveries of materials and equipment to minimize construction site congestion. Limit each shipment of materials and equipment to the items and quantities needed for the smooth and efficient flow of installations.
- F. Provide factory-applied plastic end-caps on each length of pipe and tube. Maintain end-caps through shipping, storage and handling to prevent pipe-end damage and prevent entrance of dirt, debris and moisture.
- G. Protect stored pipes and tubes. Elevate above grade and enclose with durable, waterproof wrapping. When stored inside, do not exceed structural capacity of the floor.
- H. Protect flanges, fittings and specialties from moisture and dirt by inside storage and enclosure, or be packaging with durable, waterproof wrapping.

1.18 CUTTING AND PATCHING:

- A. Refer to Division 1.
- B. Do not endanger or damage installed work through procedures and processes of cutting and patching.
- C. Arrange for repairs required to restore other work, because of damage caused as a result of mechanical installations.
- D. No additional compensation will be authorized for cutting and patching work that is necessitated by ill-timed, defective or non-conforming installations.
- E. Perform cutting, fitting and patching of mechanical equipment and materials required to:
 1. Uncover work to provide for installation of ill-timed work;
 2. Remove and replace defective work;
 3. Remove and replace work not conforming to requirements of the Contract Documents;
 4. Remove samples of installed work as specified for testing;

5. Install equipment and materials in existing structures;
 6. Upon written instructions from the Architect/Engineer, uncover and restore work to provide for Architect /Engineer observation of concealed work.
- F. Cut, remove and legally dispose of selected mechanical equipment, components, and materials as indicated, including, but not limited to removal of piping, sprinklers, and other items made obsolete by the new work.
- G. Protect the structure, furnishings, finishes and adjacent materials not indicated or scheduled to be removed.
- 1.19 ROUGH-IN:
- A. Verify final locations for rough-ins with field measurements and with the requirements of the actual equipment to be connected.
 - B. Refer to equipment shop drawings and manufacturer's requirements for actual provided equipment for rough-in requirements.
 - C. Work through all coordination before rough-in begins.
- 1.20 EXCAVATING AND BACKFILLING:
- A. General:
 1. Provide all necessary excavation and backfill for installation of work in accordance with Division 2.
 2. In general, follow all regulations of OSHA as specified in Part 1926, Subpart P, "Excavations, Trenching and Shoring."
 - B. Contact Owners of all underground utilities to have them located and marked, at least 2 business days before excavation is to begin. Also, prior to starting excavation brief employees on marking and color codes and train employees on excavation and safety procedures for natural gas lines. When excavation approaches gas lines, expose lines by carefully probing and hand digging.
 - C. Pipe Trenching:
 1. Provide all necessary pumping, cribbing and shoring.
 2. Walls of all trenches shall be a minimum of 6 inches clearance from the side of the nearest mechanical work. Install pipes with a minimum of 6 inches clearance between them when located in same trench.
 3. Dig trenches to depth, width, configuration, and grade appropriate to the piping being installed. Dig trenches to 6 inches below the level of the bottom of the pipe to be installed. Install 6 inches bed of pea gravel or squeegee, mechanically tamp to provide a firm bed for piping, true to line and grade without irregularity. Provide depressions only at hubs, couplings, flanges, or other normal pipe protrusions.
 - D. Backfilling shall not be started until all work has been inspected, tested and accepted. All backfill material shall be reviewed by the soils engineer. In no case shall lumber, metal or other debris be buried in with backfill.

1. Provide detectable warning tape for marking and locating underground utilities. Tape shall be specifically manufactured for this purpose and shall be polyethylene film, 6 inches wide, 0.004 inches thick and have a minimum strength of 1750 psi and metal strips. Tape shall carry continuous inscription naming the specific utility.
 - a. Tape shall have magnetic strip and be used for exterior underground systems.
 - E. Trench Backfill:
 1. Backfill to 12 inches above top of piping with pea gravel or squeegee, the same as used for piping bed, compact properly.
 2. Continue backfill to finish grade, using friable material free of rock and other debris. Install in 6 inch layers, each properly moistened and mechanically compacted prior to installation of ensuing layer. Compaction by hydraulic jetting is not permissible.
 - F. After backfilling and compacting, any settling shall be refilled, tamped, and refinished at this contractor's expense.
 - G. This contractor shall repair and pay for any damage to finished surfaces.
 - H. Use suitable excavated material to complete the backfill, installed in 6 inch lifts and mechanically compacted to seal against water infiltration. Compact to 95 percent for the upper, 30 inches below paving and slabs and 90 percent elsewhere.
- 1.21 CLEANING:
- A. Refer to Division 1.
- 1.22 RECORD DOCUMENTS:
- A. Refer to Division 1. The following paragraphs supplement the requirements of Division 1.
 - B. Keep a complete set of record document prints in custody during entire period of construction at the construction site. Documents shall be updated on a weekly basis.
 - C. Mark Drawing Prints to indicate revisions to piping, size and location both exterior and interior; including locations of devices, and similar units requiring periodic maintenance or repair; actual inverts and locations of underground piping; mains and branches of piping systems, with valves and devices located and numbered, and with items requiring maintenance located; Change Orders. Changes to be noted on the drawings shall include final location of any piping relocated more than 1foot-0inches from where shown on the drawings.
 - D. Mark shop drawings to indicate approved substitutions; Change Orders; actual equipment and materials used.
 - E. Revisions to the Contract Documents shall be legible and shall be prepared using the following color scheme:
 1. Red shall indicate new items, deviations and routing.
 2. Green shall indicate items removed or deleted.
 3. Blue shall be used for relevant notes and descriptions.

- F. At the completion of the project, obtain from the Architect a complete set of the Mechanical Contract Documents in a read-only electronic format (.pdf unless otherwise noted). This set will include all revisions officially documented through the Architect/Engineer. Using the above color scheme, transfer any undocumented revisions from the construction site record drawings to this complete set. Submit completed documents to the Architect/Engineer. This contract will not be considered completed until these record documents have been received and reviewed by the Architect/Engineer.
- G. Contractor may propose methods of maintaining record documents on electronic media. Obtain approval of Engineer and Owner prior to proceeding. Marked-up .pdf format readable by Bluebeam is preferred.

1.23 OPERATION AND MAINTENANCE DATA:

- A. No later than four (4) weeks prior to the completion of the project provide one complete set of Operating and Maintenance Manuals, or as specified in Sections of Division 1 (whichever is more stringent).
- B. The testing report shall be submitted and received by the Engineer at least fifteen calendar days prior to the contractor's request for final observation time frame requirements. Include in the O & M Manual after review with "No Exceptions Taken" has been accomplished.
- C. In addition to the information required by Division 1 for Maintenance Data, include the following information:
 - 1. The job name and address and contractor's name and address shall be identified at the front of the electronic submittal.
 - 2. Engineering data and tests, and complete nomenclature and commercial numbers of all replaceable parts.
 - 3. Manufacturer's service manuals for all equipment provided under this contract.
 - 4. Name, Address and Telephone numbers of the Sub-contractors and local company and party to be contacted for 24-hour service and maintenance for each item of equipment.
 - 5. Complete recommended spare parts list.
 - 6. System and Equipment Warranties.
 - 7. Copies of all test reports shall be included in the manuals.
 - 8. Provide manuals with dividers for major sections and special equipment. Mark the individual equipment when more than one model or make is listed on a page. Provide detailed table of contents.
 - 9. Final schedule of values with all mechanical change order costs included and identified.
 - 10. Contractor may propose methods of maintaining record documents on electronic media. Obtain approval of Engineer and Owner prior to proceeding. Marked-up PDF format readable by Bluebeam is preferred.
- D. This contract will not be considered completed nor will final payment be made until all specified material, including test reports, and final Schedule of Values with all change order costs included and identified is provided and the manual is reviewed by the Architect/Engineer.

1.24 PROJECT CLOSEOUT List:

- A. In addition to the requirements specified in Division 1, complete the requirements listed below.
- B. The Contractor shall be responsible for the following Submittal Checklist either by performing and/or coordinating such items prior to applying for certification of substantial completion. Refer to individual specification sections for additional requirements. (Checklist is located at the end of this section.)

1.25 WARRANTIES:

- A. Refer to the Division 1 for procedures and submittal requirements for warranties. Refer to individual equipment specifications for warranty requirements. In any case the entire mechanical system shall be warranted no less than one year from the time of acceptance by the Owner.
- B. Provide complete warranty information for each item to include product or equipment to include date or beginning of warranty or bond; duration of warranty or bond; and names, addresses, and telephone numbers and procedures for filing a claim and obtaining warranty services.

1.26 CONSTRUCTION REQUIREMENTS:

- A. The contractor shall maintain and have available at the jobsite current information on the following at all times:
 1. Up to date record drawings.
 2. Submittals
 3. Site observation reports with current status of all action items.
 4. Test results; including recorded values, procedures, and other findings.
 5. Outage information.

1.27 SUBMITTAL CHECKLIST:

Spec Section	Item	Requirements							
		Submittals			Supplemental		Factory Rep Super-Vision At Site	Training Req'd At Site	Extra Material
		Shop Drawings	Product Data	Include In O & M	Test ³	Report ³			
21 0500	Common Work Results for Fire Suppression	X	X	X	X	X		X	X
211000	Water Based Fire Protection	X	X	X	X	X		X	X
Notes:		¹ For Starters and Variable Frequency Drives ² Requires Review & Approval of calibrated balance valves from T & B Contractor ³ See Specific Specification Section for Test & Certification Requirements							

END OF SECTION 21 0500

Pivot North Architecture
100% Construction Set
March 17, 2023

TWIN FALLS TRAINING FACILITY
SECTION 21 0500
COMMON WORK RESULTS FOR FIRE PROTECTION

SECTION 21 1000 - WATER BASED FIRE PROTECTION

PART 1 - GENERAL

1.01 DESCRIPTION OF WORK:

- A. This Section specifies automatic sprinkler systems for buildings and structures. Materials and equipment specified in this Section include:
 - 1. Pipe, fittings, valves and specialties.
 - 2. Sprinklers and accessories.
- B. Products furnished and installed include sprinkler head cabinet with spare sprinkler heads.
- C. The work of this section includes design responsibility to be performed by a NICET Level III technical for the system being provided

1.02 DEFINITIONS:

- A. Pipe sizes used in this Specification are Nominal Pipe Size (NPS).
- B. Other definitions for fire protection systems are listed in NFPA Standards 13, 13R, 14, 20 and 24.
- C. Working plans as used in this Section means those documents (including drawings and calculations) prepared pursuant to the requirements contained in NFPA 13 and 14 for obtaining approval of the authority having jurisdiction.

1.03 SYSTEM DESCRIPTION:

- A. Provide a complete fire sprinkler system for the entire building except designated areas as shown on the drawings which will not require fire sprinkler coverage and will be specifically noted with "No A/S"
- B. Fire protection system is a "wet-pipe" system employing automatic sprinklers attached to a piping system containing water and connected to a water supply so that water discharges immediately from sprinklers opened by fire.

1.04 PROJECT SEISMIC REQUIREMENTS:

- A. All fire protection systems shall be installed to meet NFPA requirements. Refer to structural drawings for seismic design requirements. Provide seismic bracing as required by NFPA.
 - 1. Where any conflicts arise the more stringent requirements shall be applicable.

1.05 SUBMITTALS:

- A. Product data for each type sprinkler head, valve, piping and piping specialty, fire protection specialty, fire department connection and any equipment installed in accordance with the Contract Documents. Index per specification chapter and item number.
- B. Shop drawings prepared in accordance with NFPA 13 identified as "working plans," including detailed riser schematics indicating pipe sizes and lengths; and hydraulic calculations, which have been approved by the authority having jurisdiction. Do not proceed with the installation of the work until Authority having Jurisdiction has approved the shop drawings and the the Architect/Engineer review of shop drawings is received.
- C. Contractor shall stamp shop drawings indicating compliance with applicable codes and contract drawings. Contractor shall stamp drawing "Approved for Construction."
- D. If more than two submittals (either for shop drawings or for record drawings) are made by the contractor, the Owner reserves the right to charge the contractor for subsequent reviews by their consultants. Such extra fees shall be deducted from payments by the Owner to the contractor.
- E. Maintenance data for each type sprinkler head, valve, piping specialty, fire protection specialty, fire department connection and hose valve specified, for inclusion in operating and maintenance manual specified in Division 1 and Division-21 Section "Common Work Results for Fire Protection".
- F. Welder's qualification certificate.
- G. Test reports and certificates including "Contractor's Material and Test Certificate for Aboveground Piping" and "Contractor's Materials and Test Certificate for Underground Piping" as described in NFPA 13.
- H. Fire sprinkler piping design drawings shall show all ductwork, air devices, lighting and electrical panels.
- I. Shop drawings and hydraulic calculations shall be stamped and signed by the local fire prevention authority prior to submitting shop drawings to the Architect/Engineer.

1.06 HYDRAULIC DESIGN:

- A. The Fire Sprinkler System shall be hydraulically calculated by the Contractor. Pipe schedule method is acceptable only as allowed in NFPA 13 and local Fire Marshal.
- B. The wet pipe fire sprinkler system for the building shall be hydraulically calculated to comply with NFPA-13 and the following criteria:
 - 1. Light hazard occupancy for areas unless noted otherwise
 - 2. Ordinary hazard occupancy Group 1 for the following and per NFPA
 - a. Mechanical equipment rooms
 - b. Electrical equipment rooms

- c. Telecomm/Technology equipment rooms
 - d. Enclosed Garages
 - 3. Hose allowance shall comply with NFPA-13.
 - C. The final fire protection system demand shall be a minimum of 10 PSI below the water supply curve.
 - D. Velocities in pipes shall be shown on hydraulic calculations. Velocities in overhead piping shall not exceed 32 feet per second. Velocities in underground piping shall not exceed 16 feet per second per NFPA.
 - E. Allow 10 feet of loss for electric water flow switches and note on hydraulic calculations.
 - F. The Fire Protection Contractor shall provide as many sets of hydraulic calculations as necessary, performed and submitted to prove that the most remote and demanding areas are calculated.
 - G. Design information shall be permanently affixed to the main riser as described in NFPA-13.
 - H. The Fire Protection Contractor shall be responsible for water flow data from the appropriate water department. A copy of the water flow test data from the water department shall accompany the hydraulic calculations before hydraulically calculating equipment fire sprinkler system.
 - I. The pipe and valve sizes indicated on the drawings and details are minimum sizes to be used regardless of sizes allowed by hydraulic calculations.
 - J. If flexible sprinkler pipe heads are used increased pressure drop shall be included in hydraulic calculations.
- 1.07 QUALITY ASSURANCE:
- A. Installer Qualifications: Installation and alterations of fire protection piping, equipment, specialties, and accessories, and repair and servicing of equipment shall be performed only by qualified installer. The contractor shall be licensed for the design and installation for the specific type of system in the jurisdiction where the work is to be performed and the State Fire Marshal. Upon request, submit evidence of such qualifications to the Engineer. Refer to Division-1 Section: "Definitions and Standards" for definitions for "Installers."
 - B. Qualifications for Welding Processes and Operators: Comply with the requirements of AWS D10.9, Specifications of Qualifications of Welding Procedures and Welders for Piping and Tubing, Level AR-3."
 - C. Regulatory Requirements: Comply with the requirements of the following codes:
 - 1. NFPA 13 - Standard for the installation of Sprinkler System, including applicable seismic requirements.
 - 2. UL and FM Compliance: All fire protection system materials and components shall be Underwriter's Laboratories and Factory Mutual listed as well as labeled for the application anticipated.

3. National Electrical Code (NEC).
4. International Building Codes, including applicable seismic requirements.
5. Requirements of the local Building Department and Fire Department.
6. FM Design Compliance: the design of the fire protection system shall be in accordance with FM Global Design Standards.

- D. Reference and standards listed are minimum requirements. Where more stringent requirements are specified or noted on the drawings, those shall be applicable.

1.08 SEQUENCING AND SCHEDULING:

- A. Schedule rough-in installations with installations of other building components.
- B. Minimum time frame for notice of inspections, tests and meetings is five (5) days and list the persons to be notified.

1.09 EXTRA STOCK:

- A. Heads: For each style and temperature range (and length for dry heads) required, furnish additional sprinkler heads per NFPA-13.
 1. Obtain receipt from Owner that extra stock has been received.
- B. Wrenches: Furnish 2 wrenches for each type and size of valve connection and fire hose coupling.

PART 2 - PRODUCTS

2.01 MATERIALS AND PRODUCTS:

- A. General: Provide piping materials and factory-fabricated piping products of sizes, types, pressure ratings, temperature ratings, and capacities as indicated. Where not indicated, provide proper selection as determined by Installer to comply with installation requirements. Provide sizes and types matching piping and equipment connections; provide fittings of materials which match pipe materials used in fire protection systems.
- B. All equipment used on this project shall be new and UL listed unless noted or specified otherwise.

2.02 MANUFACTURERS:

- A. Manufacturer: Subject to compliance with requirements, provide fire protection system products from one of the following:
 1. Gate Valves:
 - a. Nibco
 - b. Kennedy Valve
 - c. Mueller
 - d. Stockham
 - e. Grinnell

- f. Milwaukee
2. Swing Check Valves:
 - a. Central
 - b. Mueller
 - c. Kennedy Valve
 - d. Star Sprinkler Corp.
 - e. Viking
 - f. Victaulic
 - g. Globe
 - h. Potter Roemer
3. Butterfly and Ball Valves:
 - a. Grinnell
 - b. Mueller
 - c. Victaulic
 - d. Milwaukee
 - e. Kennedy
4. Grooved Mechanical Couplings:
 - a. Gruvlok
 - b. Victaulic Company of America
 - c. Central Sprink, Inc.
5. Double Check Valve Assembly:
 - a. Febco Model 850
 - b. Watts Model 709
 - c. Conbraco 40-100
 - d. Ames Model 2000 (epoxy)
6. Fire Department Connection:
 - a. Croker
 - b. Potter-Roemer
 - c. Elkhart
 - d. Grinnell/Gem
 - e. Guardian
 - f. GMR
 - g. Wilson
7. Sprinkler Heads:
 - a. Automatic Sprinkler Corp. of America.
 - b. Tyco.
 - c. ITT Grinnell
 - d. Reliable Automatic Sprinkler Co., Inc.
 - e. Star Sprinkler Corp.
 - f. Viking Corp.
 - g. Globe
8. Fire Protection Specialties:
 - a. Croker-Standard Div.,; Fire-End & Croker Corp.
 - b. Elkhart Brass Mfg. Co., Inc.
 - c. Grinnell Fire Protection Systems Co., Inc.
 - d. Grunau Sprinkler Mfgr. Co., Inc.

- e. Potter Roemer, Inc.
- 9. In Building Riser
 - a. Zurn
 - b. Ames
 - c. Watts
 - d. Viking
 - e. Wilkins
- 10. Inspector's Test and Drain Module
 - a. Victaulic
 - b. A.G.F.
 - c. Grinnell/Gem

2.03 BASIC IDENTIFICATION:

- A. General: Provide identification complying with NFPA in accordance with the following listing:
 - 1. Fire Protection Valves: Valve tags.
 - 2. Fire Protection Signs: Provide the following signs Per NFPA and AJH:
 - a. At each sprinkler valve, sign indicating what portion of system valve controls.
 - b. At each outside alarm device, sign indicating what authority to call if device is activated.
 - c. At door to each sprinkler control valves or at ceiling access points, sign reading "FIRE CONTROL".
 - d. At each drain or test, sign indicating its purpose.
- B. Attach to the riser a metal sign indicating the name, address and telephone number of the fire protection contractor. Also indicate the date of installation and hydraulic information per NFPA.

2.04 BASIC PIPING SPECIALTIES:

- A. General: Provide piping specialties complying with Section 21 0500, in accordance with the following listing:
 - 1. Pipe escutcheons.
 - 2. Pipe sleeves.
 - 3. Sleeve seals.
 - 4. Fire Barrier Penetration Seals.

2.05 BASIC SUPPORTS AND ANCHORS:

- A. General: Provide supports and anchors complying with NFPA in accordance with the following listing:
 - 1. Hangers (which are acceptable for project) and hanger spacing shall be in accordance with NFPA-13.

2.06 PIPE & FITTINGS (UNDERGROUND):

- A. Underground pipe shall be ductile iron, thickness Class 52 unless specified otherwise by local authorities or ANSI/AWWA C150/A21.50-81; 350 psi pressure rating; tar coated outside, cement

mortar lined inside in accordance with ANSI/AWWA C104/A21.4-80. Full lengths of pipe shall be utilized to the greatest extent possible.

- B. Fittings for ductile iron pipe shall be 250 psi pressure rating in accordance with ANSI/AWWA C110-77, tar coated outside and cement lined inside in accordance with ANSI/AWWA C104/A21.4-80.
- C. Joints shall be push-on or mechanical type as per ANSI/AWWA C111/A21.11-80.
- D. PVC Pipe: AWWA C900 with gasketed bell and spigot fittings as allowed per Authority having Jurisdiction and NFPA
- E. In Building Riser (IBR): Provide a single extended 90 degree fitting made of 304 stainless steel tubing in maximum working pressure of 175 psig. Fitting shall have grooved end outlet and CIPS coupler on inlet for connection to AWWA C900 PVC or ductile iron. Unit shall comply with NFPA 24, UL and FM. Install per manufacturer requirements, provide thrust block and tie in brackets.

2.07 PIPE AND TUBING MATERIALS (INSIDE BUILDING):

- A. General: Refer to Part 3 Article "Pipe Applications" for identification of systems where the below specified pipe and fitting materials are used.
- B. Steel Pipe: ASTM A 53, A795 or A135, Schedule 40 or Schedule 10, U.S. manufacture, black steel pipe, with antimicrobial coating, plain ends.
- C. Bull Moose "Eddy-Thread" & "Eddy Flow", Wheatland "Mega-Thread" & "Mega-Flow", Allied Tube and Conduit Corporation "Super Flo" are acceptable to Schedule 40 pipe. Installation shall be per manufacturer's recommendations.
- D. Schedule 5 pipe shall not be allowed.
- E. The Corrosion Resistance Ratio of the pipe shall be 1.00 or greater. Documentation shall be presented with product submittal.
- F. Schedule 10 pipe shall only be allowed for pipe sizes 2-1/2inches and larger.
- G. Provide galvanized, schedule 40, piping system for drain risers.

2.08 FITTINGS (INSIDE BUILDING):

- A. Cast-Iron Threaded fittings: ANSI B16.4, Class 125 standard pattern, for threaded joints. Threads shall conform to ANSI B1.20.1.
- B. Malleable-Iron Threaded Fittings: ANSI B16.3, Class 300, standard pattern, for threaded joints. Threads shall conform to ANSI B1.20.1. Install steel pipe with threaded joints and fittings for 2inches and smaller and where shown on drawings.
- C. Steel Fittings: ASTM A234, seamless or welded, for welded joints.

- D. Grooved Mechanical Fittings: ASTM A 536, Grade 65-45-12 ductile iron; ASTM A 47 Grade 32510 malleable iron; or ASTM A53, Type F or Types E or S.
- E. Grooved Mechanical Couplings: Consist of ductile or malleable iron housing, a synthetic rubber gasket of a central cavity pressure-responsive design; with nuts, bolts, locking pin, locking toggle, or lugs to secure roll-grooved pipe and fittings. Grooved mechanical couplings including gaskets used on dry-pipe systems shall be listed for dry-pipe service.
- F. Grooved Mechanical Fittings and Couplings for the entire fire protection system shall be of the same manufacturer as submitted in shop drawing equipment review.
- G. Cast-Iron Threaded Flanges: ANSI B16.1, Class 250; raised ground face, bolt spot faced.
- H. Cast Bronze Flanges: ANSI B16.24, Class 300; raised ground face, bolt holes spot faced.
- I. Plain end, hooker type, or push-on fittings or couplings shall not be allowed.
- J. Bushings and reducing couplings shall not be allowed.

2.09 JOINING MATERIALS:

- A. Welding Materials: Comply with Section II, Part C, ASME Boiler and Pressure Vessel Code for welding materials appropriate for the wall thickness and chemical analysis of the pipe being welded.
- B. Gasket Materials: Thickness, materials and type suitable for fluid or gas to be handled, and design temperatures and pressures.

2.10 GENERAL DUTY VALVES:

- A. Gate Valves - 2 Inch and Smaller: Body and bonnet of cast bronze, 175 pound cold water working pressure - non-shock, threaded ends, solid wedge, outside screw and yoke, rising stem, screw-in bonnet, and malleable iron handwheel. Valves shall be capable of being repacked under pressure, with valve wide open.
- B. Gate Valves - 2-1/2 Inch and Larger: Iron body; bronze mounted, 175 pound cold water working pressure - non-shock. Valves shall have solid taper wedge; outside screw and yoke, rising stem; flanged bonnet, with body and bonnet conforming to ASTM A 126 Class B; replaceable bronze wedge facing rings; flanged ends; and a packing assembly consisting of a cast iron gland flange, brass gland, packing, bonnet, and bronze bonnet bushing. Valves shall be capable of being repacked under pressure, with valve wide open.
- C. Butterfly Valves: 2-1/2inches to 12inches, grooved, ductile iron body and disc ASTM-536, disc EPDM coated, listed and approved minimum 175 psi service, actuator, self-contained supervisory switch, weatherproof approved for indoor or outdoor use.
- D. Ball Valves: 1-1/2inches and smaller shall be threaded, forged brass construction, with Teflon seats and blow out proof stem. Ball shall be full port with chrome plated ball.

- E. Ball Valves: 2 inches to 3 inches shall be listed to 300 p.s.i. with optional internal tamper switch. Body shall be ductile iron with corrosion resistant coating. Ball shall be 316 stainless steel, standard port design.
- F. Swing Check Valves: MSS SP-71; Class 175, cast iron body and bolted cap conforming to ASTM A 126, Class B; horizontal swing, with a bronze disc or cast iron disc with bronze disc ring, and flanged ends. Valve shall be capable of being refitted while the valve remains in the line.
- G. Double Check Valve Assembly: Double check valve assembly shall be UL listed for fire protection service and USC-CCCF approved. Installation arrangement shall be per manufacturer's recommendations.

2.11 BASIC METERS AND GAUGES:

- A. General: Provide meters and gauges complying with NFPA 13 appropriate for system pressures and applications.
 - 1. Pressure gauges, 0-250 psi range.

2.12 ALARM DEVICE AND FIRE PROTECTION SPECIALTIES:

- A. General: Provide fire protection specialties, UL-listed, in accordance with the listing. Provide sizes and types which mate and match piping and equipment connections.
- B. Water Flow Indicators: Vane type water flow detector, rated to 250 psig; designed for horizontal or vertical installation; have 2-SPDT circuit switches to provide isolated alarm and auxiliary contacts, 7 ampere 125 volts AC and 0.25 ampere 24 volts DC; complete with factory-set field-adjustable retard element to prevent false signals, tamper-proof cover which sends a signal when cover is removed, and with activation time retarding capability set at 30 seconds. The setting shall be verified through the inspectors test prior to final inspection.
- C. Supervisory Switches: Provide products recommended by manufacturer for use in service indicated. SPST, normally closed contacts, designed to signal valve in other than full open position.
- D. Pressure Switch: Indicating low pressure trouble in sprinkler system.
- E. Pressure switch: Indicating flow in sprinkler system.
- F. Electric Alarm Bell: UL, vibrating metal bell, 8 inch, red enamel factory finish, suitable for outdoor use, listed and labeled per NFPA 70 marked for intended location and application.

2.13 AUTOMATIC SPRINKLERS:

- A. Sprinkler Heads: Fusible link or frangible bulb type, and style as indicated or required by the application. Unless otherwise indicated, provide heads with nominal ½ inch discharge orifice, for "ordinary" temperature range with a minimum temperature of 155 degrees F. Provide "intermediate" temperature heads in Electrical rooms, where required as noted in NFPA 13, and as required by the Authority having jurisdiction.

- B. Sprinkler Head Finishes: Provide heads with the following finishes:
 - 1. Upright, Pendent and Sidewall Styles: Factory brass, rough bronze finish for heads in unfinished spaces. Heads shall be stainless steel or wax coated where installed exposed to acids, chemicals, or other corrosive fumes.
 - 2. Concealed Style: Rough brass, adjustable, with painted white cover plate in finished spaces.
 - 3. Semi-Recessed Style: Bright chrome, with bright chrome escutcheon plate.
 - 4. See drawings for additional sprinkler type requirements.
 - C. Sprinkler Head Cabinet and Wrench: Finished steel cabinet, suitable for wall mounting, with hinged cover and space for spare sprinkler heads plus sprinkler head wrench. Provide amounts of each style per NFPA-13. Locate head cabinet on shop drawing submittal.
 - D. Sprinkler Escutcheons:
 - 1. Ceiling Mounted: Chrome plated steel one piece flat of 2 piece with 1" adjustment
 - 2. Wall Mounted: Chrome plated steel one piece flat of 2 piece with 1" adjustment
 - E. Plastic fire sprinkler escutcheons are not acceptable.
 - F. Sprinkler Guards: UL 199, wire cage with fastening device for attaching to sprinkler head.
- 2.14 FLEXIBLE SPRINKLER HEAD CONNECTORS
- A. General: UL listed, FM approved, braided corrugated annealed stainless steel hose with support brackets and inlet/outlet nipples
 - B. Length: no longer than 48"
 - C. Flexible Tube: 304 stainless steel
 - D. Braid: 304 stainless steel
 - E. Outlet Extension Nipple (Straight): Steel (ASTM A53 A) with yellow zinc plating.
 - F. Inlet Nipple: Steel (ASTM A53 A) with yellow zinc plating
 - G. Seal: EPDM
- 2.15 FIRE DEPARTMENT CONNECTIONS:
- A. Wall Type Connections: Rough or Polished chrome cast brass, 2-way flush wall type, with wall escutcheon and having National standard threads, for the connections size required, as specified in NFPA 1963. Each inlet shall have a clapper valve, and cap and chain. Unit shall have wall escutcheon of cast brass, finish to match connections, with words "Standpipe - Fire Dept. Connection" or "Auto Spkr. - Fire Dept. Connection" or "Auto Spkr. and Standpipe - Fire Department Connection" in raised letters to match system type. Contractor shall verify threads with local fire department. Outlet size per NFPA

- B. Fire department connections including location shall meet the approval of the fire department having jurisdiction.

2.16 INSPECTOR'S TEST AND DRAIN ASSEMBLY:

- A. Provide an alarm test module of a manufacturer listed in paragraph 2.2.
- B. Test and drain piping shall be routed to exterior. Location shall meet Owner's approval.

PART 3 - EXECUTION

3.01 PIPE APPLICATIONS:

- A. Install Schedule 40 steel pipe with threaded joints and fittings for 2 inches and smaller.
- B. Install Schedule 40 steel pipe with roll-grooved ends and grooved mechanical coupling or with threaded joints and fittings.
- C. Bull Moose Eddy thread and Eddy thro, Wheatland Mega thread and mega flow, or Allied Super Flo are acceptable to Schedule 40 pipe. Install shall be per manufacturer installation requirements.
- D. Install pipe entrance with ductile iron pipe and fittings or use In Building Riser pipe. Install supports, tie bars, etc. and provide thrust blocking per NFPA and local code requirements. Protect pipe thru concrete as required.

3.02 PIPING INSTALLATIONS:

- A. Provide a minimum 5 feet-0 inches cover for all underground pipe installations. Install in accordance with AWWA C600.
- B. Locations and Arrangements: Drawings (plans, schematics, and diagrams) indicate the general location and arrangement of piping systems. So far as practical, install piping as indicated. Drawings are diagrammatic in character and do not necessarily indicate every required offset, valve, fitting, etc.
 - 1. Deviations from approved "working plans" for sprinkler piping require written approval of the authority having jurisdiction. Written approval shall be on file with the Engineer prior to deviating from the approved "working plans."
- C. Install sprinkler piping to provide for system drainage in accordance with NFPA 13.
- D. Use approved fittings to make all changes in direction, branch takeoffs from mains, and reductions in pipe sizes. Welded outlet branch pipe fittings are acceptable.
- E. Install unions in pipe 2 inch and smaller, adjacent to each valve. Unions are not required on flanged devices or in piping installations using grooved mechanical couplings.

- F. Install flanges or flange adapters on valves, apparatus, and equipment having 2-1/2 inch and larger connections.
 - G. For welded pipe, all cutouts (coupons) shall be removed prior to installation.
 - H. Hangers and Supports: Comply with the requirements of NFPA 13. Hanger and support spacing and locations for piping joined with grooved mechanical couplings shall be in accordance with the grooved mechanical coupling manufacturer's written instructions, for rigid systems. Provide protection from damage where subject to earthquake in accordance with NFPA 13.
 - I. Make connections between underground and above-ground piping using an approved transition piece strapped or fastened to prevent separation.
 - J. Install mechanical sleeve seal at pipe penetrations in basement and foundation walls.
 - K. All piping penetrating fire walls to structure shall be sleeved and sealed per specification Section 23 0509 "Mechanical Fire Stopping".
 - L. Install test connections sized and located in accordance with NFPA 13 complete with shutoff valve.
 - M. Install pressure gauge on the riser or feed main at or near each test connection. Provide gauge with a connection not less than 1/4" and having a soft metal seated globe valve, arranged for draining pipe between gauge and valve. Install gauges to permit removal, and where they will not be subject to freezing.
 - N. The fire line entry valves shall have monitoring electrical switches, the wiring from which shall be carried to the fire annunciating panel.
 - O. The fire protection contractor shall be responsible for the coordination of his installation with all other contractors. See Section 21 0500 for prioritized components.
 - P. Protect adjacent area where pipe cutting and threading takes place (e.g. floors, ceilings, walls, etc.).
 - Q. There shall be no fire sprinkler piping in electrical rooms or IT/Technology rooms (with the exception of piping serving sprinklers directly in that room) no piping shall be installed over any electrical panels.
 - R. Install pressure gauges on city and system sides of fire entry valve assembly per NFPA.
 - S. Install hangers straight and true and piping parallel to building lines.
 - T. Do not run wet sprinkler piping through areas subject to freezing.
- 3.03 PIPE JOINT CONSTRUCTION:
- A. Welded Joints: AWS D10.9, Level AR-3.

- B. Threaded Joints: Conform to ANSI B1.20.1, tapered pipe threads for field cut threads. Join pipe, fittings, and valves as follows:
 - 1. Note the internal length of threads in fittings or valve ends, and proximity of internal seat or wall, to determine how far pipe should be threaded into joint.
 - 2. Align threads at point of assembly.
 - 3. Apply appropriate tape or thread compound to the external pipe threads.
 - 4. Assemble joint to appropriate thread depth. When using a wrench on valves place the wrench on the valve end into which the pipe is being threaded.
 - 5. Damaged Threads: Do not use pipe with threads which are corroded or damaged. If a weld opens during cutting or threading operations, that portion of pipe shall not be used.
 - C. Flanged Joints: Align flange surfaces parallel. Assemble joints by sequencing bolt tightening to make initial contact of flanges and gaskets as flat and parallel as possible. Use suitable lubricants on bolt threads. Tighten bolts gradually and uniformly to appropriate torque specified by the bolt manufacturer.
 - D. Mechanical Grooved Joints: Roll grooves on pipe ends dimensionally compatible with the couplings.
 - E. End Treatment: After cutting pipe lengths, remove burrs and fins from pipe ends.
- 3.04 VALVE INSTALLATIONS:
- A. General: Install fire protection specialty valves, fittings and specialties in accordance with the manufacturer's written instructions, NFPA 13 and the authority having jurisdiction.
 - B. Gate Valves: Install electrically supervised-open indicating valves so located to control all sources of water supply except fire department and roof manifolds connections. Where there is more than one control valve, provide permanently marked identification signs indicating the portion of the system controlled by each valve.
 - C. Valve at water main tap shall be underground gate valve with roadway box or type approved and where required by city.
 - D. Install approved double check valve assembly or reduced pressure backflow preventer in each water supply connection per city requirements. Provide check valve and indicating valve (with tamper switch) on the discharge side of reduced pressure backflow preventers. Both shut off and backflow valves are required.
- 3.05 SPRINKLER HEAD INSTALLATIONS:
- A. Any sprinkler heads with any paint on them shall be replaced. The sprinkler system shall then be hydrostatically tested again at the contractor's expense.
 - B. Sprinkler heads shall be positioned so as to comply with NFPA-13 for any obstructions. This includes, but is not limited to, soffits, surface mounted lights, large ducts, and indirect lighting arrangements. The Fire Protection Contractor is responsible for identifying these obstructions and designing the system accordingly.

- C. Run piping concealed above heated furred ceilings and in joists to minimize obstructions. Expose only heads.
- D. Protect exposed sprinkler heads against mechanical injury with standard guards. Provide sprinkler head guards in all gyms, mechanical, electrical, IT/technology, or storage rooms, and gyms, as well as exposed pendant heads which are installed less than 8 feet-0 inches A.F.F.
- E. Provide heads in "pocketed" areas caused by exposed duct, piping or beams per NFPA.
- F. Sprinkler head deflector distance from face of finished ceiling per NFPA.
- G. Sprinkler heads shall be located in the center of all 2 foot x 2 foot ceiling tiles and quarter points, along the center line lengthwise of 2 foot x 4 foot ceiling tiles.
- H. Use proper tools to prevent damage during installations.
- I. Install sprinkler piping in a manner such that mechanical equipment, ceiling tiles or lights can be accessed and easily removed. The sprinkler piping shall be installed to provide a minimum of 6 inches above the top of a finished ceiling where space allows.
- J. Minimum fire sprinkler head temperature rating for sprinklers in electrical rooms shall be 212 degrees F. Keep sprinklers as far from transformers and/or panels as spacing allows.

3.06 FIRE DEPARTMENT CONNECTION INSTALLATIONS:

- A. Install automatic drip valves at the check valve on the fire department connection to the mains. Route drain to exterior.
- B. Install mechanical sleeve seal at pipe penetration in outside walls.

3.07 INSTALLATION OF BASIC IDENTIFICATION:

- A. Install fire protection signs and identification on piping in accordance with NFPA 13 and NFPA 14 requirements.
- B. Install piping system labels to clearly identify all dry and preaction system piping. Follow requirements of Division 23 for label location and spacing.

3.08 INSTALLATION OF METERS AND GAUGES:

- A. Install meters and gauges in accordance with NFPA.

3.09 FIELD QUALITY CONTROL:

- A. Flush, test and inspect sprinkler piping systems in accordance with NFPA 13, Standard for installation of sprinkler systems.

- B. The fire sprinkler system shall not be connected to underground piping until the fire service main is tested and approved.
- C. The Fire Protection Contractor shall conduct and bear the costs of all necessary tests of the fire protection work, furnish all labor, power and equipment. All piping shall be tested with water as required, the tests witnessed by the authority having jurisdiction.
- D. The fire protection piping shall be tested under a hydrostatic pressure of not less than pressure per NFPA, for a duration of not less than 2 hours.
- E. Replace piping system components which do not pass the test procedures specified, and retest repaired portion of the system at Fire Protection Contractor's expense.
- F. All piping tests (pneumatic and hydrostatic) shall be conducted prior to the application of any painting materials. This will prevent hidden leaks and/or repainting of repaired/altered piping.

3.10 FINAL INSPECTION AND TESTING:

- A. The Contractor shall make arrangements with the Owner and Fire Marshal for final inspection and witnessing of the final acceptance tests. The Fire Protection Contractor, the Alarm System Contractor and the Owner will conduct the final inspection and witness the final acceptance test.
- B. All tests and inspections required by the referenced Codes and Standards, and the Owner shall be performed by the Contractor.
- C. The inspecting committee as referenced above will visit the job site to inspect the work and witness the final acceptance tests when they have been advised by the Contractor that the work is completed and ready for test. If the work is not complete or the test is unsatisfactory, the Contractor shall be responsible for the Consultant's extra time and expenses for re-inspection and witnessing the re-testing of the work. Such extra fees shall be deducted from payments by the Owner to the Contractor.
- D. After the system has been inspected and tested, a certificate, "Contractor's Material and Test Certificate Sprinkler System - Water Spray System," shall be provided by the contractor and shall be signed by him or his representative, the Owner's representative and by a representative of the fire department. Sufficient copies shall be prepared to ensure the Engineer, Owner, all inspecting authorities and the contractor have a copy for their files. The Contractor shall prepare one (1) test report for each inspection performed whether successful or not.
- E. The signing of the certificate by the Owner's representative shall in no way prejudice any claim against the contractor for faulty material, poor workmanship, or failure to comply with inspecting authority's requirements or local ordinances.
- F. Contractor shall provide at least five (5) working days' notice for all tests.
- G. All sprinkler supervisory initiating devices shall be functionally tested to verify proper operation.

- H. All supervisory functions of each initiating device shall be functionally tested.
- I. Receipt of all alarm and trouble signals, initiated during the course of the testing, shall be verified at the fire alarm control panel.

3.11 WORK BY OTHERS:

- A. Wiring of all water flow switches and tamper switches on valves to central alarm panel are by Division 26. Coordinate requirements.

3.12 OPERATION AND MAINTENANCE MANUAL:

- A. The Contractor shall provide the Owner with a loose-leaf manual containing:
 1. A detailed description of the systems.
 2. A detailed description of routine maintenance required or recommended or which would be provided under a maintenance contract including a maintenance schedule and detailed maintenance instructions for each type of device installed.
 3. One copy of NFPA-25.
 4. Manufacturers' data sheets and installation manuals/instructions for all equipment installed.
 5. A list of recommended spare parts.
 6. Service directory, listing the specific equipment items and where parts can be obtained, with name, address and telephone number.
 7. Set of the record drawings (PDF format).
 8. Hydraulic calculations
 9. Test certificates.
- B. Refer to Division 1 and Section 21 0500 for additional requirements.
- C. Within 15 days of the completion of the work, six (6) copies of the manual shall be submitted for approval.

3.13 RECORD DRAWINGS:

- A. The Contractor shall provide and maintain on the site an up-to-date record set of approved shop drawing prints which shall be marked to show each and every change made to the sprinkler system from the original approved shop drawings. This shall not be construed as authorization to deviate from or make changes to the shop drawings approved by the Owner without written instruction from the Owner in each case. This set of drawings shall be used only as a record set.
- B. Upon completion of the work, the record set of prints shall be used to prepare complete, accurate final record drawings reflecting any and all changes and deviations made to the sprinkler system.
- C. The Owner, at his option and at the Contractor's expense, may require revised hydraulic calculations depending on the extent and nature of field changes.

- D. The Record Drawings and Hydraulic Calculations shall have the signed stamp of the individual who prepared the design certifying the Record Drawings and the Hydraulic Calculations accurately represent the completed fire protection system.
- E. Upon completion of the work, PDFs of the record drawings shall be submitted to the Architect/Engineer and Owner for review. This contract will not be considered completed until these record documents have been received and reviewed by the Architect/Engineer.

3.14 GUARANTEE PERIOD:

- A. Guarantee: The Contractor shall guarantee all materials and workmanship for a period of one year beginning with the date of final acceptance by the Owner. The Contractor shall be responsible during the design, installation, testing and guarantee periods for any damage caused by him (or his subcontractors) or by defects in his (or his subcontractors') work, materials, or equipment.
- B. Emergency Service: During the installation and warranty period, the Contractor shall provide emergency repair service for the sprinkler system within four hours of a request by the Owner for such service. This service shall be provided on a 24 hour per day, seven days per week basis.

3.15 TRAINING:

- A. The Contractor shall conduct two (2) training sessions of four (4) hours each to familiarize the building personnel with the features, operation and maintenance of the sprinkler systems. Training sessions shall be scheduled by the Owner at a time mutually agreeable to the Contractor and the Owner.

3.16 WATER DAMAGE:

- A. The Fire Protection Contractor shall be responsible for any damage to the work of others, to building and property/ materials of others caused by leaks in automatic sprinkler equipment, unplugged or disconnected pipes or fittings, and shall pay for necessary replacement or repair of work or items so damaged during the installation, testing or guarantee periods of the automatic sprinkler work.

END OF SECTION 21 1000

SECTION 22 0500 - COMMON WORK RESULTS FOR PLUMBING

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

- A. All drawings associated with the entire project, including general provisions of the Contract, including The General Conditions of the Contract for Construction, General and Supplementary Conditions and Division-1 Conditions specification sections shall apply to the Division 21, 22, and 23 specifications and drawings. The Contractor shall be responsible for reviewing and becoming familiar with the aforementioned and all other Contract Documents associated with the project.
- B. Related Sections: Refer to all sections in Division 21, 22, and 23. Refer to Division 26 specification sections and Division 26 drawings.
- C. Where contradictions occur between this section and Division 1, the more stringent requirement shall apply.
- D. Contractor shall be defined as any and all entities involved with the construction of the project.

1.02 SUMMARY

- A. This Section includes the following:
 - 1. Piping materials and installation instructions common to most piping systems.
 - 2. Equipment installation requirements common to equipment sections.

1.03 DEFINITIONS

- A. Finished Spaces: Spaces other than mechanical and electrical equipment rooms, furred spaces, pipe chases, unheated spaces immediately below roof, spaces above ceilings, unexcavated spaces, crawlspaces, and tunnels.
- B. Exposed, Interior Installations: Exposed to view indoors. Examples include finished occupied spaces and mechanical equipment rooms.
- C. Exposed, Exterior Installations: Exposed to view outdoors or subject to outdoor ambient temperatures and weather conditions. Examples include rooftop locations.
- D. Concealed, Interior Installations: Concealed from view and protected from physical contact by building occupants. Examples include above ceilings and in chases.
- E. Concealed, Exterior 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.

- F. The following are industry abbreviations for rubber materials:
 - 1. EPDM: Ethylene-propylene-diene terpolymer rubber.
 - 2. NBR: Acrylonitrile-butadiene rubber.

1.04 SUBMITTALS

- A. Comply with Division 1 and requirements specified herein.

1.05 QUALITY ASSURANCE

- A. Steel Support Welding: Qualify processes and operators according to AWS D1.1, "Structural Welding Code--Steel."
- B. Steel Pipe 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. Electrical Characteristics for Plumbing Equipment: Equipment of higher electrical characteristics may be furnished provided such proposed equipment is approved in writing and connecting electrical services, circuit breakers, and conduit sizes are appropriately modified. If minimum energy ratings or efficiencies are specified, equipment shall comply with requirements.

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.

1.07 plumbing INSTALLATIONS:

- A. The Contract Documents are diagrammatic, showing certain physical relationships which must be established within the plumbing work and its interface with all other work. Such establishment is the exclusive responsibility of the Contractor. Drawings shall not be scaled for the purpose of establishing material quantities.
- B. Drawings and specifications are complementary. Whatever is called for in either is binding as though called for in both. Report any discrepancies to the Engineer and obtain written instructions before proceeding. Where any contradictions occur between the specifications and the drawings the more stringent requirement shall apply. The contractor shall include pricing for the more stringent and expensive requirements.
- C. Drawings shall not be scaled for rough-in measurements or used as shop drawings. Where drawings are required for these purposes or have to be made from field measurement, Contractor shall take the necessary measurements and prepare the drawings.

- D. The exact location for some items in this specification may not be shown on the drawings. The location of such items may be established by the Engineer during the progress of the work.
- E. The contract documents indicate required size and points of terminations of pipes, and suggest proper routes to conform to structure, avoid obstructions and preserve clearances. It is not intended that drawings indicate necessary offsets. The contractor shall make the installation in such a manner as to conform to the structure, avoid obstructions, preserve headroom and keep openings and passageways clear, without further instructions or costs to the Owner. All equipment shall be installed so access is maintained for serviceability.
- F. Before any work is installed, determine that equipment will properly fit the space; that required piping grades can be maintained and that ductwork can be run as intended without interferences between systems, structural elements or work of other trades.
- G. Verify all dimensions by field measurements.
- H. Coordinate installation in chases, slots and openings with all other building components to allow for proper mechanical installations.
- I. Sequence, coordinate, and integrate installations of mechanical materials and equipment for efficient flow of the work. Give particular attention to large equipment requiring positioning prior to closing-in the building.
- J. Where mounting heights are not detailed or dimensioned, install mechanical services and overhead equipment to provide the maximum headroom possible.
- K. Install mechanical equipment to facilitate 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.
- L. Make allowance for expansion and contraction for all building components and piping systems that are subject to such.
- M.** The ceiling space shall not be "layered". It is the contractor's responsibility to offset and install system as required to allow installation within the identified ceiling cavity. The contractor shall include labor and material in the base bid to accommodate such offsets.
- N. In general, all "static" piping systems shall be routed as high as possible, i.e. fire protection systems. Keep all equipment in accessible areas such as corridors and coordinate with systems and equipment from other sections.
- O. The Contractor shall provide all labor and material necessary but not limited to the starting/stopping of all plumbing equipment, opening/closing of all valves, draining/refilling all plumbing systems and operating/verifying the operation of all plumbing systems controls as required to accomplish all work necessary to meet construction document requirements. Contractor shall submit records of such activities to engineer and include in the O & M manuals.

1.08 coordination

- A. Work out all installation conditions in advance of installation. The Contractor shall be responsible for coordination of all work, in all areas. The Contractor shall be responsible for providing all labor and material, including but not limited to all fittings, isolation valves, offsets, hangers, control devices, etc., necessary to overcome congested conditions at no increase in contract sum. The Contractors base bid shall include any and all time and manpower necessary to develop such coordination efforts. Increases to contract sum or schedule shall not be considered for such effort.
- B. Provide proper documentation of equipment, product data and shop drawings to all entities involved in the project. Coordination shall include, but not be limited to the following:
 - 1. Fire Protection and Fire Alarm Contractor shall provide shop drawings to all other Division 21 and 23 Contractors.
 - 2. Automatic Temperature Controls, Building Management and Testing, Adjusting and Balancing Contractors shall be provided with equipment product data and shop drawings from other Division 21, 22, 23 and 26 Contractors and shall furnish the same information involving control devices to the appropriate Division 21, 22, and 23 Contractor.
 - 3. Furnish building equipment (elevator, food service, medical, technology, etc) information to Div 21, 22, and 23 contractors.

1.09 coordination with other divisions

- A. General:
 - 1. Coordinate all work to conform to the progress of the work of other trades.
 - 2. Complete the entire installation as soon as the condition of the building will permit. No extras will be allowed for corrections of ill-timed work, when such corrections are required for proper installation of other work.
- B. Coordinate ceiling cavity space carefully with all trades. In the event of conflict, install mechanical and electrical systems within the cavity space allocation in the following order of priority:
 - 1. Equipment and required clearances
 - 2. Plumbing waste, cooling coil drain piping and roof drain mains and leaders.
 - 3. Ductwork mains
 - 4. Plumbing vent piping
 - 5. Low pressure ductwork and air devices.
 - 6. Electrical and communication conduits, raceways and cabletray.
 - 7. Domestic hot and cold water
 - 8. Fire sprinkler mains, branch piping and drops (locate as tight to structure as possible).
 - 9. DDC control wiring and other low voltage systems.
 - 10. Fire alarm systems.
- C. Chases, Inserts and Openings:
 - 1. Provide measurements, drawings and layouts so that openings, inserts and chases in new construction can be built in as construction progresses.

2. Check sizes and locations of openings provided. Including the access panels for equipment in hard lid ceilings and wall cavities.
 3. Any cutting and patching made necessary by failure to provide measurements, drawings and layouts at the proper time shall be done at no additional cost in contract sum.
- D. Support Dimensions: Provide dimensions and drawings so that concrete bases and other equipment supports to be provided under other sections of the specifications can be built at the proper time.
- E. 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.
- F. Coordinate the cutting and patching of building components to accommodate the installation of mechanical equipment and materials. Refer to Division 1 and Division 23.
- G. Modifications required as result of failure to resolve interferences, provide correct coordination drawings or call attentions to changes required in other work as result of modifications shall be paid for by responsible Contractor/Subcontractor.
- H. Coordination with Electrical Work: Refer to Division 1 and 26.
- 1.10 design work required by contractor
- A. The construction of this project requires the Contractor to include the detailing and design of several systems and/or subsystems.
- B. The Contractor shall take the full responsibility to develop and complete routing strategies which will allow fully coordinated system to be installed in a fully functional manner. The Engineers contract drawings shall be for system design intent and general configurations.
- C. Systems or subsystems which require design responsibility by the contractor include but are not limited to:
1. Final coordinated distribution of duct, hydronic, plumbing and other systems within the ceiling cavity.
 2. Any system not fully detailed
 3. Equipment supports, hangers, anchors and seismic systems not fully detailed nor specified in these documents, or catalogued by the manufacturer.
 4. Seismic restraint systems
- D. Design Limitations:
1. The Contractor shall not modify the Engineers design intent in any way.
 2. The Contractor shall not change any pipe size or equipment size without prior written approval from the Engineer.
- 1.11 REQUIREMENTS OF REGULATORY AGENCIES
- A. Refer to Division 1.

- B. Execute and inspect all work in accordance with all Underwriters, local and state codes, rules and regulations applicable to the trade affected as a minimum, but if the plans and/or specifications call for requirements that exceed these rules and regulations, the greater requirement shall be followed. Follow recommendations of NFPA, SMACNA, EPA, OSHA and ASHRAE.
- C. Comply with the local and state codes adopted by the Authorities Having Jurisdictions at the time of permit application, including referenced standards, amendments and policies.
 - 1. Refer to the project code declaration sheet.
- D. Comply with standards in effect at the date of these Contract Documents, except where a standard or specific date or edition is indicated.
- E. After entering into contract, Contractor will be held to complete all work necessary to meet these requirements without additional expense to the Owner.

1.12 REQUIREMENTS OF LOCAL UTILITY COMPANIES

- A. Comply with rules and regulations of local utility companies. Include in bid the cost of equipment which will be required but not provided by Local Utility Company for the project.
- B. Utility Connections:
 - 1. Coordinate connection of mechanical systems with exterior underground and overhead utilities and services. Comply with requirements of governing regulations, franchised service companies and controlling agencies. Provide required connection for each service.
 - 2. The contract documents indicate the available information on existing utilities and services and on new services (if any) to be provided to the project by utility companies and agencies. Notify Engineer immediately if discrepancies are found.
 - 3. Coordinate mechanical utility interruptions one week in advance with the Owner and the Utility Company. Plan work so that duration of the interruption is kept to a minimum.

1.13 PERMITS AND FEES

- A. Refer to Division 1.
- B. The Contractor shall pay all tap, development, meter, etc., fees required for connection to municipal and public utility facilities, unless directed otherwise by the General Contractor/Owner – IN WRITING.
- C. Contractor shall arrange for and pay for all inspections, licenses and certificates required in connection with the work.

1.14 PROJECT SEISMIC REQUIREMENTS

- A. Installation shall comply with the local seismic requirements for the area of installation. Provide restraints, bracing, anchors, vibration isolation, seismic snubbers, and all other components required for the installation.
- B. All systems shall be installed to meet NFPA and IBC Seismic requirements.
 - 1. Where any conflicts arise the more stringent requirements shall be applicable.
 - 2. The design of the seismic requirements shall be the full responsibility of the Contractor.
- C. Refer to structural drawings for Seismic Design conditions

1.15 PRODUCT OPTIONS AND SUBSTITUTIONS

- A. Refer to the Instructions to Bidders and Division 1.
- B. The burden of proof that proposed equipment is equal in size, capacity, performance, and other pertinent criteria for this specific installation, or superior to that specified is up to the Contractor. If substitutions are not granted, the specified materials and equipment must be installed. Where substituted equipment is allowed, it shall be the Contractor's responsibility to notify all related trades of the accepted substitution and to assume full responsibility for all costs caused as a result of the substitution.
- C. Materials and equipment of equivalent quality shall be submitted for substitution prior to bidding. This may be done by submitting to the Architect/Engineer at least ten (10) working days prior to the bid date requesting prior review. This submittal shall include all data necessary for complete evaluation of the product.
 - 1. Substitutions shall be allowed only upon the written approval of the Architect/Engineer NO EXCEPTIONS.
 - 2. The Contractor shall be responsible for removal, replacement and remedy of any system or equipment which has been installed which does not meet the specifications and scheduled performance or which does not have prior approval.
- D. Bidders opting to bid or propose comparable products (either a product by a listed acceptable manufacturer in the respective specification section or a substitution request) are responsible for:
 - 1. Confirming the equipment they are bidding will fit in the space available, incorporating equipment's clearance requirements.
 - 2. Coordination of any variance from basis-of-design in weight, electrical requirements, other utility requirements, etc. with other trades.
 - 3. Inclusion in the bid of any applicable costs for changes in prime bidder's and their sub bidders' work required to accommodate the utilization of the comparable product.
 - 4. The contractor shall bear any and all responsibility including any changes to mechanical, plumbing, electrical, structural or architectural design. These changes shall be clearly identified and presented to the Design Team.

1.16 SUBMITTALS

A. General

1. Refer to the Conditions of the Contract (General and Supplementary), Division 1.
2. Contractor shall provide a submittal schedule appropriate for the size and schedule of the project. Limit the number of large submittals being reviewed at one time and coordinate timing of sections that are dependent on each other.
3. The Contractor shall identify any "long lead time" items which may impact the overall project schedule. If these submittal requirements affect the schedule, the Contractor shall identify the impacts and confer with the Engineer within two weeks of entering into the contract.
4. The front of each submittal package shall be identified with the specification section number, job name, Owner's project number, date, Prime Contractor and Sub-Contractor's names, addresses, and contact information, etc. Each Specification Section shall be submitted individually and submittal shall be tabbed for the equipment/materials/etc. within the section. Submittals that are not complete with the required information will not be reviewed and will be sent back to be corrected.
5. Submittals shall be provided electronically. All electronic submittals need to be complete with all design information and stamped for conformity by the contractor. Submittals will be reviewed, marked appropriately and returned by the same means received.
6. An index shall be provided which includes:
 - a. Product
 - b. Plan Code (if applicable)
 - c. Specification Section
 - d. Manufacturer and Model Number
7. Submittal schedule shall be provided for review within four (4) working weeks from award of contract to successful bidder.

B. Basis of Design: The manufacturer's material or equipment listed in the schedule or identified by name on the drawings are the basis of design and provided for the establishment of size, capacity, grade and quality. If alternates are used in lieu of the scheduled names, the cost of any changes in construction required by their use shall be borne by Contractor.

C. All equipment shall conform to the State and/or local Energy Conservation Standards.

D. Contractor Review: Submittal of shop drawings, product data and samples will be accepted only when submitted by and stamped by the General Contractor. Each submittal shall be reviewed by the contractor for general conformance with contract requirements and stamped by the respective contractor prior to submittal to the Architect/Engineer. Any submittal not stamped or complete will be sent back. Data submitted from Subcontractors and material suppliers directly to the Engineer will not be processed unless prior written approval is obtained by the Contractor.

E. Submittal Review Process: Before starting work, prepare and submit to the Architect/Engineer shop drawings and descriptive equipment data required for the project. Continue to submit in the stated format after each Architect/Engineer's action until a "No Exception Taken" or

"Make Correction Noted" action is received. When a "Make Corrections Noted" is received, make the required corrections for inclusion in the Operating and Maintenance Manual (O&M). Submittals marked "Make Corrections Noted" shall not be resubmitted during the submittal process. Unless each item is identified with specification section and sufficient data to identify its compliance with the specifications and drawings, the item will be returned "Revise and Resubmit". Where an entire submittal package is returned for action by the Contractor, the Engineer may summarize comments in letter format and return the entire set. Submittals shall be prepared per the MECHANICAL SUBMITTAL CHECKLIST, at the end of this section; supplemental requirements are listed in each Division 21 and 22 Sections.

- F. The Design Professional's review and appropriate action on all submittals and shop drawings is only for the limited purpose of checking for conformance with the design concept and the information expressed in the contract documents. This review shall not include:
 - 1. Accuracy or completeness of details, such as quantities, dimensions, weights or gauges, fabrication processes
 - 2. Construction means or methods
 - 3. Coordination of the work with other trades
 - 4. Construction safety precautions
- G. The Design Professional's review shall be conducted with reasonable promptness while allowing sufficient time in the Design Professional's judgment to permit adequate review. Review of a specific item shall not indicate that the Design Professional has reviewed the entire assembly of which the item is a component.
- H. The Design Professional shall not be responsible for any deviations from the contract documents not brought specifically to the attention of the Design Professional in writing by the Contractor. This shall clearly identify the design and the specific element which vary from the Design. The Contractor shall be responsible for all remedy for lack of strict conformance associated with this criteria.
- I. The Design Professional shall not be required to review partial submissions or those for which submissions of correlated items have not been received.
- J. If more than two submittals (either for product data, shop drawings, record drawings, or test and balance reports) are made by the Contractor, the Owner reserves the right to charge the Contractor for subsequent reviews by their consultants. Such extra fees shall be deducted from payments by the Owner to the Contractor.
- K. The contractor shall cloud all changes made on submittals that are marked "Revise and Resubmit."
- L. Required Submittals: Provide submittals for each item of equipment specified or scheduled in the contract documents. See table at the end of this section.

1.17 SPECIFIC CATEGORY SUBMITTAL REQUIREMENTS

- A. Product Listing:

1. Prepare listing of major mechanical equipment and materials for the project, within (2) two weeks of signing the Contract Documents and transmit to the Architect. A sample schedule is included at the end of this section to complete this requirement.
 - a. Provide all information requested.
 - b. Submit this listing as a part of the submittal requirement specified in Division 1, "PRODUCTS AND SUBSTITUTION."
 2. When two or more items of same material or equipment are required (plumbing fixtures, pumps, valves, air conditioning units, etc.) they shall be of the same manufacturer. Product manufacturer uniformity does not apply to raw materials, bulk materials, pipe, tube, fittings (except flanged and grooved types), sheet metal, wire, steel bar stock, welding rods, solder, fasteners, motors for dissimilar equipment units and similar items used in work, except as otherwise indicated.
 - a. Provide products which are compatible within systems and other connected items.
- B. Schedule of Values:
1. Provide preliminary schedule of values with product data submittal, within three (3) weeks from award of contract to successful bidder. Provide according to the following descriptions:
 - a. Site Utilities
 - b. Plumbing
 - 1) Underground rough-in
 - 2) Aboveground rough-in
 - 3) Fixtures
 - 4) Insulation
 - 5) Aboveground finish
 - 6) Fixture set
 - 7) Insulation
 - c. Miscellaneous
 2. Provide a final Schedule of Values at close-out of project including updated values based on actual installation.
- C. Product Data:
1. Where pre-printed data covers more than one distinct product, size, type, material, trim, accessory group or other variation, mark submitted copy with black pen to indicate which of the variations is to be provided.
 2. Delete or mark-out portions of pre-printed data which are not applicable.
 3. Where operating ranges are shown, mark data to show portion of range required for project application.
 4. For each product, include the following:
 - a. Sizes.
 - b. Weights.
 - c. Speeds.
 - d. Capacities.
 - e. Piping and electrical connection sizes and locations.
 - f. Statements of compliance with the required standards and regulations.
 - g. Performance data.

- h. Manufacturer's specifications.
- D. Shop Drawings:
- 1. Shop Drawings are defined as mechanical system layout drawings prepared specifically for this project, or fabrication and assembly type drawings of system components to show more detail than typical pre-printed materials.
 - 2. Prepare Mechanical Shop Drawings, except diagrams, to accurate scale, min 1/8"-1'-0", unless otherwise noted.
 - a. Show clearance dimensions at critical locations.
 - b. Show dimensions of spaces required for operation and maintenance.
 - c. Show interfaces with other work, including structural support.
- E. Test Reports:
- 1. Submit test reports which have been signed and dated by the accredited firm or testing agency performing the test.
 - 2. Prepare test reports in the manner specified in the standard or regulation governing the test procedure (if any) as indicated.
 - 3. Submit test reports as required for O & M manuals.
- F. Operation and Maintenance Data: See separate paragraph of this specification section.
- G. Record Drawings: See separate paragraph of this specification section.
- 1.18 DELIVERY, STORAGE, AND HANDLING
- A. Refer to Division 1 Sections on Transportation and Handling and Storage and Protection.
- B. Deliver products to project properly identified with names, model numbers, types, grades, compliance labels and similar information needed for distinct identifications; adequately packaged and protected to prevent damage or contamination during shipment, storage, and handling.
- C. Check delivered equipment against contract documents and submittals.
- D. Store equipment and materials at the site, unless off-site storage is authorized in writing. Protect stored equipment and materials from damage, dirt, dust, freezing, heat and moisture. Refer to Division 1 for insurance requirements for offsite storage.
- E. Coordinate deliveries of mechanical materials and equipment to minimize construction site congestion. Limit each shipment of materials and equipment to the items and quantities needed for the smooth and efficient flow of installations.
- F. Provide factory-applied plastic end-caps on each length of pipe and tube, except for concrete, corrugated metal, hub-and-spigot, clay pipe. Maintain end-caps through shipping, storage and handling to prevent pipe-end damage and prevent entrance of dirt, debris and moisture.
- G. Protect stored pipes and tubes. Elevate above grade and enclose with durable, waterproof wrapping. When stored inside, do not exceed structural capacity of the floor.

- H. Protect flanges, fittings and specialties from moisture and dirt by inside storage and enclosure, or by packaging with durable, waterproof wrapping.

1.19 CUTTING AND PATCHING

- A. This Article specifies the cutting and patching of mechanical equipment, components and materials to include removal and legal disposal of selected materials, components and equipment. Coordinate the cutting and patching of building components to accommodate the installation of equipment and materials.
- B. Refer to Division 1.
- C. Do not endanger or damage installed work through procedures and processes of cutting and patching.
- D. Arrange for repairs required to restore other work, because of damage caused as a result of plumbing installations.
- E. No additional compensation will be authorized for cutting and patching work that is necessitated by ill-timed, defective or non-conforming installations.
- F. Perform cutting, fitting and patching of mechanical equipment and materials required to:
 1. Uncover work to provide for installation of ill-timed work;
 2. Remove and replace defective work;
 3. Remove and replace work not conforming to requirements of the Contract Documents;
 4. Remove samples of installed work as specified for testing;
 5. Install equipment and materials in existing structures;
 6. Upon written instructions from the Architect/Engineer, uncover and restore work to provide for Architect /Engineer observation of concealed work.

1.20 ROUGH-IN

- A. Verify final locations for rough-ins with field measurements and with the requirements of the actual equipment to be connected.
- B. Refer to equipment shop drawings and manufacturer's requirements for actual provided equipment for rough-in requirements.
- C. Work through all coordination before rough-in begins.

1.21 ACCESSIBILITY

- A. Install equipment and materials to provide required access for servicing and maintenance. Allow ample space for removal of all parts that require replacement or servicing.
- B. Final installed conditions shall accommodate accessibility and replacement of system components that regularly require service and replacement. Such devices shall not be permanently obstructed by building systems such as piping, ductwork, insulation, drywall, etc.

1.22 EXCAVATING AND BACKFILLING

- A. General:
 - 1. Provide all necessary excavation and backfill for installation of mechanical work in accordance with Division 2.
 - 2. In general, follow all regulations of OSHA as specified in "Excavations, Trenching and Shoring." Follow specifications of Division 23 as they refer specifically to the mechanical work.
- B. Contact Owners of all underground utilities to have them located and marked, at least 2 business days before excavation is to begin. Also, prior to starting excavation brief employees on marking and color codes and train employees on excavation and safety procedures for natural gas lines. When excavation approaches gas lines, expose lines by carefully probing and hand digging.
- C. Pipe Trenching:
 - 1. Provide all necessary pumping, cribbing and shoring.
 - 2. Walls of all trenches shall be a minimum of 6 inches clearance from the side of the nearest mechanical work. Install pipes with a minimum of 6 inches clearance between them when located in same trench.
 - 3. Dig trenches to depth, width, configuration, and grade appropriate to the piping being installed. Dig trenches to 6 inches below the level of the bottom of the pipe to be installed. Install 6 inches bed of pea gravel or squeegee, mechanically tamp to provide a firm bed for piping, true to line and grade without irregularity. Provide depressions only at hubs, couplings, flanges, or other normal pipe protrusions.
- D. Backfilling shall not be started until all work has been inspected, tested and accepted. All backfill material shall be reviewed by the soils engineer. In no case shall lumber, metal or other debris be buried in with backfill.
 - 1. Provide detectable warning tape for marking and locating underground utilities. Tape shall be specifically manufactured for this purpose and shall be polyethylene film, 6 inches wide, 0.004 inches thick and have a minimum strength of 1750 psi. Tape shall carry continuous inscription naming the specific utility.
 - a. Tape shall have magnetic strip and be used for exterior underground system only.
- E. Trench Backfill:
 - 1. Backfill to 12 inches above top of piping with pea gravel or squeegee, the same as used for piping bed, compact properly.
 - 2. Continue backfill to finish grade, using friable material free of rock and other debris. Install in 6 inch layers, each properly moistened and mechanically compacted prior to installation of ensuing layer. Compaction by hydraulic jetting is not permissible.
- F. After backfilling and compacting, any settling shall be refilled, tamped, and refinished at this contractor's expense.
- G. This contractor shall repair and pay for any damage to finished surfaces.

- H. Use suitable excavated material to complete the backfill, installed in 6 inch lifts and mechanically compacted to seal against water infiltration. Compact to 95 percent for the upper, 30 inches below paving and slabs and 90 percent elsewhere.

1.23 NAMEPLATE DATA

- A. Provide permanent operational data nameplate, refer to the section on Plumbing Identification, on each item of mechanical equipment, indicating manufacturer, product name, model number, serial number, capacity, operating and power characteristics, labels of tested compliances, and similar essential data. Locate nameplates in an accessible location. Coordinate with Owner for specific requirements.

1.24 CLEANING

- A. Refer to Division 1.

1.25 RECORD DOCUMENTS

- A. Refer to Division 1. The following paragraphs supplement the requirements of Division 1.
- B. Keep a complete set of record document prints in custody during entire period of construction at the construction site. Documents shall be updated on a weekly basis.
- C. Mark Drawing Prints to indicate revisions to piping, size and location both exterior and interior; including locations of cleanouts, valves, strainers, and similar units requiring periodic maintenance or repair; actual equipment locations, dimensioned from column lines; actual inverts and locations of underground piping; concealed equipment, dimensioned to column lines; mains and branches of piping systems, with valves and control devices located and numbered, concealed unions located, and with items requiring maintenance located (i.e., strainers, expansion compensators, tanks, etc.); Change Orders; concealed system devices. Changes to be noted on the drawings shall include final location of any piping relocated more than 1foot-0 inches from where shown on the drawings.
NOTE: REFERENCES TO RFIs, PRs, CHANGE ORDERS, ETC., WILL NOT BE ACCEPTED AS AS-BUILT CONDITIONS.
- D. Mark shop drawings to indicate approved substitutions; Change Orders; actual equipment and materials used.
- E. Mark equipment and fixture schedules on drawings to indicate manufacturer and model numbers of installed equipment and fixtures.
- F. Revisions to the Contract Documents shall be legible and shall be prepared using the following color scheme:
 - 1. Red shall indicate new items, deviations and routing.
 - 2. Green shall indicate items removed or deleted.
 - 3. Blue shall be used for relevant notes and descriptions.

- G. At the completion of the project, obtain from the Architect a complete set of the Mechanical Contract Documents in a read-only electronic format (.pdf unless otherwise noted). This set will include all revisions officially documented through the Architect/Engineer. Using the above color scheme, transfer any undocumented revisions from the construction site record drawings to this complete set. Submit completed documents to the Architect/Engineer. This contract will not be considered completed until these record documents have been received and reviewed
- H. Contractor may propose methods of maintaining record documents on electronic media. Obtain approval of Engineer and Owner prior to proceeding. Marked-up .pdf format readable by Bluebeam is preferred.

1.26 OPERATION AND MAINTENANCE DATA

- A. Refer to Division 1.
- B. No later than four (4) weeks prior to the completion of the project provide one complete set of Operating and Maintenance Manuals, or as specified in Sections of Division 1 (whichever is more stringent).
- C. The testing and balancing report shall be submitted and received by the Engineer at least fifteen calendar days prior to the contractor's request for final observation time frame requirements. Include in the O & M Manual after review with "No Exceptions Taken" has been accomplished.
- D. In addition to the information required by Division 1 for Maintenance Data, include the following information:
 - 1. The job name and address and contractor's name and address shall be identified at the front of the electronic submittal.
 - 2. Description of equipment, function, normal operating characteristics and limitations, performance curves, engineering data and tests, and complete nomenclature and commercial numbers of all replaceable parts.
 - 3. Manufacturer's printed operating procedures to include start-up, break-in, routine and normal operating instructions; regulation, control, stopping, shut-down, and emergency instructions; and summer and winter operating instructions. Provide any test reports and start-up documents.
 - 4. Maintenance procedures for routine preventative maintenance and troubleshooting; disassembly, repair, and reassembly; aligning and adjusting instructions.
 - 5. Servicing instructions, lubrication charts and schedules, including Contractor lubrication reports.
 - 6. Manufacturer's service manuals for all equipment provided under this contract.
 - 7. Include the valve tag list.
 - 8. Name, Address and Telephone numbers of the Sub-contractors and local company and party to be contacted for 24-hour service and maintenance for each item of equipment.
 - 9. Starting, stopping, lubrication, equipment identification numbers and adjustment clearly indicated for each piece of equipment.
 - 10. Complete recommended spare parts list.

11. Mechanical System and Equipment Warranties.
12. Copies of all test reports shall be included in the manuals.
13. Provide manuals with dividers for major sections and special equipment. Mark the individual equipment when more than one model or make is listed on a page. Provide detailed table of contents.
14. Final schedule of values with all mechanical change order costs included and identified.
15. Contractor may propose methods of maintaining record documents on electronic media. Obtain approval of Engineer and Owner prior to proceeding. Marked-up PDF format readable by Bluebeam is preferred.
16. Backflow preventor test certification.

- E. This contract will not be considered completed nor will final payment be made until all specified material, including test reports, and final Schedule of Values with all Electrical and Information Technology change order costs included and identified is provided and the manual is reviewed by the Architect/Engineer.

1.27 PROJECT CLOSEOUT List

- A. In addition to the requirements specified in Division 1, complete the requirements listed below.
- B. The Contractor shall be responsible for the following Plumbing Submittal Checklist either by performing and/or coordinating such items prior to applying for certification of substantial completion. Refer to individual specification sections for additional requirements. (Checklist is located at the end of this section.)

1.28 WARRANTIES

- A. Refer to the Division 1 for procedures and submittal requirements for warranties. Refer to individual equipment specifications for warranty requirements. In any case the entire plumbing system shall be warranted no less than one year from the time of acceptance by the Owner.
- B. Compile and assemble the warranties specified in Division 21 and 22, into a separated set of vinyl covered, three ring binders, tabulated and indexed for easy reference or include the Operating and Maintenance Manuals.
- C. Provide complete warranty information for each item to include product or equipment to include date or beginning of warranty or bond; duration of warranty or bond; and names, addresses, and telephone numbers and procedures for filing a claim and obtaining warranty services.

1.29 CONSTRUCTION REQUIREMENTS

- A. The contractor shall maintain and have available at the jobsite current information on the following at all times:
1. Up to date record drawings.
 2. Submittals

3. Site observation reports with current status of all action items.
4. Test results; including recorded values, procedures, and other findings.
5. Outage information.

1.30 EQUIPMENT HOUSEKEEPING PADS

- A. Provide minimum 3.5" concrete housekeeping pad for all floor mounted equipment including, but not limited to:
 1. air compressors
 2. bottles/cylinders
 3. water heaters
- B. Fabricate pads as follows:
 1. Coordinate size of equipment bases with actual unit sizes provided. Fabricate base 4" larger in both directions than the overall dimensions of the supported unit.
 2. Form concrete pads with framing lumber with form release compounds. Chamfer top edge and corners of pad.
 3. Place concrete and allow to cure before installation of units. Use Portland cement that conforms to ASTM C 150, 4000-psi compressive strength, and normal weight aggregate.
 4. Anchor housekeeping pads to slab using #3 rebar bent in "L" or "Z" shape 12 inch on center on each side of slab.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

- A. In other Part 2 articles where subparagraph titles below introduce lists, the following requirements apply for product selection:
 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 manufacturers specified.

2.02 PIPE, TUBE, AND FITTINGS

- A. Refer to individual Division 22 piping Sections for pipe, tube, and fitting materials and joining methods.
- B. Pipe Threads: ASME B1.20.1 for factory-threaded pipe and pipe fittings.

2.03 JOINING MATERIALS

- A. Refer to individual Division 22 piping Sections for special joining materials not listed below.
- B. 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 thickness or specific material is 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.
- C. Flange Bolts and Nuts: ASME B18.2.1, carbon steel, unless otherwise indicated.
- D. Solder Filler Metals: ASTM B 32, lead-free alloys. Include water-flushable flux according to ASTM B 813.
- E. Brazing Filler Metals: AWS A5.8, BCuP Series, copper-phosphorus alloys for general-duty brazing, unless otherwise indicated; and AWS A5.8, BAg1, silver alloy for refrigerant piping, unless otherwise indicated.
- F. Welding Filler Metals: Comply with AWS D10.12 for welding materials appropriate for wall thickness and chemical analysis of steel pipe being welded.

2.04 TRANSITION FITTINGS

- A. AWWA Transition Couplings: Same size as, and with pressure rating at least equal to and with ends compatible with, piping to be joined.
1. Available Manufacturers:
 - a. Cascade Waterworks Mfg. Co.
 - b. Dresser Industries, Inc.; DMD Div.
 - c. Ford Meter Box Company, Incorporated (The); Pipe Products Div.
 - d. JCM Industries.
 - e. Smith-Blair, Inc.
 - f. Viking Johnson.
 2. Underground Piping NPS 1-1/2 and Smaller: Manufactured fitting or coupling.
 3. Underground Piping NPS 2 and Larger: AWWA C219, metal sleeve-type coupling.
 4. Aboveground Pressure Piping: Pipe fitting.

2.05 DIELECTRIC FITTINGS

- A. Description: Combination fitting of copper alloy and ferrous materials with threaded, solder-joint, plain, or weld-neck end connections that match piping system materials.
- B. Insulating Material: Suitable for system fluid, pressure, and temperature.
- C. Dielectric Unions: Factory-fabricated, union assembly, for 250-psig minimum working pressure at 180 deg F.
1. Available Manufacturers:
 - a. Capitol Manufacturing Co.
 - b. Central Plastics Company.
 - c. Eclipse, Inc.
 - d. Epco Sales, Inc.
 - e. Hart Industries, International, Inc.
 - f. Watts Industries, Inc.; Water Products Div.

- g. Zurn Industries, Inc.; Wilkins Div.
 - D. Dielectric Flanges: Factory-fabricated, companion-flange assembly, for 150- or 300-psig minimum working pressure as required to suit system pressures.
 - 1. Available Manufacturers:
 - a. Capitol Manufacturing Co.
 - b. Central Plastics Company.
 - c. Epco Sales, Inc.
 - d. Watts Industries, Inc.; Water Products Div.
 - E. Dielectric-Flange Kits: Companion-flange assembly for field assembly. Include flanges, full-face- or ring-type neoprene or phenolic gasket, phenolic or polyethylene bolt sleeves, phenolic washers, and steel backing washers.
 - 1. Available Manufacturers:
 - a. Advance Products & Systems, Inc.
 - b. Calpico, Inc.
 - c. Central Plastics Company.
 - d. Pipeline Seal and Insulator, Inc.
 - 2. Separate companion flanges and steel bolts and nuts shall have 150- or 300-psig minimum working pressure where required to suit system pressures.
 - F. Dielectric Couplings: Galvanized-steel coupling with inert and noncorrosive, thermoplastic lining; threaded ends; and 300-psig minimum working pressure at 225 deg F.
 - 1. Available Manufacturers:
 - a. Calpico, Inc.
 - b. Lochinvar Corp.
 - G. Dielectric Nipples: Electroplated steel nipple with inert and noncorrosive, thermoplastic lining; plain, threaded, or grooved ends; and 300-psig minimum working pressure at 225 deg F.
 - 1. Available Manufacturers:
 - a. Perfection Corp.
 - b. Precision Plumbing Products, Inc.
 - c. Sioux Chief Manufacturing Co., Inc.
 - d. Victaulic Co. of America.
- 2.06 MECHANICAL SLEEVE SEALS
- A. Description: Modular sealing element unit, designed for field assembly, to fill annular space between pipe and sleeve.
 - 1. Available Manufacturers:
 - a. Advance Products & Systems, Inc.
 - b. Calpico, Inc.
 - c. Metraflex Co.
 - d. Pipeline Seal and Insulator, Inc.
 - 2. Sealing Elements: EPDM or NBR interlocking links shaped to fit surface of pipe. Include type and number required for pipe material and size of pipe.

3. Pressure Plates: Plastic Carbon steel or Stainless steel. Include two for each sealing element.
4. Connecting Bolts and Nuts: Carbon steel with corrosion-resistant coating or Stainless steel of length required to secure pressure plates to sealing elements. Include one for each sealing element.

2.07 SLEEVES

- A. Galvanized-Steel Sheet: 0.0239-inch minimum thickness; round tube closed with welded longitudinal joint.
- B. Steel Pipe: ASTM A 53, Type E, Grade B, Schedule 40, galvanized, plain ends.
- C. Cast Iron: Cast or fabricated "wall pipe" equivalent to ductile-iron pressure pipe, with plain ends and integral waterstop, unless otherwise indicated.
- D. Molded PVC: Permanent, with nailing flange for attaching to wooden forms.
- E. PVC Pipe: ASTM D 1785, Schedule 40.
- F. Molded PE: PE, tapered-cup shaped, and smooth-outer surface with nailing flange for attaching to wooden forms.

2.08 ESCUTCHEONS

- A. Description: Manufactured wall and ceiling escutcheons and floor plates, with an ID to closely fit around pipe, tube, and insulation of insulated piping and an OD that completely covers opening.
- B. One-Piece, Stainless-Steel Type: With polished stainless-steel finish.
- C. One-Piece, Deep-Pattern Type: Deep-drawn, steel chrome plated spring clip fasteners, box-shaped brass with polished chrome-plated finish.
- D. One-Piece, Cast-Brass Type: With set screw.
 1. Finish: Polished chrome-plated, Rough brass or Polished chrome-plated and rough brass.
- E. One-Piece, Stamped-Steel Type: With set screw and chrome-plated finish.
- F. Split-Plate, Stamped-Steel Type: With concealed hinge, set screw or spring clips, and chrome-plated finish.
- G. One-Piece, Floor-Plate Type: Cast-iron floor plate.
- H. Split-Casting, Floor-Plate Type: Cast brass with concealed hinge and set screw.

2.09 GROUT

- A. Description: ASTM C 1107, Grade B, nonshrink and nonmetallic, dry hydraulic-cement grout.
 - 1. Characteristics: Post-hardening, volume-adjusting, nonstaining, noncorrosive, nongaseous, and recommended for interior and exterior applications.
 - 2. Design Mix: 5000-psi, 28-day compressive strength.
 - 3. Packaging: Premixed and factory packaged.

PART 3 - EXECUTION

3.01 PIPING SYSTEMS - COMMON REQUIREMENTS

- A. Install piping according to the following requirements and Division 22 Sections specifying piping systems.
- B. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems. Indicated locations and arrangements were used to size pipe and calculate friction loss, expansion, pump sizing, and other design considerations. Install piping as indicated unless deviations to layout are approved on Coordination Drawings.
- C. Install piping in concealed locations, unless otherwise indicated and except in equipment rooms and service areas.
- D. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.
- E. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal.
- F. Install piping to permit valve servicing.
- G. Install piping at indicated slopes.
- H. Install piping free of sags and bends.
- I. Install fittings for changes in direction and branch connections.
- J. Install piping to allow application of insulation.
- K. Select system components with pressure rating equal to or greater than system operating pressure.
- L. Install escutcheons for penetrations of walls, ceilings, and floors according to the following:
 - 1. New Piping:
 - a. Piping with Fitting or Sleeve Protruding from Wall: One-piece, deep-pattern type.
 - b. Chrome-Plated Piping: One-piece, cast-brass type with polished chrome-plated finish.

- c. Insulated Piping: One-piece, stamped-steel type with spring clips.
 - d. Bare Piping at Wall and Floor Penetrations in Finished Spaces: One-piece, stamped-steel or stainless steel type.
 - e. Bare Piping at Ceiling Penetrations in Finished Spaces: One-piece, stamped-steel or stainless steel type and set screw.
 - f. Bare Piping in Unfinished Service Spaces: One-piece, stamped-steel or stainless steel type with concealed hinge and set screw or spring clips.
 - g. Bare Piping in Equipment Rooms: One-piece, cast-brass type.
 - h. Bare Piping in Equipment Rooms: One-piece, stamped-steel or stainless steel type with set screw or spring clips.
 - i. Bare Piping at Floor Penetrations in Equipment Rooms: One-piece, floor-plate type.
- M. Sleeves are not required for core-drilled holes.
- N. Permanent sleeves are not required for holes formed by removable PE sleeves.
- O. Install sleeves for pipes passing through concrete and masonry walls and concrete floor and roof slabs.
- 1. Cut sleeves to length for mounting flush with both surfaces.
 - a. Exception: Extend sleeves installed in floors of mechanical equipment areas or other wet areas 2 inches above finished floor level. Extend cast-iron sleeve fittings below floor slab as required to secure clamping ring if ring is specified.
 - 2. Install sleeves in new walls and slabs as new walls and slabs are constructed.
 - 3. Install sleeves that are large enough to provide 1/4-inch annular clear space between sleeve and pipe or pipe insulation. Use the following sleeve materials:
 - a. PVC or Steel Pipe Sleeves: For pipes smaller than NPS 6.
 - b. Steel Sheet Sleeves: For pipes NPS 6 and larger, penetrating gypsum-board partitions.
 - 4. Except for underground wall penetrations, seal annular space between sleeve and pipe or pipe insulation, using joint sealants appropriate for size, depth, and location of joint. Refer to Division 07 for materials and installation.
- P. Aboveground, Exterior-Wall Pipe Penetrations: Seal penetrations using 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.
- 1. Install steel pipe for sleeves smaller than 6 inches in diameter.
 - 2. Install cast-iron "wall pipes" for sleeves 6 inches and larger in diameter.
 - 3. Mechanical Sleeve Seal Installation: Select type and number of sealing elements required for pipe material and size. Position pipe in center of sleeve. Assemble mechanical sleeve seals and install in annular space between pipe and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.
- Q. Rated Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at pipe penetrations. Seal pipe penetrations with firestop materials. Refer to Division 07 for materials.

- R. Verify final equipment locations for roughing-in.
- S. Refer to equipment specifications in other Sections of these Specifications for roughing-in requirements.

3.02 PIPING JOINT CONSTRUCTION

- A. Join pipe and fittings according to the following requirements and Division 22 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. Soldered Joints: Apply ASTM B 813, water-flushable flux, unless otherwise indicated, to tube end. Construct joints according to ASTM B 828 or CDA's "Copper Tube Handbook," using lead-free solder alloy complying with ASTM B 32.
- E. Brazed Joints: Construct joints according to AWS's "Brazing Handbook," "Pipe and Tube" Chapter, using copper-phosphorus brazing filler metal complying with AWS A5.8.
- F. Threaded Joints: Thread pipe with tapered pipe threads according to ASME B1.20.1. Cut threads full and clean using sharp dies. Ream threaded pipe ends to remove burrs and restore full ID. Join pipe fittings and valves as follows:
 - 1. Apply appropriate tape or thread compound to external pipe threads unless dry seal threading is specified.
 - 2. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged. Do not use pipe sections that have cracked or open welds.
- G. Welded Joints: Construct joints according to AWS D10.12, using qualified processes and welding operators according to Part 1 "Quality Assurance" Article.
- H. Non-Pressure PVC Joints: Clean and dry joints and surfaces. Make joints complying with ASTM F402 Safe Practices for Cleaners, Primers, and Cements. Join PVC in accordance with ASTM D2855 and D2665. Remove burrs and cuttings prior to joint pipe and fittings
- I. Hubless Cast Iron: Join in accordance with CISPI Handbook for Cast Iron Soil Pipe and Fittings and CISPI 310.
- J. Flanged Joints: Select appropriate gasket material, size, type, and thickness for service application. Install gasket concentrically positioned. Use suitable lubricants on bolt threads.

3.03 PIPING CONNECTIONS

- A. Make connections according to the following, unless otherwise indicated:
 - 1. Install unions, in piping NPS 2 and smaller, adjacent to each valve and at final connection to each piece of equipment.

2. Install flanges, in piping NPS 2-1/2 and larger, adjacent to flanged valves and at final connection to each piece of equipment.
3. Dry Piping Systems: Install dielectric unions and flanges to connect piping materials of dissimilar metals.
4. Wet Piping Systems: Install dielectric coupling and nipple fittings to connect piping materials of dissimilar metals.

3.04 EQUIPMENT INSTALLATION - COMMON REQUIREMENTS

- A. Install equipment to allow maximum possible headroom unless specific mounting heights are not indicated.
- B. Install equipment level and plumb, parallel and perpendicular to other building systems and components in exposed interior spaces, unless otherwise indicated.
- C. Install plumbing equipment to facilitate service, maintenance, and repair or replacement of components. Connect equipment for ease of disconnecting, with minimum interference to other installations. Extend grease fittings to accessible locations.
- D. Install equipment to allow right of way for piping installed at required slope.

3.05 PAINTING

- A. Painting of plumbing systems, equipment, and components is specified in Division 09.
- B. Damage and Touchup: Repair marred and damaged factory-painted finishes with materials and procedures to match original factory finish.

3.06 ERECTION OF METAL SUPPORTS AND ANCHORAGES

- A. Refer to Division 05 for structural steel.
- B. Cut, fit, and place miscellaneous metal supports accurately in location, alignment, and elevation to support and anchor plumbing materials and equipment.
- C. Field Welding: Comply with AWS D1.1.

3.07 GROUTING

- A. Mix and install grout for plumbing equipment base bearing surfaces, pump and other equipment base plates, and anchors.
- B. Clean surfaces that will come into contact with grout.
- C. Provide forms as required for placement of grout.
- D. Avoid air entrapment during placement of grout.

- E. Place grout, completely filling equipment bases.
- F. Place grout on concrete bases and provide smooth bearing surface for equipment.
- G. Place grout around anchors.
- H. Cure placed grout.

MECHANICAL SUBMITTAL CHECKLIST

Spec Section	Item	Requirements							
		Submittals			Supplemental		Factory Rep Super-Vision At Site	Training Req'd At Site	Extra Material
		Shop Drawings	Product Data	Include In O & M	Test ³	Report ³			
22 0500	Common Work Results For Plumbing			X					
22 0500	Preliminary Schedule of Values					X			
22 0500	Final Schedule of Values			X		X			
22 0500	O&M Manuals		X	X		X			X
22 0500	Record Drawings	X	X	X					
220523	General duty Valves for Plumbing		X	X					
220529	Hangers & Supports for Plumbing & Piping Equipment		X	X					
220548	Vibration & Seismic Controls for Plumbing	X	X	X					
220553	Identification for Plumbing		X	X					
220700	Plumbing Insulation		X	X					
221023	Plumbing Pumps		X	X					
221116	Domestic Water Piping		X	X					
221119	Domestic Water Piping Specialties		X	X					

Spec Section	Item	Requirements							
		Submittals			Supplemental		Factory Rep Super-Vision At Site	Training Req'd At Site	Extra Material
		Shop Drawings	Product Data	Include In O & M	Test ³	Report ³			
221316	Sanitary Waste and Vent Piping		X	X					
221319	Sanitary Waste Piping Specialties		X	X	X	X			
221413	Facility Storm Drainage Piping		X	X					
223400	Water Heaters		X	X				X	
224000	Plumbing Fixtures		X	X					X
Notes: ¹ For Starters and Variable Frequency Drives ² Requires Review & Approval of calibrated balance valves from T & B Contractor ³ See Specific Specification Section for Test & Certification Requirements									

END OF SECTION 22 0500

SECTION 22 0509 - PLUMBING FIRE STOPPING

PART 1 - GENERAL

1.01 DESCRIPTION OF WORK

- A. Extent of firestopping required by this section is indicated on the drawings and by the requirements of this section. Refer to architectural plans and specifications for additional information.
- B. Types of firestopping systems specified in this section include:
 - 1. Bare metal pipe
 - 2. Insulated metal pipe
 - 3. Plastic piping

1.02 QUALITY ASSURANCE

- A. Manufacturer's Qualifications: Firms regularly engaged in the manufacturing of firestopping systems for mechanical/electrical penetrations, whose products have been in satisfactory use for not less than 5 years, with published application data for all types of penetrations to be encountered on this job, and with local representation capable of providing training and technical assistance at the job site.
- B. Installer's Qualifications: Personnel installing firestopping systems shall have been specifically trained by the manufacturer in the application of the materials to comply with the listing of the tested assembly.
- C. Codes and Standards: Comply with the applicable State and Local codes pertaining to firestopping. Firestopping systems shall be tested and listed in accordance with the following:
 - 1. Underwriter's Laboratory:
 - a. UL 1479 test method for fire tests of through-penetration firestops.
 - b. UL Fire Resistance Directory
 - 2. American Society for Testing and Materials:
 - a. ASTM E814-88 Standard test method for fire tests of through-penetration firestops.
 - b. ASTM E2174 Standard practice for onsite inspection of firestop systems.

1.03 SUBMITTALS

- A. Product Data: Manufacturer's specifications and technical data including the following:
 - 1. Detailed specification of construction and fabrication.
 - 2. Manufacturer's installation instructions.
- B. Shop Drawings: Indicate dimensions, description of materials and finishes, general construction, specific modifications, component connections, anchorage methods, hardware and installation procedures, plus the following specific requirements:

1. Details of each proposed assembly, for all types of fire rated construction and penetrating items encountered, identifying intended products and applicable UL System Number, or UL classified devices.
2. Manufacture or manufacturer's representative shall provide qualified engineering judgments and drawings relating to non-standard applications as needed.

1.04 DELIVERY, STORAGE AND HANDLING

A. Packing and Shipping:

1. Deliver products in original, unopened packaging with legible manufacturer's identification.
2. Coordinate delivery with scheduled installation date, allow minimum storage at site.

B. Storage and Protection: Store materials in a clean, dry ventilated location. Protect from soiling, abuse, moisture and freezing when required. Follow manufacturer's instructions.

1.05 PROJECT CONDITIONS

A. Existing Conditions:

1. Verify existing conditions and substrates before starting work. Correct unsatisfactory conditions before proceeding.
2. Proceed with installation only after penetrations of the substrate and supporting brackets have been installed.

B. Environmental Requirements:

1. Furnish adequate ventilation if using solvent.
2. Furnish forced air ventilation during installation if required by manufacturer.
3. Keep flammable materials away from sparks or flame.
4. Provide masking and drop cloths to prevent contamination of adjacent surfaces by firestopping materials.
5. Comply with manufacturing recommendations for temperature and humidity conditions before, during and after installation of firestopping.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

A. Subject to compliance with the requirements of this specification, provide products by one of the following:

1. 3M, Fire Protection Products
2. Nelson Firestop Products
3. TREMCO Construction Products
4. Metalines
5. Hilti Corporation
6. Specified technologies, Inc. (STI)

2.02 GENERAL

- A. Provide fire stop systems listed in the UL Fire Resistance Directory. Provide systems with fire resistance "F" ratings equal to the fire resistance rating of the wall or floor assembly for all penetrations. In addition, provide systems with a "T" rating equal to the fire resistance rating of the floor assembly for all floor penetrations not within the cavity of a wall.

2.03 ACCESSORIES

- A. Provide forming and damming materials and sleeves as required by the firestopping system installation instructions.

PART 3 - EXECUTION

3.01 GENERAL

- A. Review all project drawings, Owner's records and existing conditions to determine location, rating, and construction of all fire resistive construction.
- B. Coordinate location of penetrations to allow for the maximum and minimum annular space around the penetrating item. Allow a minimum of 1" undisturbed building material between penetrations, or provide a firestopping system listed for multiple penetrations. Penetrating items shall be centered in hole as much as practical, unless firestopping system is listed for point contact between the wall/floor assembly and the penetrating item.
- C. Neatly form, saw cut, hole saw or core drill openings. Size openings to conform with the maximum and minimum annular space requirements of the firestopping system.

3.02 APPLICATION

- A. The Contractor shall determine the most appropriate firestopping system which complies with these specifications and requirements for system being installed.
- B. All insulation shall be continued through the penetration. Provide intumescent caulk or collar firestopping systems. Where the insulation thickness specified in Section 22 0700 exceeds the allowable insulation thickness for the firestopping system, reduce the insulation thickness 6 inches on either side of the penetration. Do not reduce insulation to less than 50 percent of the specified thickness.
- C. Provide collar type firestopping systems where shown on drawings, and for hot piping systems at penetrations where significant thermal movement can be expected, such as near expansion compensation loops or joints.
- D. See Section 22 0500 for sleeves. The use of sleeves may affect the "T" rating of the firestopping system. Coordinate use of sleeves with firestopping.

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100% Construction Set
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TWIN FALLS TRAINING FACILITY
SECTION 22 0509
PLUMBING FIRE STOPPING

END OF SECTION 22 0509

SECTION 22 0513 - COMMON MOTOR REQUIREMENTS FOR PLUMBING EQUIPMENT

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 general requirements for single-phase and polyphase, general-purpose, horizontal, small and medium, squirrel-cage induction motors for use on ac power systems up to 600 V and installed at equipment manufacturer's factory or shipped separately by equipment manufacturer for field installation.

1.03 COORDINATION

- A. Coordinate features of motors, installed units, and accessory devices to be compatible with the following:
 - 1. Motor controllers.
 - 2. Torque, speed, and horsepower requirements of the load.
 - 3. Ratings and characteristics of supply circuit and required control sequence.
 - 4. Ambient and environmental conditions of installation location.

PART 2 - PRODUCTS

2.01 GENERAL MOTOR REQUIREMENTS

- A. Comply with NEMA MG 1 unless otherwise indicated.

2.02 MOTOR CHARACTERISTICS

- A. Duty: Continuous duty at ambient temperature of 40 deg C and at altitude of 3300 feet (1000 m) above sea level.
- B. Capacity and Torque Characteristics: Sufficient to start, accelerate, and operate connected loads at designated speeds, at installed altitude and environment, with indicated operating sequence, and without exceeding nameplate ratings or considering service factor.
- C. All motors shall be premium efficiency.

2.03 SINGLE-PHASE MOTORS

- A. Motors larger than 1/20 hp shall be one of the following, to suit starting torque and requirements of specific motor application:
 - 1. Permanent-split capacitor.
 - 2. Split phase.
 - 3. Capacitor start, inductor run.
 - 4. Capacitor start, capacitor run.
- B. Multispeed Motors: Variable-torque, permanent-split-capacitor type.
- C. Bearings: Prelubricated, antifriction ball bearings or sleeve bearings suitable for radial and thrust loading.
- D. Motors 1/20 HP and Smaller: Shaded-pole type.
- E. Thermal Protection: Internal protection to automatically open power supply circuit to motor when winding temperature exceeds a safe value calibrated to temperature rating of motor insulation. Thermal-protection device shall automatically reset when motor temperature returns to normal range.

2.04 STARTERS, ELECTRICAL DEVICES AND WIRING

- A. Motor Starter Characteristics
 - 1. Coordinate with the Electrical Contractor for motor control center starters provided by Division 26.
 - 2. Enclosure: NEMA 1, general purpose enclosures with padlock ears, except in wet locations shall be NEMA 3R with conduit hubs, or units in hazardous locations which shall have NEC proper class and division
 - 3. Type and size of starter shall be as recommended by motor manufacturer and the driven equipment manufacturer for applicable protection and start up condition.
- B. Manual Switches
 - 1. See Division 26 for electrical requirements, provide control devices as required for sequence of operation and/or equipment specifications.
- C. Magnetic Starters
 - 1. Unless otherwise indicated, provide magnetic starters including contacts and coils for all 1-phase motors where interlock or automatic operation is indicated or required:
 - a. Provide equipment with Short Circuit Current Rating (SCCR) above available fault current.
 - b. Adjustable motor overload. Select range so that upper limit is no more than 150 percent of the connected motor full load amps.
 - c. Interlocks, auxiliary contacts, and similar devices as required for coordination with control requirements of Division 23 Controls sections.
 - d. H-O-A selector
 - e. Pilot lights for "power on" and "run" status.

- f. Mount starter and all appurtenances in a NEMA enclosure suitable for the environment.
 - D. Motor Connections: PVC jacketed liquid-tight flexible metallic conduit with liquid tight connectors, except where plug in electrical cords are specified.
- 2.05 DISCONNECT SWITCHES
- A. See Division 26 for electrical requirements, coordinate disconnect switch selection, installation, and wiring for equipment being provided.

PART 3 - EXECUTION (Not Applicable)

END OF SECTION 22 0513

SECTION 22 0519 - METERS AND GAGES FOR PLUMBING PIPING

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. Photo voltaic thermometer
 - 2. Pressure gages
- B. Related Sections:
 - 1. Section 21 1000 "Water Based Fire Protection"

1.03 INFORMATIONAL SUBMITTALS

- A. Product Certificates: For each type of meter and gage, from manufacturer.

1.04 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For meters and gages to include in operation and maintenance manuals.

PART 2 - PRODUCTS

2.01 MANUFACTURERS:

- A. Manufacturer: Subject to compliance with requirements, provide products by one of the following:
 - 1. Photo Voltaic Digital Thermometers:
 - a. Miljoco Corp.
 - b. Versa Gauge
 - c. Weiss Instruments
 - 2. Pressure Gauges:
 - a. Ametek/U.S. Gauge.
 - b. Ashcroft, Inc.
 - c. Ernst Flow Industries
 - d. Flo Fab, Inc.
 - e. MG Piping Products Co.

- f. Marsh Instrument Co.
- g. Marshalltown Instruments, Inc.
- h. Miljoco Corp.
- i. Trerice (H.O.) Co.
- j. Versa Gauge
- k. Weiss Instruments, Inc.

2.02 PHOTO VOLTAIC DIGITAL THERMOMETERS:

- A. Case: High image ABS, with photovoltaic power cell and digital readout.
- B. Range: Selectable between -40-300 degrees F/ -40-150 degrees F, displayed to 0.1 degrees.
- C. Accuracy: 1 percent of reading or 1 degrees F, whichever is greater. Recalibratable via internal potentiometer. Not affected by ambient temperature.
- D. Ambient light required: 10 lux.
- E. Display update: 10 seconds.
- F. Stem: Compatibly with standard thermowell for piping applications, or sampling tube with flange for air duct applications.

2.03 PRESSURE GAGES

- A. Direct-Mounted, Metal-Case, Dial-Type Pressure Gages:
 - 1. Standard: ASME B40.100.
 - 2. Case: Liquid-filled Vertical type(s); cast aluminum or drawn steel; 4-1/2-inch nominal diameter.
 - 3. Pressure-Element Assembly: Bourdon tube unless otherwise indicated.
 - 4. Pressure Connection: Brass, with NPS 1/2 ASME B1.20.1 pipe threads and bottom-outlet type unless back-outlet type is indicated.
 - 5. Movement: Mechanical, with link to pressure element and connection to pointer.
 - 6. Dial: Nonreflective aluminum with permanently etched scale markings graduated in psi.
 - 7. Pointer: Dark-colored metal.
 - 8. Window: Glass or Acrylic
 - 9. Ring: Metal, Brass or Stainless steel.
 - 10. Accuracy: Grade A, plus or minus 1 percent of middle half of scale range.
 - 11. Range: Water: 0-100 psi

2.04 GAGE ATTACHMENTS

- A. General: Provide pressure gauge cocks between pressure gauges and gauge tees on piping systems. Gauge cock shall be 1/2 inch female NPT on each end ball valve as specified in Section 22 0523 – Valves.
- B. Snubbers: ASME B40.100, brass; with NPS 1/2 (DN 15), ASME B1.20.1 pipe threads and piston porous-metal-type surge-dampening device. Include extension for use on insulated piping.

- C. Valves: Brass ball, with NPS 1/2 (DN 15), ASME B1.20.1 pipe threads.

PART 3 - EXECUTION

3.01 INSTALLATION

- A. Install direct-mounted thermometers in piping tees and adjust vertical and tilted positions.
- B. Install direct-mounted pressure gages in piping tees with pressure gage located on pipe at the most readable position.
- C. Install thermometers in the following locations:
 - 1. Inlet and outlet of each water heater.
- D. Install pressure gages in the following locations:
 - 1. Building water service entrance into building.
 - 2. Suction and discharge of each domestic water pump.
 - 3. Air compressors

3.02 CONNECTIONS

- A. Install meters and gages adjacent to machines and equipment to allow service and maintenance of meters, gages, machines, and equipment.

3.03 ADJUSTING

- A. Adjust faces of meters and gages to proper angle for best visibility.

3.04 THERMOMETER SCHEDULE

- A. Thermometers at inlet and outlet of each domestic water heater shall be the following:
 - 1. Photo voltaic type
- B. Test Plug: Install where shown

3.05 PRESSURE-GAGE SCHEDULE

- A. Pressure gages at suction and discharge of each domestic water pump shall be the following:
 - 1. Liquid-filled, direct-mounted, metal case.

3.06 PRESSURE-GAGE SCALE-RANGE SCHEDULE

- A. Scale Range for Water Service Piping: 0 to 100 psi
- B. Scale Range for Domestic Water Piping: 0 to 100 psi

3.07 ADJUSTING AND CLEANING:

- A. Adjusting: Adjust faces of meters and gauges to proper angle for best visibility.
- B. Cleaning: Clean windows of meters and gauges and factory finished surfaces. Replace cracked or broken windows, repair any scratched or marred surfaces with manufacturer's touch up paint.

END OF SECTION 22 0519

SECTION 22 0523 - GENERAL-DUTY VALVES FOR PLUMBING PIPING

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. Bronze ball valves.
 - 2. Iron ball valves.
 - 3. Bronze swing check valves.
 - 4. Iron single flange butterfly valves
- B. Related Sections
 - 1. Section 22 0553 "Identification for Plumbing Piping and Equipment" for valve tags and schedules.
 - 2. Section 22 1023 "Plumbing Pumps"
 - 3. Section 22 1116 "Domestic Water Piping" for valves applicable only to this piping.

1.03 DEFINITIONS

- A. CWP: Cold working pressure.
- B. EPDM: Ethylene propylene copolymer rubber.
- C. NBR: Acrylonitrile-butadiene, Buna-N, or nitrile rubber.

1.04 ACTION SUBMITTALS

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

1.05 QUALITY ASSURANCE

- A. Source Limitations for Valves: Obtain each type of valve from single source from single manufacturer.
- B. ASME Compliance:
 - 1. ASME B16.10 and ASME B16.34 for ferrous valve dimensions and design criteria.
 - 2. ASME B31.1 for power piping valves.
 - 3. ASME B31.9 for building services piping valves.
- C. NSF Compliance: NSF 61 for valve materials for potable-water service.

1.06 DELIVERY, STORAGE, AND HANDLING

- A. Prepare valves for shipping as follows:
 - 1. Protect internal parts against rust and corrosion.
 - 2. Protect threads, flange faces, grooves, and weld ends.
 - 3. Set ball valves open to minimize exposure of functional surfaces.
- B. Use the following precautions during storage:
 - 1. Maintain valve end protection.
 - 2. If outdoor storage is necessary, store valves off the ground in watertight enclosures.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Bronze Ball and Check Valves:
 - a. Conbraco Industries, Inc.; Apollo Valves.
 - b. Crane Co.
 - c. Hammond Valve.
 - d. Lance Valves.
 - e. Milwaukee Valve Company.
 - f. NIBCO INC.
 - g. Watts Regulator Co.
 - 2. Iron Single Flange Butterfly Valves
 - a. Apollo
 - b. Milwaukee
 - c. Crane
 - d. Watts
 - e. Nibco
 - f. Hammond
 - g. Conbraco
 - h. Kitz

2.02 GENERAL REQUIREMENTS FOR VALVES

- A. Refer to valve schedule for applications of valves.
- B. Valve Pressure and Temperature Ratings: Not less than indicated and as required for system pressures and temperatures.
- C. Valve Sizes: Same as upstream piping unless otherwise indicated.
- D. Valve Actuator Types:
 - 1. Handwheel: For valves other than quarter-turn types.
 - 2. Handlever: For quarter-turn valves NPS 6 and smaller.

- E. Valves in Insulated Piping: With 2-inch stem extensions and the following features:
 - 1. Ball Valves: With extended operating handle of non-thermal-conductive material, and protective sleeve that allows operation of valve without breaking the vapor seal or disturbing insulation.
 - 2. Butterfly Valves: With extended neck.

- F. Valve-End Connections:
 - 1. Flanged: With flanges according to ASME B16.1 for iron valves.
 - 2. Solder Joint: With sockets according to ASME B16.18.
 - 3. Threaded: With threads according to ASME B1.20.1.

2.03 BRONZE BALL VALVES

- A. Two-Piece, Full-Port, Bronze Ball Valves with Bronze Trim:
 - 1. Description:
 - a. Standard: MSS SP-110.
 - b. SWP Rating: 150 psig
 - c. CWP Rating: 200 psig
 - d. Body Design: Two piece.
 - e. Body Material: Bronze.
 - f. Ends: solder joint.
 - g. Seats: PTFE or TFE.
 - h. Stem: Stainless steel.
 - i. Ball: Chrome plated brass
 - j. Port: Full.

2.04 BRONZE SWING CHECK VALVES

- A. Class 125, Bronze Swing Check Valves with Nonmetallic Disc:
 - 1. Description:
 - a. Standard: MSS SP-80, Type 4.
 - b. CWP Rating: 200 psig
 - c. Body Design: Horizontal flow.
 - d. Body Material: ASTM B 62, bronze.
 - e. Ends: Threaded.
 - f. Disc: PTFE or TFE.

- B. Class 150, Bronze Swing Check Valves with Nonmetallic Disc:
 - 1. Description:
 - a. Standard: MSS SP-80, Type 4.
 - b. CWP Rating: 300 psig
 - c. Body Design: Horizontal flow.
 - d. Body Material: ASTM B 62, bronze.
 - e. Ends: Threaded.
 - f. Disc: PTFE or TFE.

2.05 IRON SINGLE FLANE BUTTERFLY VALVES

- A. 200 CWP, Iron, Single Flange Butterfly Valves with EPDM Seal and Aluminum Bronze Disc
 - 1. Description
 - a. Standard: MSS SP-67, Type 1
 - b. CWP: 200 psig
 - c. Body Design: Lug type, suitable for bidirectional dead-end service at rated pressure without use of downstream flange.
 - d. Body Material: ASTM A 126, cast iron or ASTM A 536, ductile iron, epoxy coated
 - e. Seat: EPDM
 - f. Stem: One or Two piece stainless steel
 - g. Disc: Aluminum bronze or Stainless steel

2.06 DRAIN VALVES

- A. For Plumbing Systems: Provide ball valve with threaded hose end.

PART 3 - EXECUTION

3.01 EXAMINATION

- A. Examine valve interior for cleanliness, freedom from foreign matter, and corrosion. Remove special packing materials, such as blocks, used to prevent disc movement during shipping and handling.
- B. Operate valves in positions from fully open to fully closed. Examine guides and seats made accessible by such operations.
- C. Examine threads on valve and mating pipe for form and cleanliness.
- D. Examine mating flange faces for conditions that might cause leakage. Check bolting for proper size, length, and material. Verify that gasket is of proper size, that its material composition is suitable for service, and that it is free from defects and damage.
- E. Do not attempt to repair defective valves; replace with new valves.

3.02 VALVE INSTALLATION

- A. Install valves with unions or flanges at each piece of equipment arranged to allow service, maintenance, and equipment removal without system shutdown.
- B. Locate valves for easy access and provide separate support where necessary.
- C. Install valves in horizontal piping with stem at or above center of pipe.
- D. Install valves in position to allow full stem movement.

- E. Install check valves for proper direction of flow and as follows:
 - 1. Swing Check Valves: In horizontal position with hinge pin level.

3.03 ADJUSTING

- A. Adjust or replace valve packing after piping systems have been tested and put into service but before final adjusting and balancing. Replace valves if persistent leaking occurs.

3.04 GENERAL REQUIREMENTS FOR VALVE APPLICATIONS

- A. Use the following valves for series indicated
 - 1. Plumbing Water Services: 3" and smaller: Ball Valve
 - 2. Plumbing Balancing: Calibrated Balancing Valve
 - 3. Pump-Discharge Check Valves:
 - a. NPS 2 and Smaller: Bronze swing check valves with nonmetallic disc.
- B. If valves with specified SWP classes or CWP ratings are not available, the same types of valves with higher SWP classes or CWP ratings may be substituted.
- C. Select valves with the following end connections:
 - 1. For Copper Tubing, NPS 2 and Smaller: Threaded ends except where solder-joint valve-end option is indicated in valve schedules below.
 - 2. For Copper Tubing, NPS 2-1/2 to NPS 4: Flanged ends except where threaded valve-end option is indicated in valve schedules below.
 - 3.
 - 4. For Steel Piping, NPS 2 and Smaller: Threaded ends.
 - 5. For Steel Piping, NPS 2-1/2 to NPS 4: Flanged ends except where threaded valve-end option is indicated in valve schedules below.

3.05 DOMESTIC, HOT- AND COLD-WATER VALVE SCHEDULE

- A. Pipe NPS 2 and Smaller:
 - 1. Bronze Valves: May be provided with solder-joint ends instead of threaded ends.
 - 2. Ball Valves: Two piece, full port, bronze with stainless-steel trim.
 - 3. Bronze Swing Check Valves: Class 125 or Class 150, nonmetallic disc.
- B. Pipe NPS 2-1/2 and Larger:
 - 1. Iron Valves, NPS 2-1/2 to NPS 4: May be provided with threaded ends instead of flanged ends.
 - 2. Iron or Bronze Ball Valves: Class 150.
 - 3. Iron, Single-Flange Butterfly Valves: 200 CWP, EPDM or NBR seat, aluminum-bronze or stainless-steel disc.
 - 4. Iron Swing Check Valves: Class 125, nonmetallic-to-metal seats.

END OF SECTION 22 0523

SECTION 22 0529 - HANGERS AND SUPPORTS FOR PLUMBING PIPING AND EQUIPMENT

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 pipe hangers and supports.
 - 2. Trapeze pipe hangers.
 - 3. Metal framing systems.
 - 4. Thermal-hanger shield inserts.
 - 5. Fastener systems.
 - 6. Equipment supports.
- B. Related Sections:
 - 1. Section 22 0548 "Vibration and Seismic Controls for Plumbing Piping and Equipment" for vibration isolation devices.
- C. Refer to individual piping sections for hanger spacing requirements.

1.03 DEFINITIONS

- A. MSS: Manufacturers Standardization Society of The Valve and Fittings Industry Inc.

1.04 PERFORMANCE REQUIREMENTS

- A. Delegated Design: Design trapeze pipe hangers and equipment supports using performance requirements and design criteria indicated.
- B. Structural Performance: Hangers and supports for plumbing piping and equipment shall withstand the effects of gravity loads and stresses within limits and under conditions indicated according to ASCE/SEI 7.
 - 1. Design supports for multiple pipes, including pipe stands, capable of supporting combined weight of supported systems, system contents, and test water.
 - 2. Design equipment supports capable of supporting combined operating weight of supported equipment and connected systems and components.
 - 3. Design seismic-restraint hangers and supports for piping and equipment .

1.05 ACTION SUBMITTALS

- A. Product Data: Submit manufacturer's technical product data, including installation instructions for each type of support and anchor. Submit pipe hanger and support schedule showing Manufacturer's figure number, size, location, and features for each required pipe hanger and support.
- B. Shop Drawings: Submit manufacturer's assembly-type shop drawings for each type of support and anchor, indicating dimensions, weights, required clearances, and methods of assembly of components. Show fabrication and installation details and include calculations for the following; include Product Data for components:
 - 1. Trapeze pipe hangers.
 - 2. Metal framing systems.
 - 3. Equipment supports
- C. Product certificates signed by the manufacturer of hangers and supports certifying that their products meet the specified requirements.
- D. Maintenance Data: Submit maintenance data and parts list for each type of support and anchor. Include this data, product data, and shop drawings in maintenance manual; in accordance with requirements of Division 22.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

- A. Manufacturer: Subject to compliance with requirements, provide products by one of the following:
 - 1. Pipe Hangers and Supports:
 - a. ANVIL International
 - b. B-Line Systems Inc.
 - c. Erico
 - d. Grinnell
 - e. Hubbard Enterprises (Supports for domestic water piping)
 - f. PHD Manufacturing, Inc.
 - g. Specialty Products Co. (Supports for domestic water piping).
 - h. Unistrut Metal Framing Systems
 - 2. Protection Shield:
 - a. ANVIL International
 - b. B-Line
 - c. Erico
 - d. Grinnell
 - e. Pipe Shields, Inc.
 - f. Snapp Itz
 - g. Value Engineered Products, Inc.

2.02 METAL PIPE HANGERS AND SUPPORTS

- A. General: Provide factory- fabricated hangers and supports complying with MSS SP-69, of one of the following MSS types listed, selected by Installer to suit piping systems, in accordance with MSS SP-69 and manufacturer's published product information. Use only one type by one manufacturer for each piping service. Select hangers and supports to suit pipe size and loading.
 - 1. Components shall have galvanized coatings where installed for piping and equipment that will not have field-applied finish.
 - 2. Pipe attachments shall have nonmetallic coating for electrolytic protection where attachments are in direct contact with copper tubing.
- B. Carbon-Steel Pipe Hangers and Supports:
 - 1. Description: MSS SP-58, Types 1 through 58, factory-fabricated components.
 - 2. Galvanized Metallic Coatings: Pregalvanized or hot dipped.
 - 3. Nonmetallic Coatings: Plastic coating, jacket, or liner.
 - 4. Hanger Rods: Continuous-thread rod, nuts, and washer made of carbon steel or stainless steel.
- C. Copper Pipe Hangers:
 - 1. Description: MSS SP-58, Types 1 through 58, copper-coated-steel, factory-fabricated components.
 - 2. Hanger Rods: Continuous-thread rod, nuts, and washer made of copper-coated steel or stainless steel.

2.03 TRAPEZE PIPE HANGERS

- A. Description: MSS SP-69, Type 59, shop- or field-fabricated pipe-support assembly made from structural carbon-steel shapes with MSS SP-58 carbon-steel hanger rods, nuts, saddles, and U-bolts.

2.04 MISCELLANEOUS MATERIALS

- A. Structural Steel: ASTM A 36/A 36M, carbon-steel plates, shapes, and bars; black and galvanized.

PART 3 - EXECUTION

3.01 INSPECTION

- A. Examine areas and conditions under which supports and anchors are to be installed. Do not proceed with work until unsatisfactory conditions have been corrected in manner acceptable to Installer.

3.02 PREPARATION

- A. Proceed with installation of hangers, supports and anchors only after required building structural work has been completed in areas where the work is to be installed. Correct inadequacies including (but not limited to) proper placement of inserts, anchors and other building structural attachments. Review Structural Drawings to obtain structural support limitations.

3.03 HANGER AND SUPPORT INSTALLATION

- A. Metal Pipe-Hanger Installation: Comply with MSS SP-69 and MSS SP-89. Install hangers, supports, clamps, and attachments as required to properly support piping from the building structure.
 - 1. Components shall have galvanized coatings where installed for piping and equipment that will not have field-applied finish.
 - 2. Pipe attachments shall have nonmetallic coating for electrolytic protection where attachments are in direct contact with copper tubing.
- B. Metal Trapeze Pipe-Hanger Installation: Comply with MSS SP-69 and MSS SP-89. Arrange for grouping of parallel runs of horizontal piping, and support together on field-fabricated trapeze pipe hangers.
 - 1. Pipes of Various Sizes: Support together and space trapezes for smallest pipe size or install intermediate supports for smaller diameter pipes as specified for individual pipe hangers. Do not use wire or perforated metal to support piping, and do not support piping from other piping.
 - 2. Field fabricate from ASTM A 36/A 36M, carbon-steel shapes selected for loads being supported. Weld steel according to AWS D1.1/D1.1M.
- C. Install hangers and supports complete with necessary attachments, inserts, bolts, rods, nuts, washers, and other accessories.
- D. Install hangers and supports to allow controlled thermal and seismic movement of piping systems, to permit freedom of movement between pipe anchors, and to facilitate action of expansion joints, expansion loops, expansion bends, and similar units and within 1'-0" of each horizontal elbow.
- E. Install lateral bracing with pipe hangers and supports to prevent swaying.
- F. Install building attachments attached to structural steel. Install additional attachments at concentrated loads, including valves, flanges, and strainers, NPS 2-1/2 and larger and at changes in direction of piping.
- G. Load Distribution: Install hangers and supports so that piping live and dead loads and stresses from movement will not be transmitted to connected equipment.
- H. Pipe Slopes: Install hangers and supports to provide indicated pipe slopes and to not exceed maximum pipe deflections allowed by ASME B31.9 for building services piping.

- I. Support fire-water piping independently from other piping systems.
 - J. Prevent electrolysis and abrasion in support of copper tubing by use of hangers and supports which are plastic coated, or with EPDM isolation strips. Duct tape or copper coated hangers without isolation are not acceptable.
 - K. Support vertical steel and copper piping at every story height but at not more than 15 foot intervals for steel and 10 feet for copper.
 - L. Where several pipes can be installed in parallel and at same elevation, provide trapeze hangers.
 - M. Where practical, support riser piping independently of connected horizontal piping.
 - N. Each pipe drop to equipment shall be adequately supported. All supporting lugs or guides shall be securely anchored to the building structure.
 - O. Securely anchor and support plumbing domestic water piping in chases or walls using pipe positioning system. Use factory manufactured clamps and brackets connected to fixtures, waste/vent piping or brackets connected to studs. Wires or straps will not be permitted.
 - 1. When copper supplies are connected to flush valves, support the tubing by the studs or by a fixture, not by clamping to waste/vent piping.
 - 2. Prevent copper tubes from making contact with steel brackets using fire retardant polyethylene inserts or other dielectric insulating material. Duct tape shall not be used.
 - P. Insulated Piping:
 - 1. Attach clamps and spacers to piping.
 - 2. Install MSS SP-58, Type 40, protective shields on all insulated piping 2 inches and less (except where required to be clamped). Shields shall span an arc of 180 degrees.
 - a. Where necessary to prevent dislocation, strap shield to pipe with wire ties or "zip strips".
- 3.04 EQUIPMENT SUPPORTS
- A. Concrete bases for the mechanical equipment indoors or outdoors will only be provided by the General Contractor if shown on the architectural or structural drawings. Otherwise, all bases shall be provided by this Contractor.
 - B. Housekeeping bases shall be 3-1/2 inches thick minimum, extended 4 inches beyond machinery bedplates.
 - C. This Contractor shall be responsible for the proper size and location of all bases and shall furnish all required anchor bolts and sleeves. If bases are provided by the General Contractor, furnish him with templates showing the bolt locations.
 - D. Equipment shall be secured to the bases with anchor bolts of ample size. Bolts shall have bottom plates and pipe sleeves and shall be securely imbedded in the concrete. All machinery shall be grouted under the entire bearing surface. After grout has set, all wedges, shims and

jack bolts shall be removed and the space filled with non-shrinking grout. This Contractor shall provide washers at all equipment anchor bolts.

3.05 ADJUSTING

- A. Hanger Adjustments: Adjust hangers to distribute loads equally on attachments and to achieve indicated slope of pipe.
- B. Trim excess length of continuous-thread hanger and support rods to 1-1/2 inches.

3.06 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 a minimum dry film thickness of 2.0 mils.
- B. Galvanized Surfaces: Clean welds, bolted connections, and abraded areas and apply galvanizing-repair paint to comply with ASTM A 780.

3.07 HANGER AND SUPPORT SCHEDULE

- A. Specific hanger and support requirements are in Sections specifying piping systems and equipment.
- B. Comply with MSS SP-69 for pipe-hanger selections and applications that are not specified in piping system Sections.
- C. Use nonmetallic coatings on attachments for electrolytic protection where attachments are in direct contact with copper tubing.
- D. Use carbon-steel pipe hangers and supports, metal trapeze pipe hangers and metal framing systems and attachments for general service applications.
- E. Use protection shields for insulated piping and tubing.
- F. Horizontal-Piping Hangers and Supports: Unless otherwise indicated and except as specified in piping system Sections, install the following types: Note: provide rubber protection spacers between clamps and bare piping on piping where type 24, 26 and 59 clamps are used, oversize rubber spacer on multiple pipe hangers for compensating movement.
 - 1. Adjustable, Steel Clevis Hangers (MSS Type 1): For suspension of noninsulated or insulated, stationary pipes NPS 1/2 to NPS 30.
 - 2. Carbon- or Alloy-Steel, Double-Bolt Pipe Clamps (MSS Type 3): For suspension of pipes NPS 3/4 to NPS 36, requiring clamp flexibility and up to 4 inches of insulation.
 - 3. Steel Pipe Clamps (MSS Type 4): For suspension of cold and hot pipes NPS 1/2 to NPS 24 if little or no insulation is required.
 - 4. Pipe Hangers (MSS Type 5): For suspension of pipes NPS 1/2 to NPS 4, where off-center closure for hanger installation before pipe erection is required.

5. Adjustable, Swivel Split- or Solid-Ring Hangers (MSS Type 6): For suspension of noninsulated, stationary pipes NPS 3/4 to NPS 8.
 6. Adjustable, Steel Band Hangers (MSS Type 7): For suspension of insulated, stationary pipes NPS 1/2 to NPS 8.
 7. Adjustable Band Hangers (MSS Type 9): For suspension of insulated, stationary pipes NPS 1/2 to NPS 8.
 8. Adjustable, Swivel-Ring Band Hangers (MSS Type 10): For suspension of insulated, stationary pipes NPS 1/2 to NPS 8.
 9. Split Pipe Ring with or without Turnbuckle Hangers (MSS Type 11): For suspension of insulated, stationary pipes NPS 3/8 to NPS 8.
 10. Extension Hinged or Two-Bolt Split Pipe Clamps (MSS Type 12): For suspension of noninsulated, stationary pipes NPS 3/8 to NPS 3.
 11. Clips (MSS Type 26): For support of insulated pipes not subject to expansion or contraction.
- G. Vertical-Piping Clamps: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
1. Extension Pipe or Riser Clamps (MSS Type 8): For support of pipe risers NPS 3/4 to NPS 24.
 2. Carbon- or Alloy-Steel Riser Clamps (MSS Type 42): For support of pipe risers NPS 3/4 to NPS 24 if longer ends are required for riser clamps.
- H. Hanger-Rod Attachments: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
1. Steel Turnbuckles (MSS Type 13): For adjustment up to 6 inches for heavy loads.
 2. Steel Clevises (MSS Type 14): For 120 to 450 deg F piping installations.
 3. Swivel Turnbuckles (MSS Type 15): For use with MSS Type 11, split pipe rings.
 4. Malleable-Iron Sockets (MSS Type 16): For attaching hanger rods to various types of building attachments.
 5. Steel Weldless Eye Nuts (MSS Type 17): For 120 to 450 deg F piping installations.
- I. Building Attachments: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
1. Steel or Malleable Concrete Inserts (MSS Type 18): For upper attachment to suspend pipe hangers from concrete ceiling.
 2. Top-Beam C-Clamps (MSS Type 19): For use under roof installations with bar-joist construction, to attach to top flange of structural shape.
 3. Side-Beam or Channel Clamps (MSS Type 20): For attaching to bottom flange of beams, channels, or angles.
 4. Center-Beam Clamps (MSS Type 21): For attaching to center of bottom flange of beams.
 5. Welded Beam Attachments (MSS Type 22): For attaching to bottom of beams if loads are considerable and rod sizes are large.
 6. C-Clamps (MSS Type 23): For structural shapes.
 7. Top-Beam Clamps (MSS Type 25): For top of beams if hanger rod is required tangent to flange edge.
 8. Side-Beam Clamps (MSS Type 27): For bottom of steel I-beams.

9. Steel-Beam Clamps with Eye Nuts (MSS Type 28): For attaching to bottom of steel I-beams for heavy loads.
 10. Linked-Steel Clamps with Eye Nuts (MSS Type 29): For attaching to bottom of steel I-beams for heavy loads, with link extensions.
 11. Malleable-Beam Clamps with Extension Pieces (MSS Type 30): For attaching to structural steel.
 12. Welded-Steel Brackets: For support of pipes from below or for suspending from above by using clip and rod. Use one of the following for indicated loads:
 - a. Light (MSS Type 31): 750 lb
 - b. Medium (MSS Type 32): 1500 lb
 - c. Heavy (MSS Type 33): 3000 lb
 13. Side-Beam Brackets (MSS Type 34): For sides of steel beams.
- J. Shields: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
1. Protection Shields (MSS Type 40): Of length recommended in writing by manufacturer to prevent crushing insulation.
- K. Comply with MSS SP-69 for trapeze pipe-hanger selections and applications that are not specified in piping system Sections.
- L. Use hangers which are vertically adjustable 1-1/2 inch minimum after piping is erected.
- M. Install piping with minimum rod sizes and maximum spacing as specified in individual sections and per plumbing code.

END OF SECTION 22 0529

SECTION 22 0548 - VIBRATION AND SEISMIC CONTROLS FOR PLUMBING PIPING AND EQUIPMENT

PART 1 - GENERAL

1.01 DESCRIPTION OF WORK

- A. Extent of vibration control work required by this section is indicated on drawings and schedules, and/or specified in other Division 22 sections.
 - 1. All plumbing equipment, and piping as noted or in the specification shall be mounted on vibration isolators to prevent the transmission of vibration and mechanically transmitted sound to the building structure. Vibration isolators shall be selected in accordance with the weight distribution so as to produce reasonably uniform deflections.
 - 2. It is the intent of the seismic portion of this specification to keep all mechanical and electrical building system components in place during a seismic event.
 - 3. All such systems must be installed in strict accordance with seismic codes, component manufacturer's and building construction standards. Whenever a conflict occurs between the manufacturers or construction standards, the most stringent shall apply.
 - 4. This specification is considered to be minimum requirements for seismic consideration and is not intended as a substitute for legislated, more stringent, national, state or local construction.
 - 5. Any variance or non-compliance with these specification requirements shall be corrected by the contractor in an approved manner.
 - 6. Seismic restraints shall be designed in accordance with seismic force levels as specified herein.

1.02 RELATED DOCUMENTS

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

1.03 SUMMARY

- A. Section Includes:
 - 1. Elastomeric isolation pads.
 - 2. Restrained elastomeric isolation mounts.
 - 3. Restrained-spring isolators.
 - 4. Housed-restrained-spring isolators.
 - 5. Pipe-riser resilient supports.
 - 6. Resilient pipe guides.
 - 7. Elastomeric hangers.
 - 8. Spring hangers.
 - 9. Snubbers.
 - 10. Restraint channel bracings.

11. Restraint cables.
12. Seismic-restraint accessories.
13. Mechanical anchor bolts.
14. Adhesive anchor bolts.

B. Related Requirements:

1. Section 23 0548 "Vibration and Seismic Controls for HVAC" for devices for HVAC equipment and systems.

1.04 DEFINITIONS

A. Positive Attachment:

1. A positive attachment is defined as a cast-in anchor, a drill-in wedge anchor, a double sided beam clamp loaded perpendicular to a beam, or a welded or bolted connection to structure. Single sided "C" type beam clamps for support rods of overhead piping, ductwork, fire protection, electrical conduit, bus duct, or cable trays, or any other equipment are not acceptable on this project as seismic anchor points.

B. Transverse Bracing:

1. Restraint(s) applied to limit motion perpendicular to the center line of the pipe, duct or conduit.

C. Longitudinal Bracing:

1. Restraint(s) applied to limit motion parallel to the centerline of the pipe, duct or conduit.

D. IBC: International Building Code.

E. ICC-ES: ICC-Evaluation Service.

1.05 ACTION SUBMITTALS

A. Shop Drawings:

1. Detail fabrication and assembly of equipment bases. Detail fabrication including anchorages and attachments to structure and to supported equipment.

B. Product Data: Submit manufacturer's technical product data and installation instructions for each type of vibration and seismic control product. Submit schedule showing size, type, deflection, and location for each product furnished.

1. Include data for each type and size of unit, showing specific restraints, isolation efficiency, stiffness, natural frequency and transmissibility at lowest operating speed of equipment detailing compliance with the specification.
2. For spring units, show wire size, spring diameter, free height, solid-compression height, operating height, fatigue characteristics, ratio of horizontal to vertical stiffness and bases of spring-rated selection for range of loading weights.
3. Detailed schedules of flexible and rigidly mounted equipment, showing vibration isolators and seismic restraints by referencing numbered descriptive drawings.

4. Illustrate and indicate style, material, strength, fastening provision, and finish for each type and size of vibration isolation device and seismic-restraint component required.
 - a. Tabulate types and sizes of seismic restraints, complete with report numbers and rated strength in tension and shear as evaluated by an evaluation service member of ICC-ES.
 - b. Annotate to indicate application of each product submitted and compliance with requirements.
5. Interlocking Snubbers: Include ratings for horizontal, vertical, and combined loads.
6. Include performance certifications from manufacturers.

1.06 QUALITY ASSURANCE

- A. Comply with seismic-restraint requirements in the IBC unless requirements in this Section are more stringent.
- B. Welding Qualifications: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."
- C. Seismic-restraint devices shall have horizontal and vertical load testing and analysis and shall bear anchorage preapproval OPA number from OSHPD, preapproval by ICC-ES, or preapproval by another agency acceptable to authorities having jurisdiction, showing maximum seismic-restraint ratings. Ratings based on independent testing are preferred to ratings based on calculations. If preapproved ratings are unavailable, submittals based on independent testing are preferred. Calculations (including combining shear and tensile loads) to support seismic-restraint designs must be signed and sealed by a qualified professional engineer.
 1. installation and performance.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 1. Restrained Spring Isolators
 - a. Ace Mountings Co., Inc.
 - b. California Dynamics Corporation.
 - c. Isolation Technology, Inc.
 - d. Kinetics Noise Control, Inc.
 - e. Mason Industries, Inc.
 - f. Vibration Eliminator Co., Inc.
 - g. Vibration Isolation.
 - h. Vibration Mountings & Controls, Inc.
 2. Spring Hangers
 - a. Ace Mountings Co., Inc.
 - b. California Dynamics Corporation.
 - c. Kinetics Noise Control, Inc.

- d. Mason Industries, Inc.
- e. Vibration Eliminator Co., Inc.
- f. Vibration Isolation.
- g. Vibration Mountings & Controls, Inc.
3. Snubbers
 - a. Kinetics Noise Control, Inc.
 - b. Mason Industries, Inc.
 - c. Vibration Mountings & Controls, Inc.
4. Seismic Restraint Accessories
 - a. B-line, an Eaton business.
 - b. Kinetics Noise Control, Inc.
 - c. Mason Industries, Inc.
 - d. TOLCO.
5. Mechanical Anchor Bolts
 - a. B-line, an Eaton business.
 - b. Hilti, Inc
 - c. Kinetics Noise Control, Inc.
 - d. Mason Industries, Inc.

2.02 PERFORMANCE REQUIREMENTS

- A. Seismic-Restraint Loading:
 1. Site Class as Defined in the IBC: C
 2. Assigned Seismic Use Group or Building Category as Defined in the IBC: IV
 - a. Component Importance Factor: 1.5
 - b. Component Response Modification Factor: Per ASCE-7
 - c. Component Amplification Factor: Per ASCE-7
 3. Design Spectral Response Acceleration at Short Periods (0.2 Second): .Per ASCE-7
 4. Design Spectral Response Acceleration at 1.0-Second Period: Per ASCE-7
 5. Rated strengths, features, and applications shall be as defined in reports by an evaluation service member of ICC-ES, OSHPD or an agency acceptable to authorities having jurisdiction.
 - a. Structural Safety Factor: Allowable strength in tension, shear, and pullout force of components shall be at least [**four**] times the maximum seismic forces to which they are subjected.

2.03 RESTRAINED-SPRING ISOLATORS

- A. Freestanding, Laterally Stable, Open-Spring Isolators with Vertical-Limit Stop Restraint:
 1. Housing: Steel housing with vertical-limit stops to prevent spring extension due to weight being removed.
 - a. Base with holes for bolting to structure with an elastomeric isolator pad attached to the underside. Bases shall limit floor load to 500 psig (3447 kPa).
 - b. Top plate with threaded mounting holes or elastomeric pad.
 - c. Internal leveling bolt that acts as blocking during installation.
 2. Restraint: Limit stop as required for equipment and authorities having jurisdiction.

3. Outside Spring Diameter: Not less than 80 percent of the compressed height of the spring at rated load.
4. Minimum Additional Travel: 50 percent of the required deflection at rated load.
5. Lateral Stiffness: More than 80 percent of rated vertical stiffness.
6. Overload Capacity: Support 200 percent of rated load, fully compressed, without deformation or failure.

2.04 SPRING HANGERS

- A. Combination Coil-Spring and Elastomeric-Insert Hanger with Spring and Insert in Compression:
 1. Frame: Steel, fabricated for connection to threaded hanger rods and to allow for a maximum of 30 degrees of angular hanger-rod misalignment without binding or reducing isolation efficiency.
 2. Outside Spring Diameter: Not less than 80 percent of the compressed height of the spring at rated load.
 3. Minimum Additional Travel: 50 percent of the required deflection at rated load.
 4. Lateral Stiffness: More than 80 percent of rated vertical stiffness.
 5. Overload Capacity: Support 200 percent of rated load, fully compressed, without deformation or failure.
 6. Elastomeric Element: Molded, oil-resistant rubber or neoprene. Steel-washer-reinforced cup to support spring and bushing projecting through bottom of frame.
 7. Adjustable Vertical Stop: Steel washer with neoprene washer "up-stop" on lower threaded rod.
 8. Self-centering hanger-rod cap to ensure concentricity between hanger rod and support spring coil.

2.05 SNUBBERS

- A. Description: Factory fabricated using welded structural-steel shapes and plates, anchor bolts, and replaceable resilient isolation washers and bushings.
 1. Anchor bolts for attaching to concrete shall be seismic-rated, drill-in, and stud-wedge or female-wedge type.
 2. Resilient Isolation Washers and Bushings: Oil- and water-resistant neoprene.
 3. Maximum 1/4-inch air gap, and minimum 1/4-inch- (6-mm-) thick resilient cushion.

2.06 SEISMIC-RESTRAINT ACCESSORIES

- A. Hanger-Rod Stiffener: Steel tube or steel slotted-support-system sleeve with internally bolted connections or Reinforcing steel angle clamped to hanger rod.
- B. Hinged and Swivel Brace Attachments: Multifunctional steel connectors for attaching hangers to rigid channel bracings and restraint cables.
- C. Bushings for Floor-Mounted Equipment Anchor Bolts: Neoprene bushings designed for rigid equipment mountings, and matched to type and size of anchor bolts and studs.

- D. Bushing Assemblies for Wall-Mounted Equipment Anchorage: Assemblies of neoprene elements and steel sleeves designed for rigid equipment mountings, and matched to type and size of attachment devices used.
- E. Resilient Isolation Washers and Bushings: One-piece, molded, oil- and water-resistant neoprene, with a flat washer face.

2.07 MECHANICAL ANCHOR BOLTS

- A. Mechanical Anchor Bolts: Drilled-in and stud-wedge or female-wedge type in zinc-coated steel for interior applications and stainless steel for exterior applications. Select anchor bolts with strength required for anchor and as tested according to ASTM E 488.

PART 3 - EXECUTION

3.01 EXAMINATION

- A. Examine areas and equipment to receive vibration isolation and seismic-control devices for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
- B. Examine roughing-in of reinforcement and cast-in-place anchors to verify actual locations before installation.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 APPLICATIONS

- A. Multiple Pipe Supports: Secure pipes to trapeze member with clamps approved for application by an evaluation service member of ICC-ES.
- B. Hanger-Rod Stiffeners: Install hanger-rod stiffeners where indicated or scheduled on Drawings to receive them and where required to prevent buckling of hanger rods due to seismic forces.
- C. Strength of Support and Seismic-Restraint Assemblies: Where not indicated, select sizes of components so strength is adequate to carry present and future static and seismic loads within specified loading limits.
- D. Install units between substrate and equipment as required for secure operation and to prevent displacement by normal forces.
- E. Where piping passes through walls, floors or ceilings the vibration isolation manufacturer shall provide split wall seals.
- F. Locate isolation hangers as near to the overhead support structure as possible.

- G. Adjust leveling devices as required to distribute loading uniformly onto isolators. Shim units as required where substrate is not level.
- H. Weld riser isolator units in place as required to prevent displacement from loading and operations.
- I. Flexible Pipe Connectors: Install on equipment side of shutoff valves, horizontally and parallel to equipment shafts wherever possible.

3.03 VIBRATION CONTROL AND SEISMIC-RESTRAINT DEVICE INSTALLATION

- A. Coordinate the location of embedded connection hardware with supported equipment attachment and mounting points and with requirements for concrete reinforcement and formwork.
- B. Installation of vibration isolators must not cause any change of position of equipment, piping, or ductwork resulting in stresses or misalignment.
- C. Comply with requirements in Section 07 for installation of roof curbs, equipment supports, and roof penetrations.
- D. No rigid connections between equipment and the building structure shall be made that degrades the noise and vibration control system herein specified.
- E. The contractor shall not install any equipment, piping, or conduit which makes rigid connections with the building unless isolation is not specified. "Building" includes, but is not limited to, slabs, beams, columns, studs and walls. Coordinate work with other trades to avoid rigid contact with the building.
- F. Any conflicts with other trades which will result in rigid contact with equipment or piping due to inadequate space or other unforeseen conditions should be brought to the architect's/engineer's attention prior to installation. Corrective work necessitated by conflicts after installation shall be at the responsible contractor's expense.
 - 1. Bring to the architect's/engineer's attention any discrepancies between the specifications and the field conditions or changes required due to specific equipment selection, prior to installation. Corrective work necessitated by discrepancies after installation shall be at the responsible contractor's expense.
- G. Correct, at no additional cost, all installations which are deemed defective in workmanship and materials at the contractor's expense.
- H. Overstressing of the building structure must not occur because of overhead support of equipment. Contractor must submit loads to the structural engineer of record for approval. Generally bracing may occur from:
 - 1. Flanges of structural beams.
 - 2. Upper truss cords in bar joist construction.
 - 3. Cast in place inserts or wedge type drill-in concrete anchors.

- I. Seismic cable restraints shall be installed slightly slack to avoid short-circuiting the isolated suspended equipment, piping or conduit.
- J. Seismic cable restraint assemblies are installed taut on non-isolated systems. Seismic solid braces may be used in place of cables on rigidly attached systems only.
- K. At all locations where seismic cable restraints or seismic solid braces restraints are attached to pipe clevis's, the clevis cross bolt must be reinforced with pipe clevis cross bolt braces.
- L. Equipment Restraints:
 - 1. Install seismic snubbers on plumbing equipment mounted on vibration isolators. Locate snubbers as close as possible to vibration isolators and bolt to equipment base and supporting structure.
 - 2. Install resilient bolt isolation washers on equipment anchor bolts where clearance between anchor and adjacent surface exceeds 0.125 inch.
 - 3. Install seismic-restraint devices using methods approved by an evaluation service member of ICC-ES that provides required submittals for component.
- M. Piping Restraints:
 - 1. Comply with requirements in MSS SP-127.
 - 2. Space lateral supports a maximum of 40 feet o.c., and longitudinal supports a maximum of 80 feet o.c.
 - 3. Brace a change of direction longer than 12 feet.

3.04 ACCOMMODATION OF DIFFERENTIAL SEISMIC MOTION

- A. Install "Metraloop" flexible connections in piping where they cross seismic joints, where adjacent sections or branches are supported by different structural elements, and where the connections terminate with connection to equipment that is anchored to a different structural element from the one supporting the connections as they approach equipment. Comply with requirements in Section 22 1116 "Domestic Water Piping" for piping flexible connections.

3.05 SEISMIC RESTRAINT EXCLUSIONS

- A. Piping
 - 1. All piping less than 2-1/2 Inches in diameter except those listed below.
 - 2. All clevis or trapeze supported piping suspended from hanger rods where the point of attachment is less than the 12 inches in length from the structure to the structural connection of the clevis or trapeze.
 - 3. All PVC and fiberglass suspended waste or vent pipe 6 inches in diameter and smaller.

3.06 EXAMINATION OF RELATED WORK

- A. Installer of vibration isolation work shall observe installation of other work related to vibration isolation work, including work connected to vibration isolation work; and, after completion of other related work (but before equipment startup), shall furnish written report to Engineer listing observed inadequacies for proper operation and performance of vibration isolation work. Report shall cover, but not necessarily be limited to the following:

1. Equipment installations (performed as work of other sections) on vibration isolators.
2. Piping connections including flexible connections.
3. Passage of piping which is to be isolated through walls and floors.

B. Do not start-up equipment until inadequacies have been corrected.

3.07 ADJUSTING

A. Adjust isolators after piping system is at operating weight.

B. Adjust limit stops on restrained-spring isolators to mount equipment at normal operating height. After equipment installation is complete, adjust limit stops so they are out of contact during normal operation.

3.08 PLUMBING VIBRATION CONTROL AND SEISMIC RESTRAINT DEVICE SCHEDULE

A. Piping connected to pumps and compressors systems

1. Spring isolator hangers with vertical limits within first five hangers from equipment

B. Piping seismic restraints

1. All piping as required by seismic design submittal.

C. Water heaters and converters and tanks

1. Seismic braces

D. Equipment Isolation

1. Equipment Base/Rail per Part 4 schedule

PART 4 - SCHEDULES

4.01 EQUIPMENT VIBRATION ISOLATION TABLE

A. The following Base and Isolator Types are for these tables only. Refer to Part 2 and Part 3 for additional information.

Base Type Legend:	Isolator Type Legend:
A = No base, isolators attached directly to equipment	1 = Pad, rubber or glass fiber
B = Structural steel rails or base	2 = Rubber floor isolator or hanger
C = Concrete inertia base	3 = Spring floor isolator or hanger
D = Curb-mounted base	4 = Restrained spring isolator
N/A = Not Applicable	5 = Thrust restraint

Equipment Type	Slab On Grade			Up To 20-FT Floor Span		
	Base Type	Isol Type	Min. Defl. (Inches)	Base Type	Isol Type	Min. Defl. (Inches)

Equipment Type	Slab On Grade			Up To 20-FT Floor Span		
	Base Type	Isol Type	Min. Defl. (Inches)	Base Type	Isol Type	Min. Defl. (Inches)
Air Compressors and Vacuum Pumps						
Tank-Mounted, Horizontal, 10 HP and smaller	A	3	.75	A	3	.75
Pumps						
Close-Coupled, 7-1/2 HP and smaller	C	3	.25	C	3	0.75

Equipment Type	20 to 30-FT Floor Span			30 to 40-FT Floor Span		
	Base Type	Isol Type	Min. Defl. (Inches)	Base Type	Isol Type	Min. Defl. (Inches)
Air Compressors and Vacuum Pumps						
Tank-Mounted, Horizontal, 10 HP and smaller	A	3	1.50	A	3	1.50
Pumps						
Close-Coupled, 7-1/2 HP and smaller	C	3	0.75	C	3	0.75

END OF SECTION 22 0548

SECTION 22 0553 - IDENTIFICATION FOR PLUMBING PIPING AND EQUIPMENT

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.
- B. Codes and Standards:
 - 1. ANSI Standards: Comply with ANSI A13.1 for lettering size, length of color field, colors, and viewing angles of identification devices.

1.02 SUMMARY

- A. Section Includes:
 - 1. Equipment labels.
 - 2. Pipe labels.

1.03 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Samples: For color, letter style, and graphic representation required for each identification material and device.
- C. Equipment Label Schedule: Include a listing of all equipment to be labeled with the proposed content for each label.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - 1. Plastic Labels for Equipment
 - a. Brady Corporation.
 - b. Brimar Industries, Inc.
 - c. Carlton Industries, LP.
 - d. Champion America.
 - e. Craftmark Pipe Markers.
 - f. emedco.
 - g. Kolbi Pipe Marker Co.

- h. LEM Products Inc.
- i. Marking Services, Inc.
- j. Seton Identification Products.
- 2. Pipe Labels
 - a. Actioncraft Products, Inc.
 - b. Brady Corporation.
 - c. Brimar Industries, Inc.
 - d. Carlton Industries, LP.
 - e. Champion America.
 - f. Craftmark Pipe Markers.
 - g. emedco.
 - h. Kolbi Pipe Marker Co.
 - i. LEM Products Inc.
 - j. Marking Services, Inc.
 - k. Seton Identification Products.

2.02 Plastic Labels for Equipment

- A. Material and Thickness: Multilayer, multicolor, plastic labels for mechanical engraving, 1/8 inch thick, and having predrilled holes for attachment hardware.
- B. Letter Color: White.
- C. Background Color: Blue.
- D. Maximum Temperature: Able to withstand temperatures up to 160 deg F.
- E. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch.
- F. Minimum Letter Size: 1/4 inch for name of units if viewing distance is less than 24 inches, 1/2 inch for viewing distances up to 72 inches, and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-quarters the size of principal lettering.
- G. Fasteners: Stainless-steel rivets or self-tapping screws.
- H. Label Content: Include equipment's Drawing designation or unique equipment number, drawing numbers where equipment is indicated (plans, details, and schedules), and the Specification Section number and title where equipment is specified.
- I. Equipment Label Schedule: For each item of equipment to be labeled, on 8-1/2-by-11-inch bond paper. Tabulate equipment identification number and identify Drawing numbers where equipment is indicated (plans, details, and schedules) and the Specification Section number and title where equipment is specified. Equipment schedule shall be included in operation and maintenance data.

2.03 PIPE LABELS

- A. General Requirements for Manufactured Pipe Labels: Preprinted, color-coded, with lettering indicating service, and showing flow direction. Furnish 1 inch thick molded fiberglass insulation with jacket for each plastic pipe marker to be installed on uninsulated pipes subjected to fluid temperatures of 125 degrees F. or greater. Cut length to extend 2 inches beyond each end of plastic pipe marker. Comply with piping system nomenclature as specified, scheduled, shown, or to match existing building lettering nomenclature system and abbreviate only as necessary for each application length if there is an existing system.
- B. Small Pipes: For external diameters less than 6 inches (including insulation if any), provide full-band pipe markers, extending 360 degrees around pipe at each location, fastened by one of the following methods:
 - 1. Snap-on application of pre-tensioned semi-rigid plastic pipe marker.
 - 2. Taped to pipe (or insulation) with color-coded plastic adhesive tape, not less than 3/4 inch wide; full circle at both ends of pipe marker, tape lapped 1-1/2 inch.
 - 3. Self-adhesive backing.
- C. Large Pipes: For external diameters of 6 inches and larger (including insulation if any), provide either full-band or strip-type pipe markers, but not narrower than 3 times letter height (and of required length), fastened by one of the following methods:
 - 1. Steel spring or non-metallic fasteners.
 - 2. Taped to pipe (or insulation) with color-coded plastic adhesive tape, not less than 1-1/2 inches wide; full circle at both ends of pipe marker, tape lapped 3 inches.
 - 3. Strapped-to-pipe (or insulation) application of semi-rigid type, with manufacturer's standard stainless steel bands.
 - 4. Self-Adhesive backing.
- D. Lettering: Comply with piping system nomenclature as specified, scheduled, shown, or to match existing building lettering nomenclature system, if remodel, and abbreviate only as necessary for each application length.
- E. Pipe Label Contents: Include identification of piping service using same designations or abbreviations as used on Drawings; also include an arrow indicating flow direction.
 - 1. Flow-Direction Arrows: Integral with piping-system service lettering to accommodate both directions or as separate unit on each pipe label to indicate flow direction.
 - 2. Lettering Size: At least 1/2 inch for viewing distances up to 72 inches and proportionately larger lettering for greater viewing distances.
- F. Underground-Type Plastic Pipe Line Markers:
 - 1. General: Manufacturer's standard permanent, bright-colored, continuous-printed plastic tape with metal core for detection, intended for direct-burial service; not less than 6 inches wide x 4 mils thick. Provide tape with printing which most accurately indicates type of service of buried pipe.
 - 2. Provide multi-ply tape consisting of solid aluminum foil core between 2-layers of plastic tape.

2.04 ENGRAVED PLASTIC-LAMINATE SIGNS

- A. General: Provide manufacturer's standard engraved 2-ply bonded plastic, in the sizes and thicknesses indicated, engraved with engraver's standard letter style of the sizes and wording indicated, black with white core (letter color) except as otherwise indicated, punched for mechanical fastening except where adhesive mounting is necessary because of substrate.
- B. Thickness: 1/16-inch, except as otherwise indicated.
- C. Fasteners: Self-tapping stainless steel screws, except contact-type permanent adhesive where screws cannot or should not penetrate the substrate.

2.05 PLASTICIZED TAGS

- A. General: Manufacturer's standard pre-printed or partially pre-printed accident-prevention tags, of plasticized card stock with matt finish suitable for writing, approximately 3-1/4-inch x 5-5/8-inch, with brass grommets and wire fasteners, and with appropriate pre-printed wording including large- size primary wording (as examples; DANGER, CAUTION, DO NOT OPERATE).

PART 3 - EXECUTION

3.01 PREPARATION

- A. Clean piping and equipment surfaces of substances that could impair bond of identification devices, including dirt, oil, grease, release agents, and incompatible primers, paints, and encapsulants.

3.02 GENERAL INSTALLATION REQUIREMENTS

- A. Coordinate installation of identifying devices with completion of covering and painting of surfaces where devices are to be applied.
- B. Coordinate installation of identifying devices with locations of access panels and doors.
- C. Install identifying devices before installing acoustical ceilings and similar concealment.

3.03 EQUIPMENT LABEL INSTALLATION

- A. Install or permanently fasten labels on each major item of mechanical equipment.
- B. Locate equipment labels where accessible and visible.

3.04 PIPE LABEL INSTALLATION

- A. Pipe Label Locations: Locate pipe labels where piping is exposed or above accessible ceilings in finished spaces; machine rooms; accessible maintenance spaces such as shafts, tunnels, and plenums; and exterior exposed locations as follows:

1. Near each valve.
 2. Near each branch connection, excluding short takeoffs for fixtures and terminal units. Where flow pattern is not obvious, mark each pipe at branch.
 3. Near penetrations through walls, floors, ceilings, and inaccessible enclosures.
 4. Near major equipment items and other points of origination and termination.
 5. Spaced at maximum intervals of 15 feet along each run. Reduce intervals to 10 feet in areas of congested piping and equipment.
- B. Directional Flow Arrows: Arrows shall be used to indicate direction of flow in pipes, including pipes where flow is allowed in both directions.
- C. Pipe Label Color Schedule: Per ANSI
- 3.05 ENGRAVED PLASTIC LAMINATE SIGNS
- A. Install where shown on plans. Use fasteners appropriate for surfaces where signs are to be installed.

END OF SECTION 22 0553

SECTION 22 0700 – PLUMBING INSTALLATION

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. Insulation Materials:
 - a. Fiberglass/ Mineral fiber
 - 2. Tapes.
- B. Related Sections include the following:
 - 1. Division 22 Section "Hangers and Supports for Plumbing and Piping Equipment"
 - 2. Division 23 Section "HVAC Insulation."
- C. Definitions
 - 1. ASJ: All Surface Jacket.
 - 2. FSK: Foil Scrim Kraft.
 - 3. MRT: Mean Temperature Rating.
 - 4. NRTL: Nationally Recognized Testing Laboratory
 - 5. PCF: Pounds per Cubic Foot.
 - 6. PSF: Pounds per Square Foot.
 - 7. SSL: Self sealing Lap
- D. Codes and Standards:
 - 1. International Energy Conservation Code, currently adopted version.
 - 2. ASHRAE 90.1, latest edition.

1.03 SUBMITTALS

- A. Product Data: For each type of product indicated. Include thermal conductivity, thickness, and jackets (both factory and field applied, if any).
- B. Material Test Reports: From a qualified testing agency acceptable to authorities having jurisdiction indicating, interpreting, and certifying test results for compliance of insulation materials, sealers, attachments, cements, and jackets, with requirements indicated. Include dates of tests and test methods employed.

1.04 QUALITY ASSURANCE

- A. Fire-Test-Response Characteristics: Insulation and related materials shall have fire-test-response characteristics indicated, as determined by testing identical products per ASTM E 84, by a testing and inspecting agency acceptable to authorities having jurisdiction. Factory label insulation and jacket materials and adhesive, mastic, tapes, and cement material containers, with appropriate markings of applicable testing and inspecting agency.
 - 1. Insulation: Flame-spread index of 25 or less, and smoke-developed index of 50 or less.

1.05 DELIVERY, STORAGE, AND HANDLING

- A. Packaging: Insulation material containers shall be marked by manufacturer with appropriate ASTM standard designation, type and grade, fire hazard indexes and maximum use temperature.
- B. Protect insulation against dirt, water, and chemical and mechanical damage. Do not install damaged or wet insulation; remove from project site.

1.06 COORDINATION

- A. Coordinate size and location of supports, hangers, and insulation shields specified in Division 22 Section "Hangers and Supports for Plumbing Piping and Equipment."
- B. Coordinate clearance requirements with piping Installer for piping insulation application and equipment Installer for equipment insulation application. Before preparing piping Shop Drawings, establish and maintain clearance requirements for installation of insulation and field-applied jackets and finishes and for space required for maintenance.
- C. Coordinate installation and testing of heat tracing if any.

1.07 SCHEDULING

- A. Schedule insulation application after pressure testing systems and, where required, after installing and testing heat tracing. Insulation application may begin on segments that have satisfactory test results.
- B. Complete installation and concealment of plastic materials as rapidly as possible in each area of construction.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

- A. Manufacturer: Subject to compliance with requirements, provide product by one of the following:
 - 1. Mechanical Insulation:
 - a. Johns Manville Corp.

- b. Knauf Fiber Glass
 - c. Manson
 - d. Owens-Corning Fiberglas Corp.
 - e. Pittsburgh Corning Corp.
2. Tapes :
- a. Avery Dennison Corporation, Specialty Tapes Division
 - b. Compac Corp.
 - c. Ideal Tape Co., Inc. An American Bilrite Company
 - d. Venture Tape

2.02 INSULATION MATERIALS

- A. Comply with requirements in Part 3 schedule articles for where insulating materials shall be applied.
- B. Products shall not contain asbestos, lead, mercury, or mercury compounds.
- C. Fiberglass Piping Insulation: ASTM C 547, Class 1 unless otherwise indicated. ASJ-SSL Jacket with tensile strength of 35 lbs/in, mullen burst 70 psi, Beach Units puncture 50 oz. in/in, permeability 0.02 perm factory applied vapor barrier jacket and adhesive self-sealing lap joint. "K" factor shall be maximum 0.23 at 75°F MRT, 0.24 at 100°F MRT, 0.29 at 200°F MRT and 0.36 at 300°F MRT.

2.03 FACTORY-APPLIED JACKETS

- A. Insulation system schedules indicate factory-applied jackets on various applications. When factory-applied jackets are indicated, comply with the following:
 - 1. ASJ: White, kraft-paper, fiberglass-reinforced scrim with aluminum-foil backing; complying with ASTM C 1136, Type I.
 - 2. ASJ-SSL: ASJ with self-sealing, pressure-sensitive, acrylic-based adhesive covered by a removable protective strip; complying with ASTM C 1136, Type I.

2.04 TAPES

- A. ASJ Tape: White vapor-retarder tape matching factory-applied jacket with acrylic adhesive, complying with ASTM C 1136.
 - 1. Width: 3 inches
 - 2. Thickness: 11.5 mils
 - 3. Adhesion: 90 ounces force/inch in width.
 - 4. Elongation: 2 percent.
 - 5. Tensile Strength: 40 lbf/inch in width.
 - 6. ASJ Tape Disks and Squares: Precut disks or squares of ASJ tape.
- B. PVC Tape: White vapor-retarder tape matching field-applied PVC jacket with acrylic adhesive. Suitable for indoor and outdoor applications.
 - 1. Width: 2 inches.
 - 2. Thickness: 6 mils

3. Adhesion: 64 ounces force/inch in width.
4. Elongation: 500 percent.
5. Tensile Strength: 18 lbf/inch in width.

2.05 SECUREMENTS

- A. Staples: Outward-clinching insulation staples, nominal 3/4-inch-wide, stainless steel or Monel.

PART 3 - EXECUTION

3.01 EXAMINATION

- A. Examine substrates and conditions for compliance with requirements for installation and other conditions affecting performance of insulation application.
 1. Verify that systems to be insulated have been tested and are free of defects.
 2. Verify that surfaces to be insulated are clean and dry.
 3. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 PREPARATION

- A. Clean and dry surfaces to receive insulation. Remove materials that will adversely affect insulation application.

3.03 GENERAL INSTALLATION REQUIREMENTS

- A. All systems shall be insulated in accordance with the locally adopted energy codes or requirements of this specification section, whichever is more stringent.
- B. Install insulation materials, accessories, and finishes with smooth, straight, and even surfaces; free of voids throughout the length of equipment and piping including fittings, valves, and specialties.
- C. Insulation shall be installed to allow maintenance and replacement of system components without compromising the insulation integrity or vapor barrier on cold systems.
- D. Workmanship shall be first class and of the highest quality, poor installation or bad appearance as determined by the engineer shall be due cause to reject the entire project in whole and retainage will be withheld until corrective action is completed to the engineer's satisfaction.
- E. Install insulation materials with smooth and even surfaces. Insulate each continuous run of piping with full-length units of insulation, with single cut piece to complete run. Do not use cut pieces or scraps abutting each other.
- F. Clean and dry pipe surfaces prior to insulating. Butt insulation joints firmly together to ensure complete and tight fit over surfaces to be covered.

- G. Install insulation materials, forms, vapor barriers or retarders, jackets, and thicknesses required for each item of equipment and pipe system as specified in insulation system schedules.
- H. Install accessories compatible with insulation materials and suitable for the service. Install accessories that do not corrode, soften, or otherwise attack insulation or jacket in either wet or dry state.
- I. Install insulation with longitudinal seams at top and bottom of horizontal runs.
- J. Do not weld brackets, clips, or other attachment devices to piping, fittings, and specialties.
- K. Keep insulation materials dry during application and finishing.
- L. Install insulation with least number of joints practical.
- M. Install insulation with factory-applied jackets as follows:
 - 1. Draw jacket tight and smooth.
 - 2. Cover circumferential joints with 3-inch- wide strips, of same material as insulation jacket. Secure strips with adhesive and outward clinching staples along both edges of strip, spaced 4 inches o.c.
 - 3. Overlap jacket longitudinal seams at least 1-1/2 inches. Install insulation with longitudinal seams at bottom of pipe. Clean and dry surface to receive self-sealing lap. Staple laps with outward clinching staples along edge at 4 inches o.c.
 - 4. Cover joints and seams with tape as recommended by insulation material manufacturer to maintain vapor seal.
- N. Cut insulation in a manner to avoid compressing insulation more than 75 percent of its nominal thickness.
- O. Finish installation with systems at operating conditions. Repair joint separations and cracking due to thermal movement.
- P. Repair damaged insulation facings by applying same facing material over damaged areas. Extend patches at least 4 inches beyond damaged areas. Adhere, staple, and seal patches similar to butt joints.

3.04 PENETRATIONS

- A. Insulation Installation at Non-Fire Rated Interior Wall and Partition Penetrations: Install insulation continuously through walls and partitions.
- B. Insulation Installation at Fire-Rated Wall and Partition Penetrations: Install insulation continuously through penetrations of fire-rated walls and partitions.
 - 1. Comply with requirements in Divisions 07 and 22 for Firestopping and fire-resistive joint sealers.
- C. Insulation Installation at Floor Penetrations:

1. Pipe: Install insulation continuously through floor penetrations.
2. Seal penetrations through fire-rated assemblies. Comply with requirements in Divisions 07 and 23.

3.05 GENERAL PIPE INSULATION INSTALLATION

- A. General: Install insulation products in accordance with manufacturer's written instructions, and in accordance with recognized industry practices to ensure that insulation serves its intended purpose.
- B. Requirements in this article generally apply to all insulation materials except where more specific requirements are specified in various pipe insulation material installation articles.
- C. Insulation Installation on Fittings, Valves, Strainers, Flanges, and Unions:
 1. Install insulation over fittings, valves, strainers, flanges, unions, and other specialties with continuous thermal and vapor-retarder integrity, unless otherwise indicated.
 2. Insulate pipe elbows using preformed fitting insulation or mitered fittings made from same material and density as adjacent pipe insulation. Each piece shall be butted tightly against adjoining piece and bonded with adhesive. Fill joints, seams, voids, and irregular surfaces with insulating cement finished to a smooth, hard, and uniform contour that is uniform with adjoining pipe insulation.
 3. Insulate tee fittings with preformed fitting insulation or sectional pipe insulation of same material and thickness as used for adjacent pipe. Cut sectional pipe insulation to fit. Butt each section closely to the next and hold in place with tie wire. Bond pieces with adhesive.
 4. Insulate valves using preformed fitting insulation or sectional pipe insulation of same material, density, and thickness as used for adjacent pipe. Overlap adjoining pipe insulation by not less than two times the thickness of pipe insulation, or one pipe diameter, whichever is thicker. For valves, insulate up to and including the bonnets, valve stuffing-box studs, bolts, and nuts. Fill joints, seams, and irregular surfaces with insulating cement.
 5. Insulate strainers using preformed fitting insulation or sectional pipe insulation of same material, density, and thickness as used for adjacent pipe. Overlap adjoining pipe insulation by not less than two times the thickness of pipe insulation, or one pipe diameter, whichever is thicker. Fill joints, seams, and irregular surfaces with insulating cement. Insulate strainers so strainer basket flange or plug can be easily removed and replaced without damaging the insulation and jacket. Provide a removable reusable insulation cover. For below ambient services, provide a design that maintains vapor barrier.
 6. Insulate flanges and unions using a section of oversized preformed pipe insulation. Overlap adjoining pipe insulation by not less than two times the thickness of pipe insulation, or one pipe diameter, whichever is thicker.
 7. Cover segmented insulated surfaces with a layer of finishing cement and coat with a mastic. Install vapor-barrier mastic for below ambient services and a breather mastic for above ambient services. Reinforce the mastic with fabric-reinforcing mesh. Trowel the mastic to a smooth and well-shaped contour.

8. For services not specified to receive a field-applied jacket except for flexible elastomeric, install fitted PVC cover over elbows, tees, strainers, valves, flanges, and unions. Terminate ends with PVC end caps. Tape PVC covers to adjoining insulation facing using PVC tape.

3.06 MINERAL-FIBER INSULATION INSTALLATION

- A. Insulation Installation on Straight Pipes and Tubes:
 1. Secure each layer of preformed pipe insulation to pipe with wire or bands and tighten bands without deforming insulation materials.
 2. Where vapor barriers are indicated, seal longitudinal seams, end joints, and protrusions with vapor-barrier mastic and joint sealant.
 3. For insulation with factory-applied jackets on above ambient surfaces, secure laps with outward clinched staples at 6 inches o.c.
 4. For insulation with factory-applied jackets on below ambient surfaces, do not staple longitudinal tabs but secure tabs with additional adhesive as recommended by insulation material manufacturer and seal with vapor-barrier mastic and flashing sealant.
- B. Insulation Installation on Pipe Flanges:
 1. Install preformed pipe insulation to outer diameter of pipe flange.
 2. Make width of insulation section same as overall width of flange and bolts, plus twice the thickness of pipe insulation.
 3. Fill voids between inner circumference of flange insulation and outer circumference of adjacent straight pipe segments with mineral-fiber blanket insulation.
 4. Install jacket material with manufacturer's recommended adhesive, overlap seams at least 1 inch, and seal joints with flashing sealant.
- C. Insulation Installation on Pipe Fittings and Elbows:
 1. Install preformed sections of same material as straight segments of pipe insulation when available.
 2. When preformed insulation elbows and fittings are not available, install mitered sections of pipe insulation, to a thickness equal to adjoining pipe insulation. Secure insulation materials with wire or bands.
- D. Insulation Installation on Valves and Pipe Specialties:
 1. Install preformed sections of same material as straight segments of pipe insulation when available.
 2. When preformed sections are not available, install mitered sections of pipe insulation to valve body.
 3. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation.
 4. Install insulation to flanges as specified for flange insulation application.

3.07 PIPING INSULATION SCHEDULE, GENERAL

- A. Acceptable preformed pipe and tubular insulation materials and thicknesses are identified for each piping system and pipe size range. If more than one material is listed for a piping system, selection from materials listed is Contractor's option.
- B. Items Not Insulated: Unless otherwise indicated, do not install insulation on the following:
 - 1. Underground piping unless noted otherwise
 - 2. Chrome-plated pipes and fittings unless there is a potential for personnel injury.

3.08 INDOOR PIPING INSULATION SCHEDULE

- A. Domestic Cold Water:
 - 1. NPS 1 and Smaller: Insulation shall be the following:
 - a. Mineral-Fiber, Preformed Pipe Insulation with ASJ-SSL Jacket: 1 inch thick.
- B. Domestic Hot and Recirculated Hot Water (140°F and lower):
 - 1. NPS 1-1/4 and Smaller: Insulation shall be the following:
 - a. Mineral-Fiber, Preformed Pipe Insulation with ASJ-SSL Jacket: 1 inch thick.
 - 2. NPS 1-1/2 and Larger: Insulation shall be the following:
 - a. Mineral-Fiber, Preformed Pipe Insulation with ASJ-SSL Jacket: 1-1/2 inch thick.

END OF SECTION 22 0700

SECTION 22 1023 – PLUMBING PUMPS

PART 1 - GENERAL

1.01 DESCRIPTION OF WORK:

- A. Pumps furnished as part of factory-fabricated equipment, are specified as part of equipment assembly in other Division-22 sections.
- B. Refer to other Division 22 sections for insulation of pump housings; vibration control of plumbing pumps; not work of this section.
- C. Refer to Division 26 sections for the following work; not work of this section.
 - 1. Power supply wiring from power source to power connection on pumps. Include starters, disconnects, and required electrical devices, except where specified as furnished, or factory-installed, by manufacturer.
- D. Provide the following electrical work as work of this section, complying with requirements of Division-26 sections:
 - 1. Control and interlock wiring between field-installed controls, indicating devices, and pump control panels.

1.02 QUALITY ASSURANCE

- A. Manufacturer's Qualifications: Firms regularly engaged in manufacture of plumbing pumps with characteristics, sizes, and capacities required, whose products have been in satisfactory use in similar service for not less than 5 years.
- B. Pumps shall be NSF/ANSI/SNF-61 certified for potable drinking water and NSF-61, Annex G for a wetted are, weighted average lead content $\leq 0.25\%$
- C. Codes and Standards:
 - 1. HI Compliance: Design, manufacture, and install plumbing pumps in accordance with HI "Hydraulic Institute Standards".
 - 2. UL Compliance: Design, manufacture, and install plumbing pumps in accordance with UL 778 "Motor Operated Water Pumps".
 - 3. UL and NEMA Compliance: Provide electric motors and components which are listed and labeled by Underwriters Laboratories and comply with NEMA standards.
- D. Certification, Pump Performance: Provide pumps whose performances, under specified operating conditions, are certified by manufacturer.

1.03 SUBMITTALS

- A. Product Data: Submit manufacturer's pump specifications, installation and start-up instructions, and current accurate pump characteristic performance curves with selection points clearly indicated.
- B. Shop Drawings: Submit manufacturer's assembly-type shop drawings indicating dimensions, weight loadings, required clearances, and methods of assembly of components.
- C. Wiring Diagrams: Submit manufacturer's electrical requirements for power supply wiring to plumbing pumps. Submit manufacturer's ladder-type wiring diagrams for interlock and control wiring. Clearly differentiate between portions of wiring that are factory-installed and portions to be field-installed.
- D. Maintenance Data: Submit maintenance data and parts lists for each type of pump, control, and accessory; including "trouble-shooting" maintenance guide. Include this data, product data, shop drawings, and wiring diagrams in maintenance manual; in accordance with requirements of Division 22

1.04 PRODUCT DELIVERY, STORAGE, AND HANDLING

- A. Handle plumbing pumps and components carefully to prevent damage, breaking, denting and scoring. Do not install damaged plumbing pumps or components; replace with new.
- B. Store plumbing pumps and components in clean dry place. Protect from weather, dirt, fumes, water, construction debris, and physical damage. Retain shipping flange protective covers and protective coatings during storage.
- C. Comply with Manufacturer's rigging and installation instructions for unloading plumbing pumps and moving them to final location.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

- A. Manufacturer: Subject to compliance with requirements, provide products by one of the following:
 - 1. In-Line Recirculation Pumps:
 - a. Armstrong
 - b. Bell & Gossett
 - c. Grundfos
 - d. Taco, Inc.
 - e. WILO

2.02 PUMPS

- A. General: Provide factory-tested pumps, thoroughly cleaned, and painted with machinery enamel prior to shipment. Type, size, and capacity of each pump is listed in pump schedule. Provide pumps of same type by same manufacturer.
- B. Coordinate sizes and locations for concrete bases with actual equipment provided.

2.03 MOTORS

- A. Comply with NEMA designation, temperature, rating, service factor, enclosure type, and efficiency requirements for motors specified in Division 22.
 - 1. Motor Sizes: Minimum size as indicated. If not indicated, large enough so driven load will not require motor to operate in service factor range above 1.0.

2.04 HORIZONTALLY MOUNTED, IN-LINE, CLOSE-COUPLED RECIRCULATION PUMPS

- A. Description: Factory-assembled and -tested, in-line, single-stage, close-coupled, overhung-impeller centrifugal pumps designed for installation with pump and motor shaft mounted horizontal.
- B. Pump Construction
 - 1. Casing: Bronze or Stainless steel, radially split with threaded companion-flange connections for pumps with NPS 2 pipe connections and flanged connections for pumps it NPS 2-1/2 pipe connections.
 - 2. Impeller: Bonze or Stainless steel, statically and dynamically balanced, closed, and keyed to shaft
 - 3. Shaft and Shaft Sleeve: Steel shaft with deflector, with copper alloy shaft sleeve. Include water slinger on shaft between motor and seal
 - 4. Seal: Mechanical, with carbon-steel rotating ring, stainless-steel spring, ceramic seat, and rubber bellows and gasket.
 - 5. Bearings; Oil-lubricated; bronze-journal or ball type
 - 6. Shaft Coupling: Flexible, capable of absorbing torsional vibration and shaft misalignment.
- C. Motor: Single speed, ECM with grease-lubricated ball bearings; and resiliently or rigidly mounted to pump casing.
- D. Capacities and Characteristics: As scheduled on drawings.
 - 1. Pump Control: Timer, in series with aquastat per IECC

PART 3 - EXECUTION

3.01 INSPECTION

- A. Examine areas and conditions under which plumbing pumps are to be installed. Do not proceed with work until unsatisfactory conditions have been corrected in manner acceptable to Installer.

- B. Examine rough-in for plumbing piping to verify actual locations of plumbing piping connections before pump installation.

3.02 INSTALLATION OF PUMPS

- A. General: Install plumbing pumps where indicated, in accordance with manufacturer's published installation instructions, complying with recognized industry practices and hydraulic institute standards to ensure that plumbing pumps comply with requirements and serve intended purposes.
- B. Access: Provide access space around plumbing pumps for service as indicated, but in no case less than that recommended by manufacturer.
- C. Electrical Wiring: Install electrical devices furnished by manufacturer but not specified to be factory-mounted. Furnish copy of manufacturer's wiring diagram submittal to Electrical Installer.
 - 1. Verify that electrical wiring installation is in accordance with manufacturer's submittal and installation requirements of Division-26 sections. Do not proceed with equipment start-up until wiring installation is acceptable to equipment installer.
 - 2. Secure and bundle float wiring to prevent turbulent water from displacing floats.
- D. Piping Connections: Refer to Division-22 plumbing piping sections. Provide piping, valves, accessories, gauges, supports, and flexible connections as indicated. Suction and discharge piping to be greater than or equal to inlet and outlet nozzle sizes.
 - 1. Install shutoff valve and strainer on suction side of each pump and check, and shutoff on discharge side of each pump. Install valves same size as connected piping. Comply with requirements for valves specified in Section 22 0523 "General Duty Valves for Plumbing Piping and Equipment" and comply with requirements for strainers specified in Section 22 1119 "Domestic Water Piping Specialties".
 - a. Install pressure gage and snubber at suction and discharge of each pump of each pump. Install at integral pressure gage tappings where provided or install pressure gage connectors in suction and discharge piping around pumps. Comply with requirements for pressure gages and snubbers specified in Section 22 0519 "Meters and Gages for Plumbing Piping".
- E. Install timers and aquastats and connect to pumps they control.

3.03 ADJUSTING AND CLEANING

- A. Start-Up: Lubricate pumps, set timers, clean strainers, check piping tightness, and verify pump installation orientation, before start-up. Start-up in accordance with manufacturer's instructions.
- B. Cleaning: Clean factory-finished surfaces. Repair any marred or scratched surfaces with manufacturer's touch-up paint.

3.04 FIELD QUALITY CONTROL

- A. Manufacturer's Field Service: Engage a factory authorized service representative to test, inspect, and adjust components, assemblies, and equipment installations, including connections.
- B. Perform the following tests and inspections:
 - 1. Perform each visual and mechanical inspection.
 - 2. Leak Test: After installation, charge system and test for leaks. Repair leaks and retest until no leaks exist.
 - 3. Operational Test: After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation.
 - 4. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
- C. Pumps and controls will be considered defective if they do not pass tests and inspections
- D. Prepare test and inspection reports.

3.05 IDENTIFICATION

- A. Comply with requirements for identification specified in Section 22 00553 "Identification for Plumbing Piping and Equipment" for identification of pumps.

END OF SECTION 22 1023

SECTION 22 1116 – DOMESTIC WATER PIPING

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.
- B. Refer to Section 23 0548 for connections required differential seismic motion.

1.02 SUMMARY

- A. Section Includes:
 - 1. Under-building-slab and aboveground domestic water pipes, tubes, and fittings inside buildings.
 - 2. Encasement for piping.
- B. Related Requirements:
 - 1. Site/Civil documents for water-service piping outside the building from source to the point where water-service piping enters the building.

1.03 ACTION SUBMITTALS

- A. Product Data: Submit industry standard and manufacturers technical product data, installation instructions, and dimensional drawings for each type of pipe and fittings. Submit schedule showing pipe or tube weight, fittings and joint type for each piping system.

1.04 INFORMATIONAL SUBMITTALS

- A. Refer to Division 1, Section 22 0500 "Common Work Results for Plumbing", and Basic Requirements for administrative and procedural requirements for submittals
- B. Certification of Compliance with ASME, NSP-61 and UL fabrication requirements.
- C. Test reports as specified in Part 3 of this section
- D. Manufacturer and product data for lead free solder with material breakdown.
- E. System purging and disinfecting activities report.

1.05 QUALITY ASSURANCE

- A. Regulatory Requirements: Comply with the provisions of the following:
 - 1. Currently adopted local plumbing code
 - 2. NSF Standard 61: "Drinking Water System Components"

3. ASME B 31.9 "Building Services Piping" for materials, products and installation. Safety valves and pressure vessels shall bear the appropriate ASME label.
 4. ASSE Compliance: Comply with applicable ASSE Standards pertaining to materials, products and installation of water distribution systems.
 5. Local utility Department requirements
 6. Local Cross Connection Control Manual
 7. Local Engineering Standards
- B. Manufacturers Qualifications: Firms regularly engaged in manufacture of pipes and pipe fittings of types and sizes required, whose products have been in satisfactory use in similar service for not less than 5 years.
- C. Each manufacturer or contractor shall be responsible for the quality of soldering and brazing done by their organization and shall repair or replace any work not in accordance with these specifications.
- 1.06 DELIVER, STORAGE AND HANDLING
- A. Store pipe in manner to prevent sagging and bending
 - B. Cap ends of piping when being stored.
 - C. Store all materials per manufacturer's recommendations
- 1.07 SEQUENCING AND SCHEDULING
- A. Coordinate the size and location of concrete equipment pads. Cast anchor bolt inserts into pad, minimum of 6" from edges. Concrete, reinforcement and formwork requirements are specified in Division 3.
 - B. Coordinate the installation of pipe sleeves for foundation wall and floor penetrations.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 1. Sleeve Type Transition Coupling
 - a. Cascade Waterworks Mfg. Co.
 - b. Dresser, Inc.
 - c. Ford Meter Box Company, Inc. (The).
 - d. Jay R. Smith Mfg. Co.
 - e. JCM Industries, Inc.
 - f. Romac Industries, Inc.
 - g. Smith-Blair, Inc.
 - h. Viking Johnson.

2. Plastic to Metal Transition Fittings:
 - a. Charlotte Pipe and Foundry Company.
 - b. Harvel Plastics, Inc.
 - c. Spears Manufacturing Company.
 - d. Uponor.
3. Dielectric Unions
 - a. A.Y. McDonald Mfg. Co.
 - b. Capitol Manufacturing Company.
 - c. Central Plastics Company.
 - d. HART Industrial Unions, LLC.
 - e. Jomar Valve.
 - f. Matco-Norca.
 - g. Watts; a Watts Water Technologies company.
 - h. Wilkins.
 - i. Zurn Industries, LLC.
4. Dielectric Flange Insulating Kits
 - a. Advance Products & Systems, Inc.
 - b. Calpico, Inc.
 - c. Central Plastics Company.
 - d. Pipeline Seal and Insulator, Inc.
5. Dielectric Nipples
 - a. Elster Perfection Corporation.
 - b. Grinnell Mechanical Products.
 - c. Matco-Norca.
 - d. Precision Plumbing Products.
 - e. Victaulic Company.
6. Copper Pressure Sealed Joints
 - a. Apollo
 - b. Viega
 - c. NIBCO

2.02 PIPING MATERIALS

- A. Comply with requirements in "Piping Schedule" Article for applications of pipe, tube, fitting materials, and joining methods for specific services, service locations, and pipe sizes.

2.03 COPPER TUBE AND FITTINGS

- A. Hard Copper Tube: ASTM B 88, Type L (ASTM B 88M, Type B) and ASTM B 88, Type K (ASTM B 88M, Type A) water tube, drawn temper.
- B. Cast-Copper, Solder-Joint Fittings: ASME B16.18, pressure fittings.
- C. Wrought-Copper, Solder-Joint Fittings: ASME B16.22, wrought-copper pressure fittings.
- D. Bronze Flanges: ASME B16.24, Class 150, with solder-joint ends.

- E. Copper Unions:
 - 1. MSS SP-123.
 - 2. Cast-copper-alloy, hexagonal-stock body.
 - 3. Ball-and-socket, metal-to-metal seating surfaces.
 - 4. Solder-joint or threaded ends.

2.04 DUCTILE IRON PIPE AND FITTINGS

- A. Mechanical Joint, Ductile Iron Pipe:
 - 1. AWWA C151/A21.51, with mechanical joint bell and plain spigot end unless grooved or flanged ends are indicated.
 - 2. Glands, Gaskets, and Bolts: AWWA C111/A21.11, ductile- or gray-iron glands, rubber gaskets, and steel bolts.
- B. Standard Pattern, Mechanical Joint Fittings
 - 1. AWWA C110/A21.10 ductile or gray iron
 - 2. Glands, Gaskets and Bolts: AWWA C111/A21.11, ductile- or gray-iron glands, rubber gaskets, and steel bolts.
- C. Push on Joint, Ductile Iron Pipe:
 - 1. AWWA C151/A21.51
 - 2. Push on joint bell and plain spigot end unless grooved or flanged ends are indicated.
- D. Standard Pattern Push on Joint Fittings:
 - 1. AWWA C110/A21.10, ductile or gray iron
 - 2. Gaskets: AWWA C111/A21.11, rubber
- E. Plain End, Ductile Iron Pipe: AWWA C151/A21.51
- F. Grooved Pipe Fittings and Couplings:
 - 1. Fittings for Grooved End Ductile Iron Pipe: ASTM A47/ A47M, malleable iron castings or ASTM A 536, ductile iron castings with dimensions that match pipe.
 - 2. Mechanical Couplings for Grooved End, Ductile Iron Piping
 - a. AWWA C606 for ductile iron pipe dimensions
 - b. Ferrous housing sections
 - c. EPDM rubber gaskets suitable for hot and cold water
 - d. Bolts and nuts
 - e. Minimum Pressure Rating: 150 psig

2.05 PIPING JOINING MATERIALS

- A. Pipe-Flange Gasket Materials:
 - 1. AWWA C110/A21.10, rubber, flat face, 1/8 inch thick or ASME B16.21, nonmetallic and asbestos free unless otherwise indicated.
 - 2. Full-face or ring type unless otherwise indicated.
- B. Metal, Pipe-Flange Bolts and Nuts: ASME B18.2.1, carbon steel unless otherwise indicated.

- C. Solder Filler Metals: ASTM B 32, lead-free alloys.
- D. Flux: ASTM B 813, water flushable.
- E. Brazing Filler Metals: AWS A5.8/A5.8M, BCuP Series, copper-phosphorus alloys for general-duty brazing unless otherwise indicated.

2.06 TRANSITION FITTINGS

- A. General Requirements:
 - 1. Same size as pipes to be joined.
 - 2. Pressure rating at least equal to pipes to be joined.
 - 3. End connections compatible with pipes to be joined.
- B. Fitting-Type Transition Couplings: Manufactured piping coupling or specified piping system fitting.
- C. Sleeve-Type Transition Coupling: AWWA C219.
- D. Plastic-to-Metal Transition Fittings:
 - 1. Description:
 - a. CPVC or PVC one-piece fitting with manufacturer's Schedule 80 equivalent dimensions.
 - b. One end with threaded brass insert and one solvent-cement-socket or threaded end.

2.07 PVC PIPE

- A. ASTM D 1765 Schedule 40 with ASTM D 2466 socket fittings and ASTM D 2564 solvent cement and approved primer.
- B. Join fittings to PVC pipe with solvent cement with clean dry pipe and fittings.
- C. Comply with ASTM F 402 and D2855.

2.08 COPPER PRESSURE SEAL JOINTS AND FITTINGS

- A. 2' and smaller shall be wrought copper with O-ring EPDM seals.
- B. 2-1/2" and larger shall be cast bronze or wrought copper with EPDM O-ring seals. Join copper tube and fittings with approved tools as required by manufacturer.
- C. Copper and copper alloy press fittings shall conform to material requirements of ASME B16.18 or ASME B16.22 and performance criteria of ASME B16.51 and IAPMO PS117. Sealing elements for press fittings shall be EPDM. Sealing elements shall be factory installed. Press end shall have a design feature that assures leakage of liquids and/or gases from inside the system past the sealing element of an unpressed connection. The function of this feature is to

provide the installer quick and easy identification of connections which have not been pressed prior to putting the system into operation.

2.09 DIELECTRIC FITTINGS

- A. General Requirements: Assembly of copper alloy and ferrous materials with separating nonconductive insulating material. Include end connections compatible with pipes to be joined.
- B. Dielectric Nipples:
 - 1. Standard: IAPMO PS 66.
 - 2. Electroplated steel nipple complying with ASTM F 1545.
 - 3. Pressure Rating and Temperature: 300 psig (2070 kPa) at 225 deg F (107 deg C).
 - 4. End Connections: Male threaded or grooved.
 - 5. Lining: Inert and noncorrosive, propylene.

PART 3 - EXECUTION

3.01 EARTHWORK

- A. Comply with requirements in Civil documents and Section 22 0500 for excavating, trenching, and backfilling. At minimum, provide 6" sand bed prior to backfill with native soil.

3.02 EXAMINATION

- A. Verify all dimensions by field measurements. Verify that all water distribution piping may be installed in accordance with pertinent codes and regulations, the original design and the applicable referenced standards.
- B. Examine rough-in requirements for plumbing fixtures and other equipment having water connections to verify actual locations of piping connections prior to installation
- C. Do not proceed until unsatisfactory conditions have been corrected.

3.03 PIPING INSTALLATION

- A. Drawing plans, schematics, and diagrams indicate general location and arrangement of domestic water piping. Indicated locations and arrangements are used to size pipe and calculate friction loss, expansion, and other design considerations. Install piping as indicated unless deviations to layout are approved on coordination drawings.
- B. Install copper tubing under building slab according to CDA's "Copper Tube Handbook."
- C. Install shutoff valve, hose-end drain valve, strainer, pressure gage, and test tee with valve inside the building at each domestic water-service entrance. Comply with requirements for pressure gages in Section 22 0519 "Meters and Gages for Plumbing Piping" and with

requirements for drain valves and strainers in Section 22 1119 "Domestic Water Piping Specialties."

- D. Install shutoff valve immediately upstream of each dielectric fitting.
- E. Install seismic restraints on piping. Comply with requirements for seismic-restraint devices in Section 22 0548 "Vibration and Seismic Controls for Plumbing Piping and Equipment."
- F. Install piping concealed from view and protected from physical contact by building occupants unless otherwise indicated and except in equipment rooms and service areas.
- G. Install piping at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.
- H. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal, and coordinate with other services occupying that space.
- I. Install piping to permit valve servicing.
- J. Install nipples, unions, special fittings, and valves with pressure ratings the same as or higher than the system pressure rating used in applications below unless otherwise indicated.
- K. Install piping free of sags and bends.
- L. Install fittings for changes in direction and branch connections.
- M. Install unions in copper tubing at final connection to each piece of equipment, machine, and specialty.
- N. Fire and Smoke Wall Penetrations: Where pipes pass through fire and smoke rated walls, partitions, ceilings, and floors, maintain the fire and smoke rated integrity. Refer to Section 22 0509 for materials.
- O. Install thermometers on inlet and outlet piping from each water heater. Comply with requirements for thermometers in Section 22 0519 "Meters and Gages for Plumbing Piping."
- P. Install sleeves for piping penetrations of walls, ceilings, and floors. Comply with requirements for sleeves specified in Section 22 0500.
- Q. Install escutcheons for piping penetrations of walls, ceilings, and floors. Comply with requirements for escutcheons specified in Section 22 0500.

3.04 SERVICE ENTRANCE

- A. Extend water distribution piping to connect to water service piping, of size and in location indicated for service entrance to building. Coordinate final connection location with Utilities Contractor. Water service piping is specified in Division 2

- B. Install sleeve and mechanical sleeve seal at penetrations through foundation wall for watertight installation shown on mechanical drawings.
- C. Install shutoff valve at service entrance inside building; complete with strainer, pressure gauge and test tee with valve.
- D. Ductile-Iron Pipe: Install in accordance with AWWA C-60.
- E. Provide thrust blocks on underground water piping at each change in direction and where shown on the drawings.
- F. Coordinate foundation and all other structural penetrations with structural engineer.

3.05 JOINT CONSTRUCTION

- A. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.
- B. Remove scale, slag, dirt, and debris from inside and outside of pipes, tubes, and fittings before assembly.
- C. Threaded Joints: Thread pipe with tapered pipe threads according to ASME B1.20.1. Cut threads full and clean using sharp dies. Ream threaded pipe ends to remove burrs and restore full ID. Join pipe fittings and valves as follows:
 - 1. Apply appropriate tape or thread compound to external pipe threads.
 - 2. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged.
- D. Brazed Joints for Copper Tubing: Comply with CDA's "Copper Tube Handbook," "Braze Joints" chapter.
- E. Soldered Joints for Copper Tubing: Apply ASTM B 813, water-flushable flux to end of tube. Join copper tube and fittings according to ASTM B 828 or CDA's "Copper Tube Handbook."
- F. Flanged Joints: Select appropriate asbestos-free, nonmetallic gasket material in size, type, and thickness suitable for domestic water service. Join flanges with gasket and bolts according to ASME B31.9.
- G. Joints for Dissimilar-Material Piping: Make joints using adapters compatible with materials of both piping systems.

3.06 TRANSITION FITTING INSTALLATION

- A. Install transition couplings at joints of dissimilar piping.
- B. Transition Fittings in Underground Domestic Water Piping:
 - 1. Fittings for NPS 1-1/2 and Smaller: Fitting-type coupling.
 - 2. Fittings for NPS 2 and Larger: Sleeve-type coupling.

3.07 DIELECTRIC FITTING INSTALLATION

- A. Install dielectric fittings in piping at connections of dissimilar metal piping and tubing.
- B. Dielectric Fittings for NPS 2 and Smaller: Use dielectric couplings or nipples.
- C. Dielectric Fittings for NPS 2-1/2 to NPS 4: Use dielectric flanges or flange kits.
- D. Dielectric Fittings for NPS 5 and Larger: Use dielectric flange kits.

3.08 HANGER AND SUPPORT INSTALLATION

- A. Comply with requirements for seismic-restraint devices in Section 22 0548 "Vibration and Seismic Controls for Plumbing Piping and Equipment."
- B. Comply with requirements for pipe hanger, support products, and installation in Section 22 0529 "Hangers and Supports for Plumbing Piping and Equipment."
 - 1. Vertical Piping: MSS Type 8 or 42, clamps.
 - 2. Individual, Straight, Horizontal Piping Runs:
 - a. 100 Feet and Less: MSS Type 1, adjustable, steel clevis or band hangers.
 - b. Longer Than 100 Feet: MSS Type 43, adjustable roller hangers.
 - 3. Multiple, Straight, Horizontal Piping Runs 100 Feet or Longer: MSS Type 44, pipe rolls. Support pipe rolls on trapeze.
 - 4. Base of Vertical Piping: MSS Type 52, spring hangers.
- C. Support vertical piping and tubing at base and at each floor.
- D. Rod diameter may be reduced one size for double-rod hangers, to a minimum of 3/8 inch.
- E. Install hangers for copper tubing with the following maximum horizontal spacing and minimum rod diameters:
 - 1. NPS 3/4 and Smaller: 60 inches with 3/8-inch rod.
 - 2. NPS 1 and NPS 1-1/4: 72 inches with 3/8-inch rod.
 - 3. NPS 1-1/2 and NPS 2: 96 inches with 3/8-inch rod.
 - 4. NPS 2-1/2: 108 inches with 1/2-inch rod.
- F. Install supports for vertical copper tubing every 10 feet
- G. Support piping and tubing not listed in this article according to MSS SP-69 and manufacturer's written instructions.

3.09 CONNECTIONS

- A. Drawings indicate general arrangement of piping, fittings, and specialties.
- B. When installing piping adjacent to equipment and machines, allow space for service and maintenance.

- C. Connect domestic water piping to exterior water-service piping. Use transition fitting to join dissimilar piping materials.
- D. Connect domestic water piping to water-service piping with shutoff valve; extend and connect to the following:
 - 1. Water Heaters: Cold-water inlet and hot-water outlet piping in sizes indicated, but not smaller than sizes of water heater connections.
 - 2. Plumbing Fixtures: Cold- and hot-water-supply piping in sizes indicated, but not smaller than that required by plumbing code.
 - 3. Equipment: Cold- and hot-water-supply piping as indicated, but not smaller than equipment connections. Provide shutoff valve and union for each connection. Use flanges instead of unions for NPS 2-1/2 and larger.
- E. Provide hot and cold water piping runouts to fixtures of sizes indicated, but in no case smaller than required by Plumbing Code. For fixtures with hot water service, extend hot water recirculation line out to fixtures greater than 20' away from main or loop hot water line down to the fixture.
- F. Connect hot and cold water piping system to mechanical equipment as indicated. Provide shutoff valve and union for each connection, provide drain valve on drain connection. Provide backflow preventor as shown as required. For connections 2-1/2" and larger, use flanges instead of unions.

3.10 IDENTIFICATION

- A. Identify system components. Comply with requirements for identification materials and installation in Section 22 0553 "Identification for Plumbing Piping and Equipment."

3.11 FIELD QUALITY CONTROL

- A. Perform the following tests and inspections:
 - 1. Piping Inspections:
 - a. Do not enclose, cover, or put piping into operation until it has been inspected and approved by authorities having jurisdiction.
 - b. During installation, notify authorities having jurisdiction at least one day before inspection must be made. Perform tests specified below in presence of authorities having jurisdiction:
 - 1) Roughing-in Inspection: Arrange for inspection of piping before concealing or closing in after roughing in and before setting fixtures.
 - 2) Final Inspection: Arrange for authorities having jurisdiction to observe tests specified in "Piping Tests" Subparagraph below and to ensure compliance with requirements.
 - c. Reinspection: If authorities having jurisdiction find that piping will not pass tests or inspections, make required corrections and arrange for reinspection.
 - d. Reports: Prepare inspection reports and have them signed by authorities having jurisdiction.
 - 2. Piping Tests:

- a. Fill domestic water piping. Check components to determine that they are not air bound and that piping is full of water.
 - b. Test for leaks and defects in new piping and parts of existing piping that have been altered, extended, or repaired. If testing is performed in segments, submit a separate report for each test, complete with diagram of portion of piping tested.
 - c. Leave new, altered, extended, or replaced domestic water piping uncovered and unconcealed until it has been tested and approved. Expose work that was covered or concealed before it was tested.
 - d. Cap and subject piping to static water pressure of 50 psig above operating pressure, without exceeding pressure rating of piping system materials. Isolate test source and allow it to stand for four hours. Leaks and loss in test pressure constitute defects that must be repaired.
 - e. Repair leaks and defects with new materials, and retest piping or portion thereof until satisfactory results are obtained.
 - f. Prepare reports for tests and for corrective action required.
- B. Domestic water piping will be considered defective if it does not pass tests and inspections.
- C. Prepare test and inspection reports.

3.12 ADJUSTING

- A. Perform the following adjustments before operation:
1. Close drain valves, hydrants, and hose bibbs.
 2. Open shutoff valves to fully open position.
 3. Adjust balancing valves in hot-water-circulation return piping to provide adequate flow.
 - a. Manually adjust ball-type balancing valves in hot-water-circulation return piping to provide hot-water flow in each branch.
 - b. Adjust calibrated balancing valves to flows indicated.
 4. Remove plugs used during testing of piping and for temporary sealing of piping during installation.
 5. Remove and clean strainer screens. Close drain valves and replace drain plugs.
 6. Remove filter cartridges from housings and verify that cartridges are as specified for application where used and are clean and ready for use.
 7. Check plumbing specialties and verify proper settings, adjustments, and operation.

3.13 CLEANING

- A. Clean and disinfect potable domestic water piping as follows:
1. Purge new piping and parts of existing piping that have been altered, extended, or repaired before using.
 2. Use purging and disinfecting procedures prescribed by authorities having jurisdiction; if methods are not prescribed, use procedures described in either AWWA C651 or AWWA C652 or follow procedures described below:
 - a. Flush piping system with clean, potable water until dirty water does not appear at outlets.
 - b. Fill and isolate system according to either of the following:

- 1) Fill system or part thereof with water/chlorine solution with at least 50 ppm of chlorine. Isolate with valves and allow to stand for 24 hours.
 - 2) Fill system or part thereof with water/chlorine solution with at least 200 ppm of chlorine. Isolate and allow to stand for three hours.
 - c. Flush system with clean, potable water until no chlorine is in water coming from system after the standing time.
 - d. Repeat procedures if biological examination shows contamination.
 - e. Submit water samples in sterile bottles to authorities having jurisdiction.
- B. Prepare and submit reports of purging and disinfecting activities. Include copies of water-sample approvals from authorities having jurisdiction.
- C. Clean interior of domestic water piping system. Remove dirt and debris as work progresses.

3.14 PIPING SCHEDULE

- A. Transition and special fittings with pressure ratings at least equal to piping rating may be used in applications below unless otherwise indicated.
- B. Flanges and unions may be used for aboveground piping joints unless otherwise indicated.
- C. Under-building-slab, domestic water, building-service piping, NPS 3 (DN 80) and smaller, shall be one of the following:
1. Hard copper tube, ASTM B 88, Type K (ASTM B 88M, Type A); wrought-copper, solder-joint fittings; and brazed joints. Piping shall be installed in 10 mil poly sleeve.
- D. Under-building-slab, domestic water, building-service piping, NPS 4 to NPS 8 (DN 100 to DN 200) and larger, shall be the following:
1. Hard copper tube, ASTM B 88, Type K (ASTM B 88M, Type A); wrought-copper, solder-joint fittings; and brazed joints. Piping shall be installed in 10 mil poly sleeve
- E. Underground, domestic water piping, NPS 6 and smaller, shall be the following:
1. Hard copper tube, ASTM B 88, Type K (ASTM B 88M, Type A); wrought-copper, solder-joint fittings; and brazed joints. Piping shall be installed in 10 mil poly sleeve.
 2. Ductile iron with standard pattern mechanical joint or push on joint fittings
 3. PVC Schedule 40 with solvent weld fittings.
- F. Aboveground domestic water piping, NPS 4 and smaller, shall be the following:
1. Hard copper tube, ASTM B 88, Type L (ASTM B 88M, Type B); grooved-joint, copper-tube appurtenances; and grooved joints. (Cold Water Only)

3.15 VALVE SCHEDULE

- A. Drawings indicate valve types to be used. Where specific valve types are not indicated, the following requirements apply:
1. Shutoff Duty: Use ball valves for piping NPS 2 and smaller. Use butterfly or ball valves with flanged ends for piping NPS 2-1/2 and larger.
 2. Hot-Water Circulation Piping, Balancing Duty: Calibrated balancing valves.

3. Drain Duty: Hose-end drain valves.
- B. Use check valves to maintain correct direction of domestic water flow to and from equipment.

END OF SECTION 22 1116

SECTION 22 1119 – DOMESTIC WATER PIPING SPECIALTIES

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. Backflow preventers.
2. Balancing valves.
3. Temperature-actuated, water mixing valves.
4. Strainers.
5. Outlet boxes.
6. Hose bibbs.
7. Wall hydrants.
8. Drain valves.
9. Water-hammer arresters.
10. Trap-seal primer valves.
11. Flexible connectors.
12. Pressure/Temperature relief valves
13. Domestic hot water expansion tanks

B. Related Requirements:

1. Section 22 0519 "Meters and Gages for Plumbing Piping" for thermometers, pressure gages, and flow meters in domestic water piping.

1.03 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Shop Drawings: For domestic water piping specialties.
 1. Include diagrams for power, signal, and control wiring.

1.04 INFORMATIONAL SUBMITTALS

- A. Field quality-control reports.

1.05 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For domestic water piping specialties to include in emergency, operation, and maintenance manuals.

PART 2 - PRODUCTS

2.01 GENERAL REQUIREMENTS FOR PIPING SPECIALTIES

- A. Potable-water piping and components shall comply with NSF 61 Annex G.

2.02 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

1. Hose bibbs, wall hydrants, yard hydrants, post hydrants

- a. Zurn
- b. Wade
- c. Woodford
- d. Tyler
- e. Mifab
- f. Josam
- g. JR Smith

2. Drain Valves

- a. Crane
- b. Milwaukee
- c. NIBCO
- d. Apollo
- e. Hammond
- f. Watts Regulator

3. Strainers

- a. Crane
- b. Milwaukee
- c. NIBCO
- d. Apollo
- e. Hammond
- f. Lance
- g. Watts Regulator

4. Backflow Preventors

- a. Ames
- b. Apollo
- c. Cash Acme
- d. Conraco
- e. FEBCO
- f. Lancer
- g. Watts
- h. Wilkens
- i. Zurn

5. Vacuum Breakers

- a. Woodford Manufacturing Co
- b. Apollo
- c. Nidel

- d. Watts
- 6. Balancing Valves
 - a. Armstrong
 - b. Bell & Gossett
 - c. NIBCO
 - d. TACO
 - e. Watts
 - f. Apollo
 - g. Therm-Omega-Tech Circuit Solver
- 7. Expansion Tanks
 - a. Amtrol
 - b. Wellxtrol
 - c. State
 - d. Bell & Gossett
- 8. Thermostatic Mixing Valves
 - a. Leonard
 - b. Bradley
 - c. Symmons
 - d. Powers
 - e. Armstrong
 - f. Lawler
 - g. Zurn
- 9. Flexible Connectors
 - a. MetraFlex
 - b. Hyspan
 - c. Wheatley
- 10. Pressure/Temperature Relief Valves
 - a. Apollo
 - b. Watts
 - c. Wilkins
- 11. Water Hammer Arrestors
 - a. Precision Plumbing Products
 - b. Sioux Chief

2.03 PERFORMANCE REQUIREMENTS

- A. Minimum Working Pressure for Domestic Water Piping Specialties: 125 psig unless otherwise indicated.

2.04 VACUUM BREAKERS

- A. Pipe-Applied, Atmospheric-Type Vacuum Breakers:
 - 1. Standard: ASSE 1001.
 - 2. Size: NPS 1/4 to NPS 3 as required to match connected piping.
 - 3. Body: Lead Free Bronze, spill resistant design suitable for indoor or outdoor installation, with vent seal diaphragm designed to seal air vent prior to opening the check valve.

Suitable for use with downstream valves. Provided with ball valve shutoffs and test cocks.

4. Inlet and Outlet Connections: Threaded.
5. Finish: Chrome plated.

B. Hose-Connection Vacuum Breakers:

1. Standard: ASSE 1011.
2. Body: Bronze, nonremovable, with manual drain.
3. Outlet Connection: Garden-hose threaded complying with ASME B1.20.7.
4. Finish: Chrome or nickel plated.

2.05 BACKFLOW PREVENTERS

A. Reduced-Pressure-Principle Backflow Preventers:

1. Standard: ASSE 1013.
2. Operation: Continuous-pressure applications.
3. Pressure Loss: 12 psig maximum, through middle third of flow range.
4. Body: Bronze for NPS 2 and smaller; cast iron with interior lining that complies with AWWA C550 or that is FDA approved steel with interior lining that complies with AWWA C550 or that is FDA approved or stainless steel for NPS 2-1/2 and larger.
5. End Connections: Threaded for NPS 2 and smaller; flanged for NPS 2-1/2 and larger.
6. Configuration: Designed for horizontal, straight-through vertical-inlet, horizontal-center-section, and vertical-outlet or vertical flow.
7. Accessories:
 - a. Valves NPS 2 and Smaller: Ball type with threaded ends on inlet and outlet.
 - b. Valves NPS 2-1/2 and Larger: Outside-screw and yoke-gate type with flanged ends on inlet and outlet.
 - c. Air-Gap Fitting: ASME A112.1.2, matching backflow-preventer connection.

B. Double-Check, Backflow-Prevention Assemblies:

1. Standard: ASSE 1015.
2. Operation: Continuous-pressure applications unless otherwise indicated.
3. Pressure Loss: 5 psig maximum, through middle third of flow range.
4. Body: Bronze for NPS 2 and smaller; cast iron with interior lining that complies with AWWA C550 or that is FDA approved steel with interior lining that complies with AWWA C550 or that is FDA approved or stainless steel for NPS 2-1/2 and larger.
5. End Connections: Threaded for NPS 2 and smaller; flanged for NPS 2-1/2 and larger.
6. Configuration: Designed for horizontal, straight-through flow.
7. Accessories:
 - a. Valves NPS 2 and Smaller: Ball type with threaded ends on inlet and outlet.
 - b. Valves NPS 2-1/2 and Larger: Outside-screw and yoke-gate type with flanged ends on inlet and outlet.

C. Beverage-Dispensing-Equipment Backflow Preventers:

1. Standard: ASSE 1022.
2. Operation: Continuous-pressure applications.
3. Size: NPS 1/4 or NPS 3/8

4. Body: Stainless steel.
5. End Connections: Threaded.

2.06 WATER PRESSURE-REDUCING VALVES

A. Water Regulators:

1. Standard: ASSE 1003.
2. Pressure Rating: Initial working pressure of 150 psig.
3. Body: Bronze for NPS 2 and smaller; cast iron with interior lining that complies with AWWA C550 or that is FDA approved for NPS 2-1/2 and NPS 3
4. Valves for Booster Heater Water Supply: Include integral bypass.
5. End Connections: Threaded for NPS 2 and smaller; flanged for NPS 2-1/2 and NPS 3

2.07 BALANCING VALVES

A. Copper-Alloy Calibrated Balancing Valves:

1. Type: Ball or Y-pattern globe valve with two readout ports and memory-setting indicator.
2. Body: bronze.
3. Size: Same as connected piping, but not larger than NPS 2

B. Memory-Stop Balancing Valves:

1. Standard: MSS SP-110 for two-piece, copper-alloy ball valves.
2. Pressure Rating: 400-psig minimum CWP.
3. Size: NPS 2 or smaller.
4. Body: Copper alloy.
5. Port: full port.
6. Ball: Chrome-plated brass.
7. Seats and Seals: Replaceable.
8. End Connections: Solder joint or threaded.
9. Handle: Vinyl-covered steel with memory-setting device.

C. Domestic Hot Water Automatic Balance Valves

1. Self-contained and fully automatic without additional piping or control mechanisms.
2. Valve shall regulate the flow of recirculated domestic hot water based on water temperature entering Circuit Solver regardless of system operating pressure.
3. When fully closed, valve shall bypass a minimum flow to maintain dynamic control of the recirculating loop and provide a means for system sanitizing.
4. Factory adjustable from 105°F to 140°F as required by project conditions.
5. Shall modulate between open and closed position within a 10°F range
6. Sizes ranging from 1/2-inch NPT to 2-inch NPT
7. Body and all internal components shall be constructed of stainless steel with major components constructed of Type 303 stainless steel
8. Rated to 200 psig maximum working pressure.
9. Standard tapered female pipe thread, NPT
10. Rated to 250°F maximum working temperature
11. ANSI/AWWA C800 compliant

12. NSF-61 compliant with zero lead content for use in all domestic water systems.
13. Thermal actuator shall be spring operated and self-cleaning, delivering closing thrust sufficient to keep orifice opening free of scale deposits.
14. Thermal actuator shall be rated for minimum of 200,000 cycles.

2.08 TEMPERATURE-ACTUATED, WATER MIXING VALVES

A. Water-Temperature Limiting Devices:

1. Standard: ASSE 1017.
2. Pressure Rating: 125 psig.
3. Type: Thermostatically controlled, water mixing valve.
4. Material: Bronze body with corrosion-resistant interior components.
5. Connections: Threaded union inlets and outlet.
6. Accessories: Check stops on hot- and cold-water supplies, and adjustable, temperature-control handle.
7. Valve Finish: Rough bronze.

B. Individual-Fixture, Water Tempering Valves:

1. Standard: ASSE 1016, thermostatically controlled, water tempering valve.
2. Pressure Rating: 125 psig minimum unless otherwise indicated.
3. Body: Bronze body with corrosion-resistant interior components.
4. Temperature Control: Adjustable.
5. Inlets and Outlet: Threaded.
6. Finish: Rough or chrome-plated bronze.

2.09 STRAINERS FOR DOMESTIC WATER PIPING

A. Y-Pattern Strainers:

1. Pressure Rating: 125 psig minimum unless otherwise indicated.
2. Body: Bronze for NPS 2 and smaller; cast iron with interior lining that complies with AWWA C550 or that is FDA approved, epoxy coated and for NPS 2-1/2 and larger.
3. End Connections: Threaded for NPS 2 and smaller; flanged for NPS 2-1/2 and larger.
4. Screen: Stainless steel with round perforations unless otherwise indicated.
5. Drain: Pipe blowdown valve with cap plug on 2-1/2 and larger.

2.10 OUTLET BOXES

A. Clothes Washer Outlet Boxes:

1. Mounting: Recessed.
2. Material and Finish: Enameled-steel or epoxy-painted-steel box and faceplate.
3. Faucet: Separate hot- and cold-water valved fittings complying with ASME A112.18.1. Include garden-hose thread complying with ASME B1.20.7 on outlets.
4. Supply Shutoff Fittings: Quarter turn NPS 1/2 ball valves and NPS 1/2 copper, water tubing, integral shock arrestors.
5. Drain: NPS 2 standpipe and P-trap for direct waste connection to drainage piping.

B. Icemaker Outlet Boxes:

1. Mounting: Recessed.
2. Material and Finish: Enameled-steel or epoxy-painted-steel box and faceplate.
3. Faucet: Valved fitting complying with ASME A112.18.1. Include NPS 1/2 or smaller copper tube outlet.
4. Supply Shutoff Fitting: NPS 1/2 (DN 15) ball valve and NPS ½ copper, water tubing, integral shock arrestors.

2.11 HOSE BIBBS

- A. Hose Bibbs: Refer to fixture schedule on drawings.
1. Bronze body with replaceable bronzy seat and integral wall flange
 2. 3/4" threaded or solder joint
 3. Garden hose outlet ASME B1.20.7
 4. Integral vacuum breaker per ASSE 1011
 5. Chrome plated
 6. Loose key Provide 2 keys

2.12 WALL HYDRANTS

- A. Nonfreeze Wall Hydrants: Refer to fixture schedule on drawings.
1. Standard: ASME A112.21.3M.
 2. Type: Nonfreeze, exposed-outlet post hydrant
 3. Operation: Lever handle
 4. Casing and Operating Rod: Of at least length required for burial of valve below frost line.
 5. Casing: Bronze with casing guard
 6. Inlet: NPS 3/4
 7. Outlet: Garden hose thread complying with ASME B1.20.7
 8. Drain: Designed with hole to drain into ground when shutoff
 9. Vacuum Breaker:
 - a. Nonremovable, drainable, hose connection vacuum breaker complying with ASSE 1011 or backflow preventor complying with ASSE 1052
 - b. Garden hose thread complying with ASME B1.20.7 on outlet.

2.13 DRAIN VALVES

- A. Ball-Valve-Type, Hose-End Drain Valves:
1. Standard: MSS SP-110 for standard-port, two-piece ball valves.
 2. Pressure Rating: 400-psig minimum CWP.
 3. Size: NPS 3/4
 4. Body: Copper alloy.
 5. Ball: Chrome-plated brass.
 6. Seats and Seals: Replaceable.
 7. Handle: Vinyl-covered steel.
 8. Inlet: Threaded or solder joint.
 9. Outlet: Threaded, short nipple with garden-hose thread complying with ASME B1.20.7 and cap with brass chain.

2.14 WATER-HAMMER ARRESTERS

- A. Water-Hammer Arresters:
 - 1. Standard: ASSE 1010.
 - 2. Type: Metal bellows or Copper tube with piston and EPDM O-rings.
 - 3. Size: ASSE 1010, Sizes AA and A through F.

2.15 TRAP-SEAL PRIMER SYSTEMS

- A. Trap-Seal Primer Systems:
 - 1. Standard: ASSE 1044.
 - 2. Piping: NPS 3/4, ASTM B 88, Type L; copper, water tubing.
 - 3. Cabinet: Surface-mounted steel box with stainless-steel cover.
 - 4. Electric Controls: 24-hour timer, solenoid valve, and manual switch for 120-V ac power.
 - 5. 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.
 - 6. Vacuum Breaker: ASSE 1001.
 - 7. Number Outlets: as required.
 - 8. Size Outlets: NPS 1/2.

2.16 DOMESTIC HOT WATER EXPANSION TANKS

- A. Steel, Precharged, Diaphragm, Water Storage Tanks:
 - 1. Description: Steel, vertical, pressured-rated tank with cylindrical sidewalls and with air charging valve and air precharge.
 - 2. Fabricate supports and attachments to tank with reinforcement strong enough to resist tank movement during seismic event when tank supports are anchored to building structure.
 - 3. Operation: Factory installed, butyl-rubber diaphragm.
- B. Entire tank assembly shall be NSF-61 listed. Provide documentation in submittal package.
- C. Maximum operating temperature of 200°F
- D. Tappings: Factory fabricated stainless steel, brass or bronze, welded to tank before testing and labeling.
 - 1. NPS 2 and Smaller: ASME B1.20.1, with female thread
 - 2. NPS 1-1/2 and Larger: ASME B16.5, flanged
- E. Specialties and Accessories: Include tappings in tank and the following:
 - 1. Pressure gauge.
- F. Vertical Tank Supports: Factory fabricated steel legs or steel skirt, welded to tank before testing and labeling.

- G. Tank Interior Finish: Materials and thicknesses complying with NSF 61 barrier materials for potable water tank linings and comply with FDA approved materials. Extend finish into and through tank fittings and outlets.
- H. Exterior Coating: Manufacturers standard painted finish.

2.17 PRESSURE/TEMPERATURE RELIEF VALVES (PTRV)

- A. Fully automatic, all bronze pressure/temperature relief valve with test lever and extension thermostatic element.
- B. Temperature relief setting at 210°F and pressure setting at 150 psig or local code requirements if different.
- C. Valve to meet ASME standards and comply with the latest AGA ratings
- D. Relief opening to be piped full size to an indirect connection at nearest floor drain or floor sink.

PART 3 - EXECUTION

3.01 INSTALLATION

- A. Install backflow preventers in each water supply to mechanical equipment and systems and to other equipment and water systems that may be sources of contamination. Comply with authorities having jurisdiction.
 - 1. Locate backflow preventers in same room as connected equipment or system.
 - 2. Install drain for backflow preventers with atmospheric-vent drain connection with air-gap fitting, fixed air-gap fitting, or equivalent positive pipe separation of at least two pipe diameters in drain piping and pipe-to-floor drain. Locate air-gap device attached to or under backflow preventer. Simple air breaks are unacceptable for this application.
 - 3. Do not install bypass piping around backflow preventers.
- B. Install water regulators with union inlet and union outlet shutoff valves and bypass with memory-stop balancing valve. Install pressure gages on inlet and outlet.
- C. Install balancing valves in locations where they can easily be adjusted.
- D. Install temperature-actuated, water mixing valves with check stops or shutoff valves on inlets and with shutoff valve and thermometer (2" diameter minimum) on outlet.
 - 1. Install cabinet-type units surface mounted on wall as specified.
- E. Install Y-pattern strainers for water on supply side of each control valve water pressure-reducing valve solenoid valve and pump.
- F. Install outlet boxes recessed in wall or surface mounted on wall. Install wall reinforcement between studs.

- G. Install trap-seal primer systems with outlet piping pitched down toward drain trap a minimum of 1 percent, and connect to floor-drain body, trap, or inlet fitting. Adjust system for proper flow. Provide distributor as required. Pipe with 3/8 poly pipe to traps. Exposed piping to be chrome plated bronze.
- H. Install shock arresters at all water connections to equipment with flush valves, quick closing valves, including, but not limited to: water closets, urinals, clinical service sinks, dishwashers, disposals, clothes washers, ice makers, autoclaves, pre-rinse spray hose, etc. Install in accessible location. Refer to detail on drawings. Provide access doors in accordance with architectural recommendations for access to devices and/or valves.

3.02 CONNECTIONS

- A. Comply with requirements for grounding of equipment in Division 26.

3.03 LABELING AND IDENTIFYING

- A. Equipment Nameplates and Signs: Install engraved plastic-laminate equipment nameplate or sign on or near each of the following:
 - 1. Reduced-pressure-principle backflow preventers.
 - 2. Double-check, backflow-prevention assemblies.
 - 3. Calibrated balancing valves.
 - 4. Outlet boxes.
 - 5. Supply-type, trap-seal primer valves.
 - 6. Trap-seal primer systems.
- B. Distinguish among multiple units, inform operator of operational requirements, indicate safety and emergency precautions, and warn of hazards and improper operations, in addition to identifying unit. Nameplates and signs are specified in Section 22 0553 "Identification for Plumbing Piping and Equipment."

3.04 INSTALLATION OF PIPING SPECIALTIES

- A. Drain Valves: Install drain valves on each plumbing equipment item, located to completely drain equipment for service or repair. Install drain valves at the base of each riser, at low points of horizontal runs, and elsewhere as required to completely drain distribution piping system. For drain valves use ball valves.
- B. Balance Valves: Install in each hot water recirculating loop, discharge side of each pump, and elsewhere as indicated.
- C. Hose Bibbs: Install where indicated. Secure on unistrut to wall.
- D. Wall Hydrants: Install where indicated. Coordinate with wall finish materials. Provide barrel length to prevent freezing.
- E. Install backflow preventors at each connection to mechanical equipment and systems, and in compliance with the plumbing code and authority having jurisdiction. Locate in same room as

equipment being connected. Pipe relief outlet through air gap and without valves, to nearest floor sink. Provide access and required clearances to backflow preventor as required by Code. Test backflow proven for prior to building turnover.

- F. Install pressure regulating valves with inlet and outlet shutoff valves, and balance valve bypass.
- G. Install shock arresters at all water connections to equipment with flush valves, quick closing valves, including, but not limited to: water closets, urinals, dishwashers, clothes washers, ice makers, etc. Install in accessible location. Provide hinged metal access panel doors in accordance with architectural recommendations and provide isolation valve.
 - 1. Units shall be sized in accordance with the following schedule:

2.	Fixture Rating	Unit	3.	P.D.I Size
4.	1-11		5.	A
6.	12-32		7.	B
8.	33-60		9.	C
10.	61-113		11.	D
12.	114-154		13.	E
14.	155-330		15.	F

3.05 DOMESTIC HOT WATER AUTOMATIC BALANCE VALVE

- A. Install as indicated on drawings and in each domestic hot water return piping branch beyond last hot water device in that branch.
- B. Provide suitable line size isolation valves, unions, and other components in piping for removal.
- C. Provide suitable hinged metal access panel as required in non-accessible ceilings and walls.

3.06 INSTALLATION OF DOMESTIC HOT WATER EXPANSION TANKS

- A. Install expansion tanks in compliance with the plumbing code and the authority having jurisdiction.
- B. Locate tanks in the same room as the water heaters or storage tanks on the cold water supply line as close to the water heater or storage tank as possible. Installation is to be between the water heater or storage tank and backflow preventor, check valve, pressure reducing valve and/or water meter.
- C. Provide independent support for in-line mounted tanks and seismic brace to wall
- D. Precharge tank to minimum static water pressure at the tank location prior to installation.

3.07 FIELD QUALITY CONTROL

- A. Perform the following tests and inspections:

1. Test each pressure vacuum breaker, reduced-pressure-principle backflow preventer and double-check, backflow-prevention assembly according to authorities having jurisdiction and the device's reference standard.
- B. Inspections: Inspect domestic specialties as follows:
 1. Do not enclose, over, or put into operation system until it has been inspected and approved by the authority having jurisdiction
 2. During the progress of the installation, notify the Local Authority Having Jurisdiction, at least 48 hours prior to the time such inspection must be made. Perform tests specified below in the presence of the plumbing official.
 - a. Rough-in Inspection: Arrange for inspection of the piping system after the system is roughed-in but before concealing or closing in piping and prior to setting fixtures.
 - b. Final Inspection: Arrange for a final inspection by the plumbing official to observe the tests specified below and to ensure compliance with the requirements of the plumbing code.
 3. Reinspection: Whenever the plumbing official finds that piping system will not pass the test or inspection, make the required corrections and arrange for reinspection by the plumbing official
 4. Reports: Prepare inspection reports, signed by the plumbing official.
- C. Domestic water piping specialties will be considered defective if they do not pass tests and inspections.
- D. Prepare test and inspection reports.

3.08 ADJUSTING AND CLEANING

- A. Clean and disinfect water distribution piping as follows:
 1. Purge all new water distribution piping prior to use.
 2. Use the purging and disinfecting procedure prescribed by the authority having jurisdiction, or in case a method is not prescribed by that authority, the procedure described in either AWWA C651, AWWA C652 or described below:
 - a. Flush the piping system with clean, potable water until dirty water does not appear at the points of outlet.
 - b. Fill the system or part thereof, with a water/chlorine solution containing at least 50 parts per million of chlorine. Isolate (valve off) the system, or part thereof, and allow to stand for 24 hours.
 - c. Drain the system, or part thereof, of the previous solution, and refill with a water/chlorine solution containing at least 200 parts per million of chlorine and isolate and allow to stand for 3 hours.
 - d. Following the allowed standing time, flush the system with clean potable water until chlorine does not remain in the water coming from the system
 - e. Submit water samples in sterile bottles to the authority having jurisdiction. Repeat the procedure if the biological examination made by the authority shows evidence of contamination.

- B. Prepare reports for all purging and disinfecting activities.
- C. Set field-adjustable pressure set points of water pressure-reducing valves.
- D. Set field-adjustable flow set points of balancing valves.
- E. Set field-adjustable temperature set points of temperature-actuated, water mixing valves.

3.09 SYSTEM START UP

- A. Fill the system
- B. Check compression tanks to determine that they are not air bound and that the system is completely full of water.
- C. Before operating the system perform these steps:
 - 1. Open valves to full open position. Close drains, valves, hydrants and sill cocks
 - 2. Remove and clean strainers
 - 3. Check pump for proper direction of rotation. Correct improper wiring
 - 4. Lubricate pump motors and bearings.

END OF SECTION 22 1119

SECTION 22 1123 – FACILITY NATURAL-GAS PIPING

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.
- B. Refer to Section 23 0548 for connections required for differential seismic motion.

1.02 SUMMARY

- A. Section Includes:
 - 1. Pipes, tubes, and fittings.
 - 2. Piping specialties.
 - 3. Piping and tubing joining materials.
 - 4. Manual gas shutoff valves.
 - 5. Pressure regulators.

1.03 DEFINITIONS

- A. Exposed, Exterior Installations: Exposed to view outdoors or subject to outdoor ambient temperatures and weather conditions. Examples include rooftop locations.
- B. Exposed, Interior Installations: Exposed to view indoors. Examples include finished occupied spaces and mechanical equipment rooms.
- C. Finished Spaces: Spaces other than mechanical and electrical equipment rooms, furred spaces, pipe and duct shafts, unheated spaces immediately below roof, spaces above ceilings, unexcavated spaces, crawlspaces, and tunnels.

1.04 SUBMITTALS

- A. Product Data: For each gas piping specialty and special duty valve. Include rated capacities of selected models, furnished specialties and accessories, and installation instructions.
- B. Shop drawings detailing dimensions, required clearances, for connection to gas meter.
- C. Record Drawings: At project closeout, submit record drawings of installed systems products; in accordance with requirements of Division 23.
- D. Maintenance data for gas specialties and special duty valves, for inclusion in operating and maintenance manual specified in Division 23.

- E. Welders qualification certificates, certificates, certifying that welders comply with the quality requirements specified under "Quality Assurance" below.
- F. Test reports specified in Part 3 below.

1.05 QUALITY ASSURANCE

- A. Steel Support Welding Qualifications: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."
- B. Pipe Welding Qualifications: Qualify procedures and operators according to ASME Boiler and Pressure Vessel Code.
- C. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

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 and handle pipes and tubes having factory-applied protective coatings to avoid damaging coating, and protect from direct sunlight.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
- B. Manual Gas Shutoff Valves
 - 1. One Piece Bronze Ball Valve with Bronze Trim
 - a. A.Y. McDonald Mfg. Co.
 - b. Apollo Valves; a part of Aalberts Integrated Piping Systems.
 - c. BrassCraft Manufacturing Co.; a Masco company.
 - d. Lyall, R. W. & Company, Inc.
 - e. Perfection Corporation.
 - 2. Two Piece Full Port Bronze Ball Valve with Bronze Trim
 - a. A.Y. McDonald Mfg. Co.
 - b. Apollo Valves; a part of Aalberts Integrated Piping Systems.
 - c. BrassCraft Manufacturing Co.; a Masco company.
 - d. Lyall, R. W. & Company, Inc.
 - e. Perfection Corporation.
 - 3. Bronze Plug Valves
 - a. A.Y. McDonald Mfg. Co.

- b. Lee Brass Company.
- 4. Cast Iron Nonlubricated Plug Valves
 - a. A.Y. McDonald Mfg. Co.
 - b. Mueller Co.
 - c. Xomox Corporation.
- 5. Cast Iron Lubricated plug Valves
 - a. A.Y. McDonald Mfg. Co.
 - b. Flowserve Corporation.
 - c. Homestead Valve, a division of Olson Technologies, Inc.
 - d. Milliken Valve Company.
 - e. Mueller Co.
 - f. R & M Energy Systems; Robbins & Myers.

C. Pressure Regulators

- 1. Line Pressure Regulators
 - a. Actaris.
 - b. American Meter Company.
 - c. Dormont; a WATTS brand.
 - d. Eclipse Innovative Thermal Technologies.
 - e. Fisher Control Valves & Instruments; a brand of Emerson Process Management.
 - f. Invensys.
 - g. Itron Gas.
 - h. Maxitrol Company.
 - i. Richards Industries.
- 2. Appliance Regulators
 - a. Canadian Meter Company Inc.
 - b. Dormont; a WATTS brand.
 - c. Eaton.
 - d. Harper Wyman Co.
 - e. Maxitrol Company.
 - f. SCP, Inc.

2.02 PIPES, TUBES, AND FITTINGS

- A. Steel Pipe: ASTM A53/A53M, black steel, Schedule 40, Type E or S, Grade B.
 - 1. Malleable-Iron Threaded Fittings: ASME B16.3, Class 150, standard pattern.
 - 2. Wrought-Steel Welding Fittings: ASTM A234/A234M for butt welding and socket welding.
 - 3. Unions: ASME B16.39, Class 150, malleable iron with brass-to-iron seat, ground joint, and threaded ends.
 - 4. Forged-Steel Flanges and Flanged Fittings: ASME B16.5, minimum Class 150, including bolts, nuts, and gaskets of the following material group, end connections, and facings:
 - a. Material Group: 1.1.
 - b. End Connections: Threaded or butt welding to match pipe.
 - c. Lapped Face: Not permitted underground.
 - d. Gasket Materials: ASME B16.20, metallic, flat, asbestos free, aluminum o-rings, and spiral-wound metal gaskets.

- e. Bolts and Nuts: ASME B18.2.1, carbon steel aboveground and stainless steel underground.
- 5. Protective Coating for Underground Piping: Factory-applied, three-layer coating of epoxy, adhesive, and PE.
 - a. Joint Cover Kits: Epoxy paint, adhesive, and heat-shrink PE sleeves.

2.03 PIPING SPECIALTIES

A. Appliance Flexible Connectors:

- 1. Indoor, Fixed-Appliance Flexible Connectors: Comply with ANSI Z21.24.
- 2. Indoor, Movable-Appliance Flexible Connectors: Comply with ANSI Z21.69.
- 3. Outdoor, Appliance Flexible Connectors: Comply with ANSI Z21.75.
- 4. Corrugated stainless-steel tubing with polymer coating.
- 5. Operating-Pressure Rating: 0.5 psig
- 6. End Fittings: Zinc-coated steel.
- 7. Threaded Ends: Comply with ASME B1.20.1.
- 8. Maximum Length: 72 inches

B. Y-Pattern Strainers:

- 1. Body: ASTM A126, Class B, cast iron with bolted cover and bottom drain connection.
- 2. End Connections: Threaded ends for NPS 2 and smaller; flanged ends for NPS 2-1/2 and larger.
- 3. Strainer Screen: 60-mesh startup strainer and perforated stainless-steel basket with 50 percent free area.
- 4. CWP Rating: 125 psig

C. Weatherproof Vent Cap: Cast- or malleable-iron increaser fitting with corrosion-resistant wire screen, with free area at least equal to cross-sectional area of connecting pipe and threaded-end connection.

2.04 JOINING MATERIALS

A. Joint Compound and Tape: Suitable for natural gas.

B. Welding Filler Metals: Comply with AWS D10.12/D10.12M for welding materials appropriate for wall thickness and chemical analysis of steel pipe being welded.

2.05 MANUAL GAS SHUTOFF VALVES

A. General Requirements for Metallic Valves, NPS 2 and Smaller: Comply with ASME B16.33.

- 1. CWP Rating: 125 psig
- 2. Threaded Ends: Comply with ASME B1.20.1.
- 3. Tamperproof Feature: Locking feature for valves indicated.
- 4. Listing: Listed and labeled by an NRTL acceptable to authorities having jurisdiction for valves 1 inch and smaller.
- 5. Service Mark: Valves 1-1/4 inches to NPS 2 shall have initials "WOG" permanently marked on valve body.

- B. General Requirements for Metallic Valves, NPS 2-1/2 and Larger: Comply with ASME B16.38.
 - 1. CWP Rating: 125 psig.
 - 2. Flanged Ends: Comply with ASME B16.5 for steel flanges.
 - 3. Tamperproof Feature: Locking feature for valves indicated.
 - 4. Service Mark: Initials "WOG" shall be permanently marked on valve body.

- C. One-Piece, Bronze Ball Valve with Bronze Trim: MSS SP-110.
 - 1. Body: Bronze, complying with ASTM B584.
 - 2. Ball: Chrome-plated brass.
 - 3. Stem: Bronze; blowout proof.
 - 4. Seats: Reinforced TFE; blowout proof.
 - 5. Packing: Separate packnut with adjustable-stem packing threaded ends.
 - 6. Ends: Threaded.
 - 7. CWP Rating: 600 psig
 - 8. Listing: Valves NPS 1 and smaller shall be listed and labeled by an NRTL acceptable to authorities having jurisdiction.
 - 9. Service: Suitable for natural-gas service with "WOG" indicated on valve body.

- D. Two-Piece, Full-Port, Bronze Ball Valves with Bronze Trim: MSS SP-110.
 - 1. Body: Bronze, complying with ASTM B584.
 - 2. Ball: Chrome-plated bronze.
 - 3. Stem: Bronze; blowout proof.
 - 4. Seats: Reinforced TFE; blowout proof.
 - 5. Packing: Threaded-body packnut design with adjustable-stem packing.
 - 6. Ends: Threaded.
 - 7. CWP Rating: 600 psig.
 - 8. Listing: Valves NPS 1 and smaller shall be listed and labeled by an NRTL acceptable to authorities having jurisdiction.
 - 9. Service: Suitable for natural-gas service with "WOG" indicated on valve body.

- E. Bronze Plug Valves: MSS SP-78.
 - 1. Body: Bronze, complying with ASTM B584.
 - 2. Plug: Bronze.
 - 3. Ends: Threaded or flanged.
 - 4. Operator: Square head or lug type with tamperproof feature where indicated.
 - 5. Pressure Class: 125 psig
 - 6. Listing: Valves NPS 1 and smaller shall be listed and labeled by an NRTL acceptable to authorities having jurisdiction.
 - 7. Service: Suitable for natural-gas service with "WOG" indicated on valve body.

- F. Cast-Iron, Nonlubricated Plug Valves: MSS SP-78.
 - 1. Body: Cast iron, complying with ASTM A126, Class B.
 - 2. Plug: Bronze or nickel-plated cast iron.
 - 3. Seat: Coated with thermoplastic.
 - 4. Stem Seal: Compatible with natural gas.
 - 5. Ends: Threaded or flanged.
 - 6. Operator: Square head or lug type with tamperproof feature where indicated.

7. Pressure Class: 125 psig.
8. Listing: Valves NPS 1 and smaller shall be listed and labeled by an NRTL acceptable to authorities having jurisdiction.
9. Service: Suitable for natural-gas service with "WOG" indicated on valve body.

G. Cast-Iron, Lubricated Plug Valves: MSS SP-78.

1. Body: Cast iron, complying with ASTM A126, Class B.
2. Plug: Bronze or nickel-plated cast iron.
3. Seat: Coated with thermoplastic.
4. Stem Seal: Compatible with natural gas.
5. Ends: Threaded or flanged.
6. Operator: Square head or lug type with tamperproof feature where indicated.
7. Pressure Class: 125 psig
8. Listing: Valves NPS 1 and smaller shall be listed and labeled by an NRTL acceptable to authorities having jurisdiction.
9. Service: Suitable for natural-gas service with "WOG" indicated on valve body.

2.06 PRESSURE REGULATORS

A. General Requirements:

1. Single stage and suitable for natural gas.
2. Steel jacket and corrosion-resistant components.
3. Elevation compensator.
4. End Connections: Threaded for regulators NPS 2 and smaller; flanged for regulators NPS 2-1/2 and larger.

B. Line Pressure Regulators: Comply with ANSI Z21.80.

1. Body and Diaphragm Case: Cast iron or die-cast aluminum.
2. Springs: Zinc-plated steel; interchangeable.
3. Diaphragm Plate: Zinc-plated steel.
4. Seat Disc: Nitrile rubber resistant to gas impurities, abrasion, and deformation at the valve port.
5. Orifice: Aluminum; interchangeable.
6. Seal Plug: Ultraviolet-stabilized, mineral-filled nylon.
7. Single-port, self-contained regulator with orifice no larger than required at maximum pressure inlet, and no pressure sensing piping external to the regulator.
8. Pressure regulator shall maintain discharge pressure setting downstream, and not exceed 150 percent of design discharge pressure at shutoff.
9. Overpressure Protection Device: Factory mounted on pressure regulator.
10. Atmospheric Vent: Factory- or field-installed, stainless-steel screen in opening if not connected to vent piping.
11. Refer to the plans for the operating pressures.

C. Appliance Pressure Regulators: Comply with ANSI Z21.18.

1. Body and Diaphragm Case: Die-cast aluminum.
2. Springs: Zinc-plated steel; interchangeable.
3. Diaphragm Plate: Zinc-plated steel.

4. Seat Disc: Nitrile rubber.
5. Seal Plug: Ultraviolet-stabilized, mineral-filled nylon.
6. Factory-Applied Finish: Minimum three-layer polyester and polyurethane paint finish.
7. Include vent connection for piping to outside.
8. Refer to the plans for the operating pressures.

2.07 LABELING AND IDENTIFYING

- A. Detectable Warning Tape: Acid- and alkali-resistant, PE film warning tape manufactured for marking and identifying underground utilities, a minimum of 6 inches wide and 4 mils thick, continuously inscribed with a description of utility, with metallic core encased in a protective jacket for corrosion protection, detectable by metal detector when tape is buried up to 30 inches deep; colored yellow.

PART 3 - EXECUTION

3.01 EXAMINATION

- A. Examine roughing-in for natural-gas piping system to verify actual locations of piping connections before equipment installation.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 PREPARATION

- A. Close equipment shutoff valves before turning off natural gas to premises or piping section.
- B. Inspect natural-gas piping according to the International Fuel Gas Code to determine that natural-gas utilization devices are turned off in piping section affected.
- C. Comply with International Fuel Gas Code requirements for prevention of accidental ignition.

3.03 OUTDOOR PIPING INSTALLATION

- A. Comply with International Fuel Gas Code for installation and purging of natural-gas piping.
- B. Install fittings for changes in direction and branch connections.

3.04 INDOOR PIPING INSTALLATION

- A. Comply with the International Fuel Gas Code for installation and purging of natural-gas piping.
- B. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems. Indicated locations and arrangements are used to size pipe and calculate friction loss, expansion, and other design considerations. Install piping as indicated unless deviations to layout are approved on Coordination Drawings.

- C. Arrange for pipe spaces, chases, slots, sleeves, and openings in building structure during progress of construction, to allow for mechanical installations.
- D. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.
- E. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal.
- F. Locate valves for easy access.
- G. Install natural-gas piping at uniform grade of 2 percent down toward drip and sediment traps.
- H. Install piping free of sags and bends.
- I. Install fittings for changes in direction and branch connections.
- J. Verify final equipment locations for roughing-in.
- K. Comply with requirements in Sections specifying gas-fired appliances and equipment for roughing-in requirements.
- L. Drips and Sediment Traps: Install drips at points where condensate may collect, including service-meter outlets. Locate where accessible to permit cleaning and emptying. Do not install where condensate is subject to freezing.
 - 1. Construct drips and sediment traps using tee fitting with bottom outlet plugged or capped. Use nipple a minimum length of 3 pipe diameters, but not less than 3 inches long and same size as connected pipe. Install with space below bottom of drip to remove plug or cap.
- M. Extend relief vent connections for service regulators, line regulators, and overpressure protection devices to outdoors and terminate with weatherproof vent cap.
- N. Concealed Location Installations: Except as specified below, install concealed natural-gas piping and piping installed under the building in containment conduit constructed of steel pipe with welded joints as described in Part 2. Install a vent pipe from containment conduit to outdoors and terminate with weatherproof vent cap.
 - 1. Above Accessible Ceilings: Natural-gas piping, fittings, valves, and regulators may be installed in accessible spaces without containment conduit.
 - 2. Prohibited Locations:
 - a. Do not install natural-gas piping in or through circulating air ducts, clothes or trash chutes, chimneys or gas vents (flues), ventilating ducts, or dumbwaiter or elevator shafts.
 - b. Do not install natural-gas piping in solid walls or partitions.
- O. Use eccentric reducer fittings to make reductions in pipe sizes. Install fittings with level side down.

- P. Connect branch piping from top or side of horizontal piping.
- Q. Install unions in pipes NPS 2 and smaller, adjacent to each valve, at final connection to each piece of equipment. Unions are not required at flanged connections.
- R. Do not use natural-gas piping as grounding electrode.
- S. Install strainer on inlet of each line-pressure regulator and automatic or electrically operated valve.
- T. Install sleeves for piping penetrations of walls, ceilings, and floors. Comply with requirements for sleeves specified in Section 23 0500.
- U. Install sleeve seals for piping penetrations of concrete walls and slabs. Comply with requirements for sleeve seals specified in Section 23 0500
- V. Install escutcheons for piping penetrations of walls, ceilings, and floors. Comply with requirements for escutcheons specified in Section 23 0500.

3.05 VALVE INSTALLATION

- A. Install manual gas shutoff valve for each gas appliance ahead of connector.
- B. Install regulators and overpressure protection devices with maintenance access space adequate for servicing and testing.

3.06 PIPING JOINT CONSTRUCTION

- A. Ream ends of pipes and tubes and remove burrs.
- B. Remove scale, slag, dirt, and debris from inside and outside of pipe and fittings before assembly.
- C. Threaded Joints:
 - 1. Thread pipe with tapered pipe threads complying with ASME B1.20.1.
 - 2. Cut threads full and clean using sharp dies.
 - 3. Ream threaded pipe ends to remove burrs and restore full inside diameter of pipe.
 - 4. Apply appropriate tape or thread compound to external pipe threads unless dryseal threading is specified.
 - 5. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged. Do not use pipe sections that have cracked or open welds.
- D. Welded Joints:
 - 1. Construct joints according to AWS D10.12/D10.12M, using qualified processes and welding operators.
 - 2. Bevel plain ends of steel pipe.
 - 3. Patch factory-applied protective coating as recommended by manufacturer at field welds and where damage to coating occurs during construction.

3.07 HANGER AND SUPPORT INSTALLATION

- A. Comply with requirements for seismic-restraint devices specified in Section 23 0548 "Vibration and Seismic Controls for HVAC."
- B. Comply with requirements for pipe hangers and supports specified in Section 23 0529 "Hangers and Supports for HVAC Piping and Equipment."
- C. Install hangers for steel piping, with maximum horizontal spacing and minimum rod diameters, to comply with MSS-58, locally enforced codes, and authorities having jurisdiction requirements, whichever are most stringent. Refer to Section 23 0529 for additional information.
- D. Support horizontal piping within 12 inches of each fitting.
- E. Support vertical runs of steel piping to comply with MSS-58, locally enforced codes, and authorities having jurisdiction requirements, whichever are most stringent.

3.08 CONNECTIONS

- A. Connect to utility's gas main according to utility's procedures and requirements.
- B. Install natural-gas piping electrically continuous, and bonded to gas appliance equipment grounding conductor of the circuit powering the appliance according to NFPA 70.
- C. Install piping adjacent to appliances to allow service and maintenance of appliances.
- D. Connect piping to appliances using manual gas shutoff valves and unions. Install valve within 72 inches of each gas-fired appliance and equipment. Install union between valve and appliances or equipment.
- E. Sediment Traps: Install tee fitting with capped nipple in bottom to form drip, as close as practical to inlet of each appliance.

3.09 LABELING AND IDENTIFYING

- A. Comply with requirements in Section 22 0553 "Identification for HVAC Piping and Equipment" for piping and valve identification.

3.10 PAINTING

- A. Coordinate paint finishes with architectural .
- B. Paint exposed, exterior metal piping, valves, service regulators, service meters and meter bars, earthquake valves, and piping specialties, except components, with factory-applied paint or protective coating.
 - 1. Alkyd System: MPI EXT 5.1D.
 - a. Prime Coat: Alkyd anticorrosive metal primer.

- b. Intermediate Coat: Exterior alkyd enamel matching topcoat.
- c. Topcoat: Exterior alkyd enamel (semigloss).
- d. Color: Gray.

3.11 FIELD QUALITY CONTROL

- A. Perform tests and inspections.
- B. Tests and Inspections:
 - 1. Test, inspect, and purge natural gas according to the International Fuel Gas Code and authorities having jurisdiction.
- C. Natural-gas piping will be considered defective if it does not pass tests and inspections.
- D. Prepare test and inspection reports.

3.12 OUTDOOR PIPING SCHEDULE

- A. Aboveground natural-gas piping shall be the following:
 - 1. Steel pipe with malleable-iron fittings and threaded joints, 2" and smaller.
 - 2. Steel pipe with wrought-steel fittings and welded joints, 2-1/2" and larger.

3.13 INDOOR PIPING SCHEDULE FOR SYSTEM PRESSURES LESS THAN 5 PSIG

- A. Aboveground, branch piping NPS 1 and smaller shall be the following:
 - 1. Steel pipe with malleable-iron fittings and threaded joints.
- B. Aboveground, distribution piping shall be the following:
 - 1. Steel pipe with malleable-iron fittings and threaded joints, 2" and smaller.
 - 2. Steel pipe with steel welding fittings and welded joints, 2-1/2" and larger.

3.14 ABOVEGROUND MANUAL GAS SHUTOFF VALVE SCHEDULE

- A. Distribution piping valves for pipe sizes NPS 2 and smaller shall be the following:
 - 1. One-piece, full port bronze ball valve with bronze trim.
 - 2. Two-piece, full-port, bronze ball valves with bronze trim.
 - 3. Bronze plug valve.
- B. Distribution piping valves for pipe sizes NPS 2-1/2 and larger shall be the following:
 - 1. Two-piece, full-port, bronze ball valves with bronze trim.
 - 2. Bronze plug valve.
 - 3. Cast-iron, lubricated plug valve.
- C. Valves in branch piping for single appliance shall be the following:
 - 1. One-piece, full port bronze ball valve with bronze trim.
 - 2. Two-piece, full-port, bronze ball valves with bronze trim.
 - 3. Bronze plug valve.

Pivot North Architecture
100% Construction Set
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TWIN FALLS TRAINING FACILITY
SECTION 22 1123
FACILITY NATURAL-GAS PIPING

END OF SECTION 22 1123

SECTION 22 1316 – SANITARY WASTE AND VENT PIPING

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.
- B. Refer to Section 23 0548 for connections required for differential seismic motion.

1.02 SUMMARY

- A. Section Includes:
 - 1. Pipe, tube, and fittings.
 - 2. Specialty pipe fittings.

1.03 ACTION SUBMITTALS

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

1.04 INFORMATIONAL SUBMITTALS

- A. Field quality-control reports.

1.05 FIELD CONDITIONS

- A. Interruption of Existing Sanitary Waste Service: Do not interrupt service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary service according to requirements indicated:
 - 1. Notify Owner no fewer than two weeks in advance of proposed interruption of sanitary waste service.
 - 2. Do not proceed with interruption of sanitary waste service without Owner's written permission.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to , the following:
 - 1. Cast Iron Pipe and Fittings
 - a. AB&I
 - b. Charlotte

- c. Tyler Pipe
- 2. PVC Pipe and Fittings
 - a. Charlotte Pipe and Foundry
 - b. GF Piping Systems
 - c. JM Eagle
 - d. Mueller Industries
 - e. National Pipe and Plastic
 - f. North American Pipe
 - g. Silverline Plastics
- 3. Standard Duty CISPI Couplings
 - a. Anaco-Husky
 - b. Charlotte Pipe and Foundry Co
 - c. Clamp- All Corp
 - d. Dallas Specialty & Mfg Co
 - e. MIFAB, Inc
 - f. Mission Rubber Company, LLC
 - g. Stant
 - h. Tyler Pipe

2.02 PERFORMANCE REQUIREMENTS

- A. Components and installation shall be capable of withstanding the following minimum working pressure unless otherwise indicated:
 - 1. Soil, Waste, and Vent Piping: 10-foot head of water (30 kPa).
- B. Seismic Performance: Soil, waste, and vent piping and support and installation shall withstand the effects of earthquake motions determined according to ASCE/SEI 7.

2.03 PIPING MATERIALS

- A. Piping materials shall bear label, stamp, or other markings of specified testing agency.
- B. Comply with requirements in "Piping Schedule" Article for applications of pipe, tube, fitting materials, and joining methods for specific services, service locations, and pipe sizes.

2.04 HUB AND SPIGOT, CAST IRON PIPE AND FITTINGS

- A. Pipe and fittings to meet ASTM A70
- B. Gaskets to comply with ASTM C564 rubber.

2.05 HUBLESS, CAST-IRON SOIL PIPE AND FITTINGS

- A. Pipe and Fittings: ASTM A 888 and CISPI 301.
- B. Cast-Iron, Hubless-Piping Couplings:
 - 1. Standard: CISPI-310 and ASTM C 1277.

2. Description: Two-piece ASTM A 48/A 48M, cast-iron housing; stainless-steel bolts and nuts; and ASTM C 564, rubber sleeve with integral, center pipe stop.

2.06 SPECIALTY PIPE FITTINGS

A. Transition Couplings:

1. Fitting-Type Transition Couplings: Manufactured piping coupling or specified piping system fitting.
2. Unshielded, Nonpressure Transition Couplings:
 - a. Standard: ASTM C 1173.
 - b. Description: Elastomeric, sleeve-type, reducing or transition pattern. Include shear ring and corrosion-resistant-metal tension band and tightening mechanism on each end.
 - c. End Connections: Same size as and compatible with pipes to be joined.
 - d. Sleeve Materials:
 - 1) For Cast-Iron Soil Pipes: ASTM C 564, rubber.
 - 2) For Plastic Pipes: ASTM F 477, elastomeric seal or ASTM D 5926, PVC.
 - 3) For Dissimilar Pipes: ASTM D 5926, PVC or other material compatible with pipe materials being joined.

2.07 COPPER TUBE AND FITTINGS

- A. Copper Type DWV Tube: ASTM B 306, drainage tube, drawn temper.
- B. Copper Drainage Fittings : ASME B16.23, cast copper or ASME B16.29, wrought copper, solder-joint fittings.
- C. Hard Copper Tube: ASTM B88, Type L and Type M (ASTM B 88M, Type B and Type C), water tube, drawn temper.
- D. Copper Pressure Fittings:
 1. Copper Fittings: ASME B16.18, cast copper alloy or ASME B16.22, wrought copper, solder joint fittings. Furnish wrought copper fittings if indicated.
- E. Solder: ASTM B 32, lead free with ASTM B813, Water flushable flux.

2.08 PLASTIC PIPE AND PIPE FITTINGS

- A. Label PVC pipe with "NSF-DWV" per NSF 14 for PVC piping systems.
- B. Polyvinylchloride Sewer Pipe (PVC): ASTM D2729, 2 inch thru 5 inch; ASTM D2665, 1-1/2 inches thru 8 inches
- C. PVC Fittings: Solvent cement joints per ASTM F656 and D2564, threaded shall be Schedule 80 and be per ASME B1.20.1 and be tapped to allow for sloped piping.

PART 3 - EXECUTION

3.01 EARTH MOVING

- A. Comply with requirements for excavating, trenching, and backfilling specified in Civil documents. At minimum, provide 6" sand bed above and below prior to backfill with native soil.

3.02 PIPING INSTALLATION

- A. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems.
 - 1. Indicated locations and arrangements were used to size pipe and calculate friction loss, expansion, pump sizing, and other design considerations.
 - 2. Install piping as indicated unless deviations to layout are approved on coordination drawings.
- B. Install piping in concealed locations unless otherwise indicated and except in equipment rooms and service areas.
- C. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.
- D. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal.
- E. Install piping at indicated slopes.
- F. Install piping free of sags and bends.
- G. Install fittings for changes in direction and branch connections.
- H. Install piping to allow application of insulation.
- I. For Seismic Installation: Install seismic restraints on piping. Comply with requirements for seismic-restraint devices specified in Section 22 0548 "Vibration and Seismic Controls for Plumbing Piping and Equipment."
- J. Make changes in direction for soil and waste drainage and vent piping using appropriate branches, bends, and long-sweep bends.
 - 1. Sanitary tees and short-sweep 1/4 bends may be used on vertical stacks if change in direction of flow is from horizontal to vertical.
 - 2. Use long-turn, double Y-branch and 1/8-bend fittings if two fixtures are installed back to back or side by side with common drain pipe.
 - a. Straight tees, elbows, and crosses may be used on vent lines.
 - 3. Do not change direction of flow more than 90 degrees.
 - 4. Use proper size of standard increasers and reducers if pipes of different sizes are connected.

- a. Reducing size of waste piping in direction of flow is prohibited.
- K. Install 1 inch thick extruded polystyrene over underground drainage piping that is above frost line and not under building. Provide width to extend minimum of 12 inches beyond each side of pipe. Install directly over pipe, centered on pipe center line.
- L. Lay buried building waste piping beginning at low point of each system.
 - 1. Install true to grades and alignment indicated, with unbroken continuity of invert. Place hub ends of piping upstream.
 - 2. Install required gaskets according to manufacturer's written instructions for use of lubricants, cements, and other installation requirements.
 - 3. Maintain swab in piping and pull past each joint as completed.
- M. Install soil and waste and vent piping at the following minimum slopes unless otherwise indicated
 - 1. Sanitary Waste Piping: 1/4"/ft downward in direction of flow for piping NPS 2-1/2 and smaller; 1/8"/ft downward in direction of flow for piping NPS 3 to NPS 6; 1/16"/ft downward in direction of flow for piping NPS 8 or larger.
 - 2. Vent and branch vent pipes: Grade and connect as to drain back to the drainage pipe by gravity.
 - 3. Grease Waste Piping: 1/4"/ft downward in direction of flow.
- N. Install steel piping according to Oregon Plumbing Code.
- O. All below grade plastic piping shall meet ASTM D2321-89 requirements
- P. Install aboveground copper tubing according to CDA's "Copper Tube Handbook."
- Q. Plumbing Specialties:
 - 1. Install cleanouts at grade and extend to where building sanitary drains connect to building sanitary sewers in sanitary waste gravity-flow piping.
 - a. Comply with requirements for cleanouts specified in Section 22 1319 "Sanitary Waste Piping Specialties."
 - 2. Install drains in sanitary waste gravity-flow piping.
 - a. Comply with requirements for drains specified in Section 22 1319 "Sanitary Waste Piping Specialties."
- R. Do not enclose, cover, or put piping into operation until it is inspected and approved by authorities having jurisdiction.
- S. Install sleeves for piping penetrations of walls, ceilings, and floors.
 - 1. Comply with requirements for sleeves specified in Division 22.
- T. Install sleeve seals for piping penetrations of concrete walls and slabs.
 - 1. Comply with requirements for sleeve seals specified in Division 22.
- U. Install escutcheons for piping penetrations of walls, ceilings, and floors.
 - 1. Comply with requirements for escutcheons specified in Division 22.

3.03 JOINT CONSTRUCTION

- A. Join hubless, cast-iron soil piping according to CISPI 310 and CISPI's "Cast Iron Soil Pipe and Fittings Handbook" for hubless-piping coupling joints.
- B. PVC: Join pipe and fittings in accordance with ASTM D2855 and D2665, using primers and solvent cement.

3.04 SPECIALTY PIPE FITTING INSTALLATION

- A. Transition Couplings:
 - 1. Install transition couplings at joints of piping with small differences in ODs.
 - 2. In Waste Drainage Piping: Shielded, nonpressure transition couplings.

3.05 HANGER AND SUPPORT INSTALLATION

- A. Comply with requirements for seismic-restraint devices specified in Section 22 0548 "Vibration and Seismic Controls for Plumbing Piping and Equipment."
- B. Comply with requirements for pipe hanger and support devices and installation specified in Section 22 0529 "Hangers and Supports for Plumbing Piping and Equipment."
 - 1. Install carbon-steel pipe hangers for horizontal piping in noncorrosive environments.
 - 2. Install carbon-steel pipe support clamps for vertical piping in noncorrosive environments.
 - 3. Vertical Piping: MSS Type 8 or Type 42, clamps.
 - 4. Install individual, straight, horizontal piping runs:
 - a. 100 Feet (30 m) and Less: MSS Type 1, adjustable, steel clevis hangers.
- C. Support horizontal piping and tubing within 12 inches of each fitting, valve, and coupling.
- D. Support vertical piping and tubing at base and at each floor.
- E. Rod diameter may be reduced one size for double-rod hangers, with 3/8-inch minimum rods.
- F. Install hangers for cast-iron soil piping with the following maximum horizontal spacing and minimum rod diameters:
 - 1. NPS 1-1/2 and NPS 2: 60 inches with 3/8-inch rod.
 - 2. NPS 3: 60 inches with 1/2-inch rod.
 - 3. NPS 4 and NPS 5: 60 inches with 5/8-inch rod.
 - 4. Spacing for 10-foot lengths may be increased to 10 feet. Spacing for fittings is limited to 60 inches.
- G. Install supports for vertical cast-iron soil piping every 15 feet.
- H. Install hangers for steel piping with the following maximum horizontal spacing and minimum rod diameters:
 - 1. NPS 1-1/4: 84 inches with 3/8-inch rod.
 - 2. NPS 1-1/2: 108 inches with 3/8-inch rod.

3. NPS 2: 10 feet with 3/8-inch rod.
 - I. Install supports for vertical steel piping every 15 feet.
 - J. Install hangers for plastic piping with the following maximum horizontal spacing and minimum rod diameters:
 1. PVC with solvent cemented joints
 - a. NPS 1-1/4 through 4: 48 inches and every horizontal branch connection with 3/8 inch rod.
 - b. NPS 5 through 8: 48 inches and every horizontal branch connection with 1/2 inch rod.
 - c. All sizes: Allow for expansion every 30 feet
 - K. Install vertical supports for plastic piping at the base and every 10 feet. Provide mid-story guides.
 1. For PVC, provide for expansion every 30 feet.
 - L. Support piping and tubing not listed above according to MSS SP-58 and manufacturer's written instructions.
- 3.06 CONNECTIONS
 - A. Drawings indicate general arrangement of piping, fittings, and specialties.
 - B. Connect soil and waste piping to exterior sanitary sewerage piping. Use transition fitting to join dissimilar piping materials.
 - C. Connect waste and vent piping to the following:
 1. Plumbing Fixtures: Connect waste piping in sizes indicated, but not smaller than required by plumbing code.
 2. Plumbing Fixtures and Equipment: Connect atmospheric vent piping in sizes indicated, but not smaller than required by authorities having jurisdiction.
 3. Plumbing Specialties: Connect waste and vent piping in sizes indicated, but not smaller than required by plumbing code.
 4. Install test tees (wall cleanouts) in conductors near floor and floor cleanouts with cover flush with floor.
 5. Comply with requirements for cleanouts and drains specified in Section 22 1319 "Sanitary Waste Piping Specialties."
 6. Equipment: Connect waste piping as indicated.
 - D. Where installing piping adjacent to equipment, allow space for service and maintenance of equipment.

3.07 IDENTIFICATION

- A. Identify exposed sanitary waste and vent piping.

- B. Comply with requirements for identification specified in Section 22 0553 "Identification for Plumbing Piping and Equipment."

3.08 FIELD QUALITY CONTROL

- A. During installation, notify authorities having jurisdiction at least 24 hours before inspection must be made. Perform tests specified below in presence of authorities having jurisdiction.
 - 1. Roughing-in Inspection: Arrange for inspection of piping before concealing or closing-in after roughing-in and before setting fixtures.
 - 2. Final Inspection: Arrange for final inspection by authorities having jurisdiction to observe tests specified below and to ensure compliance with requirements.
- B. Reinspection: If authorities having jurisdiction find that piping will not pass test or inspection, make required corrections and arrange for reinspection.
- C. Reports: Prepare inspection reports and have them signed by authorities having jurisdiction.
- D. Test sanitary waste and vent piping according to procedures of authorities having jurisdiction or, in absence of published procedures, as follows:
 - 1. Test for leaks and defects in new piping and parts of existing piping that have been altered, extended, or repaired.
 - a. If testing is performed in segments, submit separate report for each test, complete with diagram of portion of piping tested.
 - 2. Leave uncovered and unconcealed new, altered, extended, or replaced waste and vent piping until it has been tested and approved.
 - a. Expose work that was covered or concealed before it was tested.
 - 3. Roughing-in Plumbing Test Procedure: Test waste and vent piping except outside leaders on completion of roughing-in.
 - a. Close openings in piping system and fill with water to point of overflow, but not less than 10-foot head of water (30 kPa).
 - b. From 15 minutes before inspection starts to completion of inspection, water level must not drop.
 - c. Inspect joints for leaks.
 - 4. Repair leaks and defects with new materials and retest piping, or portion thereof, until satisfactory results are obtained.
 - 5. Prepare reports for tests and required corrective action.

3.09 CLEANING AND PROTECTION

- A. Clean interior of piping. Remove dirt and debris as work progresses.
- B. Protect sanitary waste and vent piping during remainder of construction period to avoid clogging with dirt and debris and to prevent damage from traffic and construction work.
- C. Place plugs in ends of uncompleted piping at end of day and when work stops.
- D. Repair damage to adjacent materials caused by waste and vent piping installation.

- E. Exposed PVC Piping: Protect plumbing vents exposed to sunlight with 2 coats of water based latex paint. Color selection shall be by Architect.

3.10 PIPING SCHEDULE

- A. Note: Standard duty coupling may be used for waste and vent piping for up to 2 stories only.
- B. NOTE: PVC waste and vent may not be used in return air plenums.
- C. Aboveground, soil and waste piping NPS 4 and smaller shall be any of the following:
 - 1. Service weight cast iron with hub and spigot gasket joints and fittings.
 - 2. Hubless, cast-iron soil pipe and fittings; standard-duty hubless-piping couplings; and coupled joints.
 - 3. Copper Type DWV tube, copper drainage fittings, and soldered joints.
 - 4. PVC pipe with socket fittings and solvent cement joints.
 - 5. Dissimilar Pipe-Material Couplings: Shielded, nonpressure transition couplings.
- D. Aboveground, soil and waste piping NPS 5 and larger shall be any of the following:
 - 1. Service weight cast iron with hub and spigot gasket joints and fittings.
 - 2. Hubless, cast-iron soil pipe and fittings; standard-duty hubless-piping couplings; and coupled joints.
 - 3. PVC pipe with socket fittings and solvent cement joints.
- E. Aboveground, vent piping NPS 4 and smaller shall be any of the following:
 - 1. Service weight cast iron with hub and spigot gasket joints and fittings.
 - 2. Hubless, cast-iron soil pipe and fittings; standard-duty hubless-piping couplings; and coupled joints.
 - 3. Copper Type DWV tube, copper drainage fittings, and soldered joints.
 - 4. PVC pipe with socket fittings and solvent cement joints.
- F. Underground, soil, waste, and vent piping NPS 4 and smaller shall be any of the following:
 - 1. Service weight cast iron with hub and spigot gasket joints and fittings.
 - 2. Hubless, cast-iron soil pipe and fittings; standard-duty hubless-piping couplings; and coupled joints.
 - 3. PVC pipe with socket fittings and solvent cement joints.
 - 4. Dissimilar Pipe-Material Couplings: Shielded, nonpressure transition couplings.

END OF SECTION 22 1316

SECTION 22 1319 – SANITARY WASTE PIPING SPECIALTIES

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. Cleanouts.
2. Roof flashing assemblies.
3. Through-penetration firestop assemblies.
4. Miscellaneous sanitary drainage piping specialties.
5. Floor Drains
6. Trench Drains

B. Related Requirements:

1. Section 22 1423 "Storm Drainage Piping Specialties" for roof and overflow drains.
2. Site/Civil Documents for "Sanitary Drainage Piping" for sewer drainage piping and piping specialties outside the building.

1.03 ACTION SUBMITTALS

- A. Product Data: For each type of product. Include rated capacities, operating characteristics, and accessories.

1.04 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For sanitary waste piping specialties to include in emergency, operation, and maintenance manuals.

1.05 QUALITY ASSURANCE

A. Regulatory Requirements: Comply with the provisions of the following:

1. Plumbing Code Compliance: Comply with applicable portions of Local Plumbing Code.
2. ANSI Compliance: Comply with applicable ANSI standards pertaining to materials, products and installation of soil and waste systems.
3. ASSE Compliance: Comply with applicable ASSE Standards pertaining to materials, products and installation of soil and waste systems.
4. PDI Compliance: Comply with applicable PDI standards pertaining to products and installation of soil and waste systems.

5. PVC Pipe: Only Contractors personnel which have received training in the installation of this material and meet the manufacturers qualifications shall do the assembly of such material.

1.06 SEQUENCING AND SCHEDULING

- A. Coordinate the installation of flashing and roof penetrations.
- B. Coordinate flashing materials installation of roofing, waterproofing and adjoining substrate work.
- C. Coordinate the installation of drains in poured-in-place concrete slabs, to include proper drain elevations, installation of flashing and slope of slab to drains.
- D. Coordinate with installation of sanitary sewer systems as necessary to interface building drains with drainage piping systems.
- E. Coordinate all penetrations with Structural Engineer
- F. Coordinate all installations with work of other trades.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
- B. Cast Iron Exposed Cleanouts
 1. Jay R. Smith Mfg. Co.
 2. Josam Company.
 3. MIFAB, Inc.
 4. Tyler Pipe
 5. Watts.
 6. Zurn Industries, LLC.
- C. Cast Iron Exposed Floor Cleanouts
 1. Jay R. Smith Mfg. Co.
 2. Josam Company.
 3. Oatey
 4. Sioux Chief Manufacturing Co
 5. Tyler Pipe
 6. Watts.
 7. Zurn Industries, LLC.
- D. Cast Iron Wall Cleanouts
 1. Jay R. Smith Mfg. Co.
 2. Josam Company.

3. MIFAB, Inc.
4. Tyler Pipe
5. Watts.
6. Zurn Industries, LLC.

E. Cast Iron Floor Drains

1. Jay R. Smith Mfg. Co.
2. Josam Company.
3. MIFAB, Inc.
4. Tyler Pipe
5. Watts.
6. Zurn Industries, LLC.
7. Commercial Enameling

F. Cast Iron Floor Sinks

1. Jay R. Smith Mfg. Co.
2. Josam Company.
3. MIFAB, Inc.
4. Tyler Pipe
5. Watts.
6. Zurn Industries, LLC.
7. Commercial Enameling

G. Non-Metallic Trench Drains

1. ABT
2. Aquastat
3. Aco USA
4. Multidrain
5. Tufftite
6. Fort composites
7. Polycas
8. NDS
9. Jay R Smith
10. Josam
11. Infinity

H. Roof Flashing Assemblies

1. Acorn Engineering Company.
2. Thaler Metal Industries Ltd.
3. Zurn Industries, LLC.

2.02 ASSEMBLY DESCRIPTIONS

- A. Sanitary waste piping specialties shall bear label, stamp, or other markings of specified testing agency.

- B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing, and marked for intended location and application.

2.03 CLEANOUTS

- A. Cast-Iron Exposed Cleanouts:
 - 1. Standard: ASME A112.36.2M.
 - 2. Size: Same as connected drainage piping
 - 3. Body Material: Hub-and-spigot, cast-iron soil pipe T-branch or Hubless, cast-iron soil pipe test tee as required to match connected piping.
 - 4. Closure: Raised-head, brass plug.
 - 5. Closure Plug Size: Same as or not more than one size smaller than cleanout size.
- B. Cast-Iron Exposed Floor Cleanouts:
 - 1. Standard: ASME A112.36.2M for adjustable housing, cast-iron soil pipe with cast-iron ferrule or threaded, adjustable housing cleanout.
 - 2. Size: Same as connected branch.
 - 3. Type: Adjustable housing, Cast-iron soil pipe with cast-iron ferrule or Threaded, adjustable housing.
 - 4. Body or Ferrule: Cast iron.
 - 5. Clamping Device: Required.
 - 6. Outlet Connection: Inside calk, Spigot or Threaded.
 - 7. Closure: brass/bronze plug.
 - 8. Adjustable Housing Material: Cast iron with threads, setscrews or other device.
 - 9. Frame and Cover Material and Finish: Rough bronze.
 - 10. Frame and Cover Shape: Round.
 - 11. Top Loading Classification: Light Duty.
 - 12. Riser: ASTM A 74, Service class, cast-iron drainage pipe fitting and riser to cleanout.
- C. Cast-Iron Wall Cleanouts:
 - 1. Standard: ASME A112.36.2M. Include wall access.
 - 2. Size: Same as connected drainage piping.
 - 3. Body: Hub-and-spigot, cast-iron soil pipe T-branch or Hubless, cast-iron soil pipe test tee as required to match connected piping.
 - 4. Closure Plug:
 - a. Brass/bronze
 - b. Raised head.
 - c. Drilled and threaded for cover attachment screw.
 - d. Size: Same as or not more than one size smaller than cleanout size.
 - 5. Wall Access: Round, deep, chrome-plated bronze or flat, chrome-plated brass or stainless-steel cover plate with screw.
 - 6. Wall Access: Round, nickel-bronze, copper-alloy, or stainless-steel wall-installation frame and cover.
- D. Site Surface Cleanout: Cast iron body ferrule with raised head brass plug, medium duty cast iron manhole cover and ring 12-inch diameter to be set in concrete pad, Neenah No. R-1791-A

2.04 ROOF FLASHING ASSEMBLIES

A. Roof Flashing Assemblies:

1. Description: Manufactured assembly made of 6.0-lb/sq. ft., 0.0938-inch-thick, lead flashing collar and skirt extending at least 8 inches from pipe, with galvanized-steel boot reinforcement and counterflashing fitting.
 - a. Open-Top Vent Cap: Without cap.

2.05 MISCELLANEOUS SANITARY DRAINAGE PIPING SPECIALTIES

A. Open Drains:

1. Description: Shop or field fabricate from ASTM A 74, Service class, hub-and-spigot, cast-iron soil-pipe fittings. Include P-trap, hub-and-spigot riser section; and where required, increaser fitting joined with ASTM C 564 rubber gaskets.
2. Size: Same as connected waste piping with increaser fitting of size indicated.

B. Floor-Drain, Trap-Seal Primer Fittings:

1. Description: Cast iron, with threaded inlet and threaded or spigot outlet, and trap-seal primer valve connection.
2. Size: Same as floor drain outlet with NPS 1/2 side inlet.

C. Air-Gap Fittings:

1. Standard: ASME A112.1.2, for fitting designed to ensure fixed, positive air gap between installed inlet and outlet piping.
2. Body: Bronze or cast iron.
3. Inlet: Opening in top of body.
4. Outlet: Larger than inlet.
5. Size: Same as connected waste piping and with inlet large enough for associated indirect waste piping.

D. Sleeve Flashing Device:

1. Description: Manufactured, cast-iron fitting, with clamping device that forms sleeve for pipe floor penetrations of floor membrane. Include galvanized-steel pipe extension in top of fitting that will extend 2 inches above finished floor and galvanized-steel pipe extension in bottom of fitting that will extend through floor slab.
2. Size: As required for close fit to riser or stack piping.

E. Expansion Joints:

1. Standard: ASME A112.6.4.
2. Body: Cast iron with bronze sleeve, packing, and gland.
3. End Connections: Matching connected piping.
4. Size: Same as connected soil, waste, or vent piping.

2.06 FLOOR DRAINS (FD)

- A. Floor Drain types, designation and sizes are indicated on drawings.

- B. Toilet Rooms and Finished Areas: Round cast iron body with flashing collar, seepage holes, and clamping ring when installed with membrane, 6" round nickel bronze adjustable strainer head with secured square hole grate, bottom outlet, and cast iron trap with primer connection. Provide center pin torx security screws on grate for all detention floor drains.
- C. Mechanical Rooms: Round cast iron, light duty, shallow body drain with flashing collar, seepage holes and cast iron clamping ring, when used with membrane, 8 inch round tractor type non tilt, slotted grate with sediment bracket, bottom waste outlet.
- D. Ice Maker or Drip Pan Drain, Recessed Top Grate: Round cast iron body with flashing collar, weep holes, and clamping rings when used with membrane. Provide 7" round nickel bronze adjustable strainer head with loose set recessed square hole grate, bottom waste outlet with cast iron trap and primer connection. Top outside edge of drain to be set flush with finished floor.

2.07 FLOOR SINKS (FS)

- A. Floor sinks type designations and sizes are indicated on drawings.

2.08 TRENCH DRAINS

A. GRP Channel Drainage Systems

1. Description: Modular system of channel sections, grates, and appurtenances; designed so grates fit into channel recesses without rocking or rattling.
2. Channel Sections: Interlocking joint sloped invert, GRP modular units, with end caps. Include flat, rounded, or inclined inside bottom with outlets in number, sizes, and locations indicated.
 - a. Dimensions: 10 inches wide. Include number of units required to form total lengths indicated.
 - b. Frame: Manufacturers standard metal for grates.
3. Grates: With slots or perforations and widths and thickness that fit recesses in channel sections.
 - a. Material: Gray iron.
 - b. Locking Mechanism: Manufacturers standard, unless otherwise indicated.
 - c. Channel-Section Joining and Fastening Materials: As recommended by system manufacturer.

PART 3 - EXECUTION

3.01 EXAMINATION

- A. General: Install piping in accordance with Local Authority Having Jurisdiction (AHJ), except where more stringent requirements are indicated.
- B. Inspect piping before installation to detect apparent defects. Mark defective materials and promptly remove from site.

- C. Verify all dimensions by field measurements. Verify that all drainage, vent piping and specialties may be installed in accordance with pertinent codes and regulations, the original design and referenced standards.
- D. Verify all existing grades, inverts, utilities, obstacles and topographical conditions prior to installations.
- E. Examine rough in requirements for plumbing fixtures and other equipment having drain connections to verify actual locations of piping connections prior to installation.
- F. Examine walls, floors, roof and plumbing chases for suitable conditions where piping and specialties are to be installed.
- G. Do not proceed until unsatisfactory conditions have been corrected.
- H. Refer to Division 2 for trenching and backfill requirements.

3.02 INSTALLATION

- A. Install cleanouts in aboveground piping and building drain piping according to the following, unless otherwise indicated:
 - 1. Size same as drainage piping up to NPS 4.
 - 2. Locate at each change in direction of piping greater than 45 degrees.
 - 3. Locate at minimum intervals of 50 feet for piping NPS 4 and smaller and 100 feet for larger piping.
 - 4. Locate at base of each vertical soil and waste stack.
 - 5. At each toilet group
 - 6. At egress of building
 - 7. At sinks on grade
 - 8. Where required by Oregon plumbing code.
- B. For floor cleanouts for piping below floors, install cleanout deck plates with top flush with finished floor.
- C. For cleanouts located in concealed piping, install cleanout wall access covers, of types indicated, with frame and cover flush with finished wall.
- D. Install roof flashing assemblies on sanitary stack vents and vent stacks that extend through roof. Comply with requirements in Division 07.
- E. Lubricate metallic cleanout plugs with mixture of graphite and linseed oil. Prior to building turnover remove cleanout plugs, relubricate and reinstall using only enough force to ensure permanent leakproof joint.
- F. Install flashing fittings on sanitary stack vents and vent stacks that extend through roof. Comply with requirements in Division 07.

- G. Install floor-drain, trap-seal primer fittings on inlet to floor drains that require trap-seal primer connection.
 - 1. Exception: Fitting may be omitted if trap has trap-seal primer connection.
 - 2. Size: Same as floor drain inlet.
 - H. Install air-gap fittings on draining-type backflow preventers and on indirect-waste piping discharge into sanitary drainage system.
 - I. Install sleeve and sleeve seals with each riser and stack passing through floors with waterproof membrane.
 - J. Install reinforcement for wall-mounting-type specialties.
 - K. Install traps on plumbing specialty drain outlets. Omit traps on indirect wastes unless trap is required. Prime all traps unless noted otherwise.
 - L. All floor drains are to be provided with P-rap the same size as the floor drain unless otherwise noted on mechanical drawings.
 - M. Above Ground Cleanouts: Install in above ground piping and building drain piping as indicated, and extend cleanouts to floor or wall above. Line cleanouts are not acceptable unless otherwise noted on the drawings.
 - 1. As required by plumbing code.
 - 2. At each change in direction of piping greater than 135 degrees below slab
 - 3. At base of each vertical soil or waste stack
 - 4. At sinks and urinals on grade
 - 5. At egress of building (surface cleanout)
 - 6. At each toilet group.
 - N. Cleanouts Covers: Install floor and wall cleanout covers, types as indicated, and in accessible locations.
 - O. Flashing Flanges: install flashing flange and clamping device with each stack and cleanout passing through waterproof membranes.
 - P. Vent Flashing Sleeves: Install on stacks passing through roof, secure over stack flashing in accordance with manufacturer's instructions.
 - Q. Exposed PVC, CPVC and PVDF Piping: Protect plumbing vents exposed to sunlight with 2 coat of water based latex paint. Color selection shall be by Architect.
- 3.03 CONNECTIONS
- A. Comply with requirements in Section 22 1316 "Sanitary Waste and Vent Piping" for piping installation requirements. Drawings indicate general arrangement of piping, fittings, and specialties.

- B. Provide drainage and vent piping runouts to plumbing fixtures and drains, with approved trap, of sizes indicated, but in no case smaller than required by the plumbing code.
- C. Install piping adjacent to equipment to allow service and maintenance.

3.04 PIPE AND TUBE JOINT CONSTRUCTION

- A. Install pipes and pipe joints in accordance with Division 22.

3.05 INSTALLATION OF FLOOR DRAINS

- A. Install floor drains in accordance with manufactures written instructions and in locations indicated.
- B. Install floor drains at low points of surface areas to be drained, or as indicated. Set tops of drains flush with finished floor. Coordinate floor slopes and exact drain locations with Architectural drawings.
- C. Trap all drains connected to the sanitary sewer with minimum trap size that of drain connected.
- D. Install drain flashing collar or flange so that no leakage occurs between drain and adjoining flooring. Maintain integrity of waterproof membranes where penetrated.
- E. Position drains so that they are accessible and easy to maintain.

3.06 INSTALLATION OF TRENCH DRAINS

- A. Install trench drains per manufacturers requirements
- B. Install sections end to end with alignment tools and devices per manufacturer for straight installation.
- C. Support drains for concrete pour and set elevation flush with finish floor
- D. Verify with architectural drawings for lengths and elevations.

3.07 INSTALLATION OF TRAP PRIMERS

- A. Install trap primers on all traps with piping pitched towards drain trap, minimum of 1/8 inch per foot (1 percent) Adjust trap primer for proper flow.

3.08 FLASHING INSTALLATION

- A. Comply with requirements in Division 07 for flashing.
- B. Fabricate flashing from single piece unless large pans, sumps, or other drainage shapes are required.

- C. Install sheet flashing on pipes, sleeves, and specialties passing through or embedded in floors and roofs with waterproof membrane.
 - 1. Pipe Flashing: Sleeve type, matching pipe size, with minimum length of 10 inches, and skirt or flange extending at least 8 inches around pipe.
 - 2. Sleeve Flashing: Flat sheet, with skirt or flange extending at least 8 inches around sleeve.
 - 3. Embedded Specialty Flashing: Flat sheet, with skirt or flange extending at least 8 inches around specialty.
- D. Set flashing on floors and roofs in solid coating of bituminous cement.
- E. Secure flashing into sleeve and specialty clamping ring or device.
- F. Install flashing for piping passing through roofs with counterflashing or commercially made flashing fittings, according to Division 07.
- G. Extend flashing up vent pipe passing through roofs and turn down into pipe, or secure flashing into cast-iron sleeve having calking recess.
- H. Provide flashing membrane for all floor drains in structure above slab on grade level; see flashing detail on mechanical drawings.
- I. Provide flashing for all floor drains, floor cleanouts in wet areas and shower drains above grade. Make watertight with underslab moisture vapor barrier. Refer to Division 7 for requirements of vapor barriers. Flashing shall extend at least 24 inches from drain rim into floor membrane or on structural floor. Fasten flashing to drain clamp device and make watertight, durable joint. Provide flashing collar extension with all drains and cleanouts installed above grade.

3.09 LABELING AND IDENTIFYING

- A. Label Piping and Accessories
 - 1. Pipe labeling is specified in Section 22 0553 "Identification for Plumbing Piping and Equipment."

3.10 FIELD QUALITY CONTROL

- A. Do not enclose, cover or put into operation drainage and vent piping system until it has been pressure tested, inspected and approved by the Local Authority Having Jurisdiction.
- B. During the progress of the installation, notify the plumbing official having jurisdiction, at least 48 hours prior to the time such inspection must be made. Perform tests specified in Division 22 in the presence of the plumbing official.
- C. Perform tests and inspections and prepare test reports.
- D. Tests and Inspections:

1. Leak Test: After installation, charge system and test for leaks. Repair leaks and retest until no leaks exist.
2. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

3.11 PROTECTION

- A. Protect drains during remainder of construction period to avoid clogging with dirt or debris and to prevent damage from traffic or construction work.
- B. Place plugs in ends of uncompleted piping at end of each day or when work stops.

3.12 ADJUSTING AND CLEANING

- A. Clean interior of piping. Remove dirt and debris as work progresses
- B. Clean drain strainers and traps. Remove dirt and debris.

END OF SECTION 22 1319

SECTION 22 3000 – WATER HEATERS

PART 1 - GENERAL

1.01 DESCRIPTION OF WORK:

- A. Extent of water heater work required by this section is indicated on drawings and schedules, and by requirements of this section.
- B. Refer to other Division 22 sections for piping, specialties, pumps, fuel piping; breechings which are required external to water heaters for installation; for field installed automatic temperature controls required in conjunction with water heaters; not work of this section.
- C. Refer to Division 23 section "Mechanical/Electrical Requirements for Mechanical Equipment" for requirements.
- D. Electrical Work: Provide the following wiring as work of this section, in accordance with requirements of Division 26:
 - 1. Low voltage wiring between water heaters and remote mounted thermostats and controls.
 - 2. Provide factory-mounted and factory-wired controls and electrical devices as specified in this section.
- E. Refer to Division 26 sections for other electrical wiring including motor starters, disconnects, wires/cables, raceways, and other required electrical devices; not work of this section.

1.02 QUALITY ASSURANCE:

- A. Manufacturer's Qualifications: Firms regularly engaged in manufacturer of water heaters of types and capacities required, whose products have been in satisfactory use in similar service for not less than 5 years.
- B. Codes and Standards:
 - 1. Provide water heater components which are UL-listed and labeled.
 - 2. NSF Compliance: Construct and install water heaters located in food service establishments in accordance with NSF 5, "Standard for Hot Water Generating Equipment for Food Service Establishments using Spray Type Dish washing Machines".
 - 3. NEC Compliance: Install electric water heaters in accordance with requirements of NFPA 70, "National Electrical Code".
 - 4. NFPA Compliance: Install gas-fired water heaters in accordance with requirements of NFPA 54, "National Fuel Gas Code".
 - 5. AGA and NSF Labels: Provide water heaters which are listed and labeled by American Gas Association and National Sanitation Foundation.
 - 6. ASME Code Symbol Stamps: Provide water heaters and safety relief valves which comply with ASME Boiler and Pressure Vessel Code, and are stamped with appropriate code symbols.

7. ASHRAE Compliance: Provide water heaters with Performance Efficiencies not less than prescribed in ANSI/ASHRAE/IES Standard 90.1 Energy Standard for Buildings, Except Low-Rise Residential Buildings.
8. ANSI Compliance: Provide gas-fired water heaters that comply with ANSI Z21.10.

1.03 SUBMITTALS:

- A. Product Data: Submit manufacturer's technical product data including rated capacities and efficiencies of selected model clearly indicated; operating weights; furnished specialties and accessories; and installation and start-up instructions.
- B. Shop Drawings: Submit manufacturer's assembly type shop drawings indicating dimensions, required clearances, and methods of assembly of components.
- C. Wiring Diagrams: Submit manufacturer's electrical requirements for electrical power supply wiring to water heaters. Submit manufacturer's ladder-type wiring diagrams for interlock and control wiring required for final installation of water heaters and controls. Differentiate between portions of wiring that are factory-installed and portions that are to be field-installed.
- D. Record Drawings: At project closeout, submit record drawings of installed systems products; in accordance with requirements of Division 23.
- E. Maintenance Data: Submit maintenance data and parts lists for each type and size of water heater, control, and accessory; including "trouble-shooting" maintenance guide. Include this data, product data, shop drawings, and wiring diagrams in maintenance manual; in accordance with requirements of Division 23.
- F. Certificates: Submit appropriate Certificates of Shop Inspection and Data Report as required by provisions of ASME Boiler and Pressure Vessel Code.

1.04 DELIVERY, STORAGE, AND HANDLING:

- A. Handle water heaters and components carefully to prevent damage, breaking, denting and scoring. Do not install damaged water heaters or components; remove from site and replace with new.
- B. Store water heaters and components in clean dry place. Protect from weather, dirt, fumes, water, construction debris, and physical damage.
- C. Comply with manufacturer's rigging and installation instructions for unloading water heaters, and moving units to final location for installation.

1.05 SPECIAL PROJECT WARRANTY:

- A. Warranty on Burner: Provide written warranty, signed by manufacturer, agreeing to replace/repair, within warranty period, coils, heat exchangers, and burners with inadequate or defective materials and workmanship, including leakage, breakage, improper assembly, or failure to perform as required; provided manufacturer's instructions for handling, installing,

protecting, and maintaining units have been adhered to during warranty period. Replacement is limited to component replacement only, and does not include labor for removal and reinstallation.

1. Warranty Period: 5 years from Date of Substantial Completion.

PART 2 - PRODUCTS

2.01 MANUFACTURERS:

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 1. Commercial Gas-Fired:
 - a. Bradford White
 - Lochinvar
 - PVI Industries, Inc.
 - Rheem
 - A.O. Smith
 - State Industries, Inc.

2.02 COMMERCIAL GAS-FIRED STORAGE TANK, CONDENSING

- A. Natural gas water heater(s) shall be minimum 95% thermal efficiency, a storage capacity, input rating, a recovery rating at degree rise indicated on the drawings with a maximum hydrostatic working pressure of 150 psi.
- B. Water Heater(s) shall:
 1. Have a modulating gas burner that automatically adjusts the input based on demand.
 2. Have powered anodes that are non-sacrificial and maintenance free.
 3. Have seamless glass lined steel tank construction, with glass lining applied to all water side surfaces after the tank has been assembled and welded;
 4. Meet the thermal efficiency and/or standby loss requirements of the US Department of Energy and current edition of ASHRAE/IESNA 90.1
 5. Have foam insulation and a CSA Certified and ASME rate T&P relief valve.
 6. Have a down fired power burner designed for precise mixing of air and gas for optimum efficiency, requiring no special calibration on startup.
 7. Be approved for zero clearance to combustibles.
 8. Provide acid neutralization kit.
- C. The control shall be an integrated solid state temperature and ignition control device with integral diagnostics, graphic user interface, fault history display, and shall have digital temperature readout.
 1. All models are design certified by Underwriters Laboratories (UL), Inc., according to ANSI Z21.10.3 – CSA 4.3 standards governing storage type water heaters
 2. Meet the thermal efficiency and standby loss requirements of the US Department of Energy and current edition ASHRAE/IESNA 90.1. Complies with SCAQMD Ruel 1146.2 and other air quality management districts with similar requirements for low NOx emissions.

3. Provide capability of remote shutdown via emergency power off. Refer to Division 23 "Sequence of Operations".
4. Provide BACnet Interface for integration into the DDC System

PART 3 - EXECUTION

3.01 EXAMINATION:

- A. Examine areas and conditions under which water heaters are to be installed. Do not proceed with work until unsatisfactory conditions have been corrected in manner acceptable to Installer.

3.02 INSTALLATION OF WATER HEATERS:

- A. General: Install water heaters in accordance with manufacturer's installation instructions. Install units plumb and level, firmly anchored in locations indicated, and maintain manufacturer's recommended clearances. Arrange units so controls and devices needing service are accessible.
- B. Install combination temperature and pressure relief valves. Use relief valves with sensing elements that extend into tanks. Extend relief outlet, with drain piping same as domestic water piping in continuous downward pitch. And discharge by positive air bap on to closest floor drain.
- C. Install water heater drain piping as indirect waste to spill by positive air gap into open drains or over floor drains. Install hose end drain valves at low points in water piping for water heaters that do not have tank drains. Refer to Division 22 Section "Domestic Water Piping Specialties" for hose-end drain valves.
- D. Install acid neutralization kit on condensate drain piping form condensing gas water heaters.
- E. Assemble and install inlet and outlet piping manifold kits for multiple water heaters. Fabricate, modify, or arrange manifolds for balanced water flow through each water heater. Include shutoff valve, thermometer in each water heater inlet and outlet, and throttling valve in each water heater outlet refer to Division 22 Section "General Duty Valves for Plumbing Piping" for general duty valves.
- F. Install anodes on heaters per manufacturers requirements.
- G. Charge expansion tanks with air prior to connecting to system.
- H. Ground equipment according to Division 26
- I. Connect wiring according to Division 26.
- J. Gauges: Provide thermometers on inlet and outlet piping of water heaters.
- K. Condensing Gas-Fired Water Heaters
 1. General: Install per NFPA 54 and IFGC

2. Connect gas supply to gas line with drip leg, tee, gas cock and union. Pipe size shall be system size to unit inlet connection. Locate piping so as not to interfere with service of unit. Pressure regulating valves shall be provided where system pressure exceeds pressure capability of water heater; provide relief vent to exterior using rigid piping.
3. Venting
Install vent piping with material as approved by unit manufacturer.
The exhaust vent must be UL Listed for use with the appliances and compatible with positive pressure, condensing flue gas service.
Follow guidelines specified in manufacturer's venting guide.

3.03 FIELD QUALITY CONTROL:

- A. Start-Up: Start-up, test, and adjust gas-fired water heaters in accordance with manufacturer's start-up instructions, and utility company's requirements. Check and calibrate controls, adjust burner for maximum efficiency.
- B. Remove and replace water heaters that do not pass tests and inspections and retest.

END OF SECTION 22 3000

SECTION 22 4000 – PLUMBING FIXTURES

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.
- B. Requirements of the following Division 22 Sections apply to this Section

1.02 SUMMARY

- A. This Section includes plumbing fixtures and trim, fittings and accessories, appliances, appurtenances, equipment and supports associated with plumbing fixtures.
- B. Products furnished but not installed under this Section include:
 - 1. Plumbing fittings (including faucets) and piping indicated for fixtures, appliances, appurtenances and equipment provided by Owner
 - 2. Plumbing fittings (including faucets) and piping indicated for fixtures, appliances, appurtenances, and equipment specified in other sections.
- C. Products installed but not furnished under this Section include:
 - 1. Owner supplied fixtures, as indicated
 - 2. Accessories, appliances, appurtenances and equipment specified in other sections requiring plumbing services or fixture related devices, as indicated.

1.03 DEFINITIONS

- A. Accessible: Describes a plumbing fixture, building, facility, or portion thereof that can be approached, entered and used by physically handicapped people.
- B. Accessory: Device that adds effectiveness, convenience or improved appearance to a fixture but is not essential to its operation
- C. Appliance: Device or machine designed and intended to perform a specific function.
- D. Appurtenance: Device or assembly designed to perform some useful function when attached to or used with a fixture.
- E. Equipment: Device used with plumbing fixtures or plumbing systems to perform a certain function for plumbing fixtures but that is not part of the fixture.
- F. Fitting: Fitting installed on or attached to a fixture to control the flow of water into or out of the fixture.

- G. Fixture: Installed receptor connected to the water distribution system that receives and makes available potable water and discharges the used liquid or liquid borne wastes directly or indirectly into the drainage system. The term "Fixture" means the actual receptor except when used in a general application where terms "Fixture" and Plumbing Fixture" include associated trim, fittings, accessories, appliances, appurtenances, support and equipment.
- H. Roughing In: Installation of piping and support for the fixture prior to the actual installation of the fixture.
- I. Support: Device normally concealed in building construction for supporting and securing plumbing fixtures to walls and structural members. Supports for urinals, lavatories and sinks are made in types suitable for fixture construction and the mounting required. Categories of supports are:
 - 1. Carrier: Floor mounted support for wall mounted water closet and support fixed to wall construction for wall hung fixture.
 - 2. Chair Carrier: Support for wall hung fixture having steel pipe uprights that transfer weight to the floor.
 - 3. Chair Carrier, Heavy Duty: Support for wall hung fixture having rectangular steel uprights that transfer weight to the floor.
 - 4. Reinforcement: Wood blocking or steel plate built into wall construction for securing fixture to wall.
- J. Trim: Hardware and miscellaneous parts specific to fixture and normally supplied with it required to complete fixture assembly and installation.

1.04 SUBMITTALS

- A. General: Submit the following in accordance with Conditions of Contract and Division 1 Specification Sections:
 - 1. Product data for each type of plumbing fixture specified including fixture and trim, fittings, accessories, appliances, appurtenances, equipment, supports, construction details, dimensions of components and finishes.
 - 2. Wiring diagrams for field installed wiring of electrically operated units.
- B. Product Data: Submit product data and installation instructions of each fixture, faucet, specialty, accessory and trim specified or shown on plumbing fixture schedule; clearly indicate rated capacities of selected models.
- C. Shop Drawings: Submit rough in drawings with brand names on each sheet and item. Detail dimensions, rough in requirements, required clearances and methods of assembly of components and anchorages. Coordinate requirements with architectural casework shop drawings specified in Division 6 for fixtures installed in countertops and cabinets. Furnish templates for use in casework shop drawings.
- D. Wiring Diagrams: Submit manufacturer electrical requirements and wiring diagrams for power supply to units. Clearly differentiate between portions of wiring that are factory installed and

field installed. Coordinate and provide matrix of mechanical and electrical requirements as specified in Division 22.

- E. Color Charts: Coordinate fixture color with Architect and submit manufacturers standard color charts for cabinet finishes and fixture colors.
- F. Maintenance Data: Submit maintenance data and spare parts lists for each type of manufactured plumbing fixture, valve and trim. In addition to providing in the submittals, include this data, product data and shop drawings with operations and maintenance manuals.
- G. Submit certification of compliance with specified performance verification requirements and IPC, NSF, ANSI, UL, and ASHRAE Standards.

1.05 QUALITY ASSURANCE

- A. ADA Requirements: Comply with requirements of Americans with Disability Act. Provide Fixtures complying with ADA accessibility requirements
- B. Regulatory Requirements: Comply with requirements of ANSI Standard A117.1 "Buildings and Facilities Providing Accessibility and Usability for Physically Handicapped People" and Public Law 90 480 "Architectural Barriers Act, 1968" with respect to plumbing fixtures for the physically handicapped.
- C. Regulatory Requirements: Comply with requirements of ATBCB (Architectural and Transportation Barriers Compliance Board) "Uniform Federal Accessibility Standards (UFAS) 1985 494 187" with respect to plumbing fixtures for the physically handicapped.
- D. Listing and Labeling: Provide electrically operated fixtures specified in this Section that are listed and labeled.
 - 1. The terms "listed" and "labeled" shall be as defined in the National Electrical Code, Article 100.
 - 2. Listing and Labeling Agency Qualifications: A "Nationally Recognized Testing Laboratory" (NTRL) as defined in OSHA Regulation 1910.7.
- E. Design Concept: The drawings indicate types of plumbing fixtures and are based on the specific descriptions, manufacturers, models, and numbers indicated. Plumbing fixtures having equal performance characteristics by other manufacturers may be considered provided that deviations in dimensions, operation, color or finish or other characteristics are minor and do not change the design concept or intended performance as judged by the Architect. Burden of proof for equality of plumbing fixtures is on the proposer.
- F. Codes and Standards
 - 1. Current Adopted Plumbing Code
 - 2. NSF Standard 61: "Drinking Water System Components"
 - 3. ASHRAE Standard 18: "Methods of Testing for Rating Drinking Water Coolers with Self-Contained Mechanical Refrigeration"
 - 4. ARI Standard 1010: "Self-Contained, Mechanically Refrigerated Drinking Water Coolers"
 - 5. UL Standard 399: "Drinking Water Coolers"

6. Drinking Water Act – Current Edition
 7. Department of Public Health and Environment Regulations
 8. Cross- Connection Control Manual: Current Edition
 9. ANSI Standard A117.1: “Standard on Accessible and Usable Buildings and Facilities”
 10. Accessibility Guidelines and Standards of the United States Access Board
 11. Current Appliance and Equipment Standards of the United States Department of Energy
- G. Where fixtures are indicated on the architectural drawings and intended to be ADA Compliant, it shall be the sole responsibility for all manufacturers and/or suppliers to provide plumbing fixtures and related trim which meets the ADA requirements. Such indication may be shown by note on floor plans or schedules, by clearance dimensions or areas on the plans or other graphics or notes on elevations.
- 1.06 DELIVERY, STORAGE AND HANDLING
- A. Deliver plumbing fixtures in manufacturer’s protective packing, crating and covering.
 - B. Store plumbing fixtures on elevated platforms in a dry location.

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. Water Closets:
 - a. American Standard
 - b. Kohler
 - c. Zurn
 - d. Toto
 2. Lavatories:
 - a. American Standard
 - b. Kohler
 - c. Zurn
 - d. Toto
 3. Stainless Steel Sinks:
 - a. Elkay
 - b. Just
 - c. Moen
 4. Mop Basins:
 - a. Fiat
 - b. Floreston
 - c. Stern Williams
 - d. Swan
 - e. Manstone
 5. Showers:

- a. Best Bath
 - b. Fiberglass Systems
 - c. Aquatic
 - d. Freedom
 - e. Floreston
 - f. Manstone
 - g. Fiat
 - h. Lasco
 - i. Kohler
 - j. Prefabricated Showers
6. Toilet Seats:
 - a. Bemis
 - b. Beneke
 - c. Church
 - d. Kohler
 - e. Olsonite
 - f. Sperzel
 - g. American Standard
 7. Flushometers:
 - a. Sloan
 - b. Zurn
 - c. American Standard
 - d. Kohler
 - e. Toto
 8. Pressure Balance Bath/Shower Faucets:
 - a. American Standard
 - b. Bradley
 - c. Chicago Faucet
 - d. Delta Faucet
 - e. Kohler
 - f. Leonard
 - g. Powers Process Controls
 - h. Symmons
 9. Sensor Operated Faucets and Devices:
 - a. Sloan
 - b. Zurn
 - c. American Standard
 10. Fixture Supplies, Stops, Traps:
 - a. McGuire
 - b. Brasscraft
 11. Protective Pipe Covers:
 - a. McGuire
 - b. TruBro
 12. Fixture Carriers and Supports:
 - a. Josam
 - b. Smith (Jay R)

- c. Wade
- d. Zurn
- e. Watts

2.02 PLUMBING FIXTURES, GENERAL

- A. Provide plumbing fixtures and trim, fittings, other components and supports as specified. All fixtures to be lead free per NSF 61 App 6, AB1953.
- B. Refer to schedule on drawings
- C. All fixtures to be white unless otherwise noted.
- D. Provide a cane apron for non-high/low drinking fountains and water coolers shown to protrude into the walkway.
- E. Water Closets:
 - 1. Fixture Color: White unless specified otherwise. Coordinate with architectural
 - 2. Action: Siphon jet
 - 3. Rim: Elongated round front
 - 4. Trim: All trim shall be chrome plated, cast brass or copper tube. Plastics or metal alloy base type material will not be acceptable.
 - 5. All ADA installation for operating handles shall meet ANSI 117.1 requirements.
 - 6. Cast iron or red brass threaded nipples for wall hung fixture connections to carrier.
 - 7. Provide fully glazed trapways. Partial glazing is not acceptable.
- F. Lavatories
 - 1. Material: Plastic formed or enameled steel lavatories are not acceptable.
 - 2. Fixture Color: White, unless specified otherwise. Coordinate with architectural
 - 3. Mounting: Lavatories specified or scheduled as wall hung shall be supported from floor mounted top and bottom bearing plate or concealed arm carrier. Wall mounted wood or metal blocking hangers will not be permitted. Counter mounting, self-rimming or composite countertop with integral bowl as specified or scheduled.
 - 4. Faucet hold drilling: Drilling shall be provided by the fixture manufacturer to match the required fixture mounting and accessories specified by this and other sections of the plans and specifications. Faucet hole covers will not be acceptable. Contractor to coordinate prior to ordering lavatories.
 - 5. Size and style of listed acceptable units shall match the specified or scheduled unit including appearance, shrouds, enclosures, soap depressions, front or rear overflows, flat slab rim, splash rack, shelf back side shields, etc.
- G. Stainless Steel Sinks:.
 - 1. Material: Type 304, 18 gauge stainless steel for self rimming or undermount sinks and 16 gauge for floor mount sinks.
 - 2. Fixture Color: No.4 satin finish for stainless steel.
 - 3. Mounting: Wall mounted and carrier mounted sinks shall be installed per manufacturer recommendations and instructions. Floor mounted sinks shall be supported by four 16

gauge stainless steel 1-5/8" O.D. tubular legs with bullet shaped feet, adjustable up to 1".

4. Faucet hole drillings shall match the faucet configuration and accessories specified in the mechanical and architectural documents, i.e. dishwasher air gaps, liquid dispensers, remote drain operators, eye washes, etc., when mounted in the sink back ledge. NOTE: Faucet hole covers will not be acceptable. Contractor to coordinate prior to ordering sinks
5. Self rimming or undermount stainless steel sinks to be sound deadened with undercoating.

H. Prefabricated Showers:

1. Color: White, unless otherwise specified
2. Provide center drain with a brass or stainless steel shower drain cover.
3. Floor shall have a slip resistant, textured bottom
4. Provide reinforcement of shower where grab bars are specified.

2.03 FAUCETS

A. Faucets, General: Unless otherwise specified, provide faucets that are cast-brass with polished chrome plated finish

B. Lavatory Trim:

1. All lavatory faucets shall be provided with 1/4 -turn handles, laminar flow controls in lieu of aerators.
2. All lavatory faucets shall be provided with ceramic disc cartridges.
3. Faucets shall be chrome plated brass complying with restrictions for lead content for the requirements of the jurisdiction or district
4. Infrared faucets must e provided with integral stops.

C. Sink Trim

1. All sink faucets shall be provided with 1/4 turn handles, laminar flow controls in lieu of aerators.
2. All sink faucets shall be provided with ceramic disc cartridges
3. Alternate faucet controls, i.e. self closing, knee operated, foot operated, etc., shall be provided complete with all necessary anchoring and mounting devices recommended and supplied by the device manufacturer.
4. All sink faucets shall be chrome plated brass complying with restrictions for lead content for the requirements of the jurisdiction or district. Types include hand, foot, knee, infra-red or heat sensing type operations.
5. Infrared faucets must be provided with integral stops.

2.04 FITTINGS, EXCEPT FAUCETS

A. Provide 1/4 turn convertible angle stops whether angle or straight for all applications.

B. Fittings, General: Unless otherwise specified, provide fittings fabricated of brass with a polished chrome plated finish.

- C. Lavatory Supplies and Stops: 1/4 turn ball angle stop having 1/2" NPS inlet with wall flange and 3/8" by 12" flexible chrome plated tubing riser outlet.
 - D. Lavatory Traps: Cast Brass, 1-1/4" NPS adjustable P-trap with clean out, 17 gauge tubular waste to wall and wall flange.
 - E. Sink Supplies and Stops: 1/4 turn ball angle stop having 1/2" NPS inlet with wall flange and 1/2" by 12" flexible chrome plated tubing riser outlet.
 - F. Supply and drain plumbing service fittings not listed above shall be as specified and as scheduled.
 - G. Fittings installed concealed inside a plumbing fixture or within wall construction may be without chrome plate finish.
 - H. Escutcheons: Polished chrome plated, sheet steel wall flange with friction clips.
 - I. Deep Pattern Escutcheons: Wall flange with set screw or sheet steel wall flange with friction clips, of depth adequate to conceal protruding roughing in fittings
 - J. Provide fittings specified as part of a fixture description in lieu of fitting requirements above.
 - K. Hot water supply shall always be located on the left side of fixture and the cold supply shall always be located on the right side of fixture
 - L. ADA accessible Lavatories and Sinks: Provide white, molded antimicrobial vinyl cover for stops supplies, trap and tailpiece.
- 2.05 FLUSHOMETERS
- A. Provide flushometers compatible with fixtures with features and of consumption indicated.
 - B. Construction: Cast brass body, brass or copper pie or tubing inlet with wall flange and tailpiece with spud, screwdriver check stop, vacuum breaker and brass lever handle actuation except where other variations are specified. Type shall be diaphragm operation except where other type is specified.
 - C. Finish: Exposed metal parts shall be polished chrome plated except components installed in a concealed location may be rough brass or unfinished.
 - D. Flushometers: Furnish with the following features
 1. Non hold open feature
 2. ADA actuator on handicapped fixtures mounted on wide side of fixture
 3. Seat bumper on stop
 4. Furnish flushometers with factory set or field adjusted maximum water consumption to match fixture

2.06 TOILET SEATS

- A. General: Provide toilet seats compatible with water closets of type, color and features indicated.
- B. Toilet Seats: Extra heavy-duty, commercial/industrial type, elongated, open front, solid plastic, with check hinge.

2.07 PLUMBING FIXTURE SUPPORTS

- A. Supports: ASME A112.6.1M, categories and types as required for wall hanging fixtures specified and wall reinforcement.
- B. Support categories are:
 - 1. Carriers: Supports for wall hanging water closets and fixtures supported from wall construction. Water closet carriers shall have an additional faceplate and coupling when used for wide pipe spaces. Provide tiling frame or setting gauge with carriers for wall hanging water closets
 - 2. Chair Carriers: Supports with steel pipe uprights for wall hanging lavatories and fixtures. Urinal chair carriers shall have bearing plates.
 - 3. Chair Carriers, Heavy Duty: Supports with rectangular steel uprights for wall hanging fixtures
 - 4. Reinforcement: 2" by 4" wood blocking between studs or 1/4" by 6" steel plates attached to studs in wall construction to secure floor mounted and special fixtures to wall.
- C. Support Types: Provide support of category specified of type having features required to match fixture.
- D. Provide supports specified as part of fixture description in lieu of category and type requirements above.

PART 3 - EXECUTION

3.01 EXAMINATION

- A. Examine roughing in for potable cold water and hot water supplies and soil, waste, and vent piping systems to verify actual locations of piping connections prior to installing fixtures.
- B. Examine walls, floors, and cabinets for suitable conditions where fixtures are to be installed.
- C. Do not proceed until unsatisfactory conditions have been corrected.

3.02 APPLICATION

- A. Install plumbing fixtures and specified components in accordance with designations and locations indicated on drawings.

- B. Install supports for plumbing fixtures in accordance with categories indicated and of type required.
 - 1. Carriers for following fixtures
 - a. Wall hanging water closets
 - b. Wall hanging fixtures supported from wall construction
 - 2. Chair carriers for the following fixtures
 - a. Wall hanging lavatories and sinks
 - 3. Heavy duty chair carriers for the following fixtures
 - a. Accessible lavatories
 - b. Fixtures where specified
 - 4. Reinforcement for the following fixtures
 - a. Fixtures required to be secured to wall

3.03 INSTALLATION OF PLUMBING FIXTURES

- A. Install plumbing fixtures level and plumb in accordance with fixture manufacturers written installation instructions, roughing in drawings and referenced standards.
- B. Install wall hanging, back outlet water closets and urinals with gasket seals.
- C. All wall hung fixtures shall be supported from the building structure with floor mounted carriers. Do not support from walls.
- D. Fasten floor mounted fixtures and special fixtures having holes for securing fixture to wall construction to reinforcement built into walls.
- E. Fasten wall mounted fittings to reinforcement built into walls.
- F. Fasten counter mounting type plumbing fixtures to casework.
- G. Secure supplies behind wall or within wall pipe space, providing rigid installation.
- H. Install trap on fixture outlet except for fixtures having integral trap
- I. Install escutcheons at each wall, floor and ceiling penetration in exposed finished locations and within cabinets and millwork. Use deep pattern escutcheons where required to conceal protruding pipe fittings.
- J. Seal fixtures to walls, floors and counters using a sanitary type, one part, mildew resistant, silicone. Match sealant color to fixture color.
- K. Flush valves shall be anchored behind walls to eliminate and push-pull, horizontal or vertical movement.
- L. All flush valves shall have a properly sized water hammer arrestor
- M. Set prefabricated showers in a level bed of cement grout; material shall be as recommended by manufacturer or as specified by Architect.

- N. Install fixture water stop valves in accessible locations. Hot water supply shall always be located on left side of fixture and the cold supply shall always be located on the right side of fixture.
- O. Provide cleanouts as shown on drawings or per the applicable Plumbing Code
- P. Chrome plated cap nuts for wall hung fixtures shall be installed with strap wrench to prevent marring
- Q. Fixtures shall be product of one manufacturer and must be manufactured in the USA per Division 22.
- R. Install hose end faucets and hose connection with field backflow preventers to meet local Cross Connection Control Manual regulations and current jurisdictional codes.

3.04 CONNECTIONS

- A. Piping installation requirements are specified in other sections of Division 22. The drawings indicate general arrangement of piping, fittings and specialties. The following are specific connection requirements:
 - 1. Install piping connections between plumbing fixtures and dipping systems and plumbing equipment specified in other sections of Division 22.
 - 2. Install piping connections indicated between appliances and equipment specified in other sections, direct connected to plumbing piping systems.

3.05 ADA ACCESSIBILITY

- A. Review Mechanical and Architectural drawings to determine fixtures requiring ADA Accessibility. Notify Architect/Engineer of any physical conflicts preventing full dimensional compliance prior to beginning work.
- B. Comply with the installation requirements of ANSI A117.1 and "Accessibility Guidelines and Standards of the United States Access Board" with respect to plumbing fixtures for the physically handicapped. Arrange flush valve/flush tank handles with proper orientation to meet ADA requirements.

3.06 FIELD QUALITY CONTROL

- A. Inspect each installed fixture for damage. Replace damaged fixtures and components.
- B. Test fixtures to demonstrate proper operation upon completion of installation and after units are water pressurized. Replace malfunctioning fixtures and components, then retest. Repeat procedure until all units operate properly.

3.07 ADJUSTING AND CLEANING

- A. Operate and adjust faucets and controls. Replace damaged and malfunctioning fixtures, fittings, and controls.

- B. Adjust water pressure at faucets, shower valves and flushometers having controls to provide proper flow and stream
- C. Replace washers of leaking and dripping faucets and stops.
- D. Clean fixtures, fittings and spout and drain strainers with manufacturers recommended cleaning methods and materials.
- E. Review the data in Operating and maintenance Manuals. Refer to Division 1 Section "Project Closeout".

3.08 PROTECTION

- A. Provide protective covering for installed fixtures and fittings
- B. Do not allow use of fixtures for temporary facilities except when approved in writing by the Owner.

3.09 WATER CONSERVATION

NOTE: All fixture flow rates shall meet Idaho State Plumbing Code.

- A. All plumbing fixtures shall be of water conservation design per the US EPA WaterSense flow rates. Maximum water flow rates shall be as follows:

Flush Tank Toilets	1.28 Gallons per Flush
Flush Valve Toilets	1.28 Gallons per Flush
Lavatories	1.50 Gallons per Minute
Bathroom Sinks	1.50 Gallons per Minute
Showerheads	2.00 Gallons per Minute

- B. Other fixtures not required to comply with UP EPA WaterSense

Sinks	2.20 Gallons per Minute
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- C. Refer to Plumbing Fixture Schedule on drawings for specified water flow rates for each fixture type on this project.
- D. Lower water flow rates are permissible.

END OF SECTION 22 4000

SECTION 23 0500 – COMMON WORK RESULTS FOR MECHANICAL

PART 1 - GENERAL

1.01 RELATED DOCUMENTS:

- A. All drawings associated with the entire project, including general provisions of the Contract, including The General Conditions of the Contract for Construction, General and Supplementary Conditions and Division-1 Conditions specification sections shall apply to the Division 21, 22, and 23 specifications and drawings. The Contractor shall be responsible for reviewing and becoming familiar with the aforementioned and all other Contract Documents associated with the project.
- B. Related Sections: Refer to all sections in Division 21, 22, and 23. Refer to Division 26 specification sections and Division 26 drawings.
- C. Where contradictions occur between this section and Division 1, the more stringent requirement shall apply.
- D. Contractor shall be defined as any and all entities involved with the construction of the project.

1.02 SUMMARY:

- A. This Section specifies the basic requirements for mechanical installations and includes requirements common to more than one section of Divisions 21, 22, and 23. It expands and supplements the requirements specified in Division 1.

1.03 MECHANICAL INSTALLATIONS:

- A. The Contract Documents are diagrammatic, showing certain physical relationships which must be established within the mechanical work and its interface with all other work. Such establishment is the exclusive responsibility of the Contractor. Drawings shall not be scaled for the purpose of establishing material quantities.
- B. Drawings and specifications are complementary. Whatever is called for in either is binding as though called for in both. Report any discrepancies to the Engineer and obtain written instructions before proceeding. Where any contradictions occur between the specifications and the drawings the more stringent requirement shall apply. The contractor shall include pricing for the more stringent and expensive requirements.
- C. Drawings shall not be scaled for rough-in measurements or used as shop drawings. Where drawings are required for these purposes or have to be made from field measurement, Contractor shall take the necessary measurements and prepare the drawings.
- D. The exact location for some items in this specification may not be shown on the drawings. The location of such items may be established by the Engineer during the progress of the work.

- E. The contract documents indicate required size and points of terminations of pipes, and suggest proper routes to conform to structure, avoid obstructions and preserve clearances. It is not intended that drawings indicate necessary offsets. The contractor shall make the installation in such a manner as to conform to the structure, avoid obstructions, preserve headroom and keep openings and passageways clear, without further instructions or costs to the Owner. All equipment shall be installed so access is maintained for serviceability.
 - F. Before any work is installed, determine that equipment will properly fit the space; that required piping grades can be maintained and that ductwork can be run as intended without interferences between systems, structural elements or work of other trades.
 - G. Verify all dimensions by field measurements.
 - H. Coordinate installation in chases, slots and openings with all other building components to allow for proper mechanical installations.
 - I. Sequence, coordinate, and integrate installations of mechanical materials and equipment for efficient flow of the work. Give particular attention to large equipment requiring positioning prior to closing-in the building.
 - J. Where mounting heights are not detailed or dimensioned, install mechanical services and overhead equipment to provide the maximum headroom possible.
 - K. Install mechanical equipment to facilitate 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.
 - L. Make allowance for expansion and contraction for all building components and piping systems that are subject to such.
 - M.** The ceiling space shall not be “layered”. It is the contractor’s responsibility to offset the system as required to allow installation within the identified ceiling cavity. The contractor shall include labor and material in the base bid to accommodate such offsets.
 - N. In general, all “static” piping systems shall be routed as high as possible, i.e. fire protection systems. Keep all equipment in accessible areas such as corridors and coordinate with systems and equipment from other sections.
 - O. The Contractor shall provide all labor and material necessary but not limited to the starting/stopping of all mechanical equipment, and operating/verifying the operation of all mechanical systems controls as required to accomplish all work necessary to meet construction document requirements. Contractor shall submit records of such activities to engineer and include in the O & M manuals.
- 1.04 coordination:
- A. Work out all installation conditions in advance of installation. The Contractor shall be responsible for coordination of all work, in all areas. The Contractor shall be responsible for

providing all labor and material, including but not limited to all fittings, , offsets, hangers, control devices, etc., necessary to overcome congested conditions at no increase in contract sum. **The Contractors base bid shall include any and all time and manpower necessary to develop such coordination efforts. Increases to contract sum or schedule shall not be considered for such effort.**

- B. Provide proper documentation of equipment, product data and shop drawings to all entities involved in the project. Coordination shall include, but not be limited to the following:
 - 1. Fire Protection and Fire Alarm Contractor shall provide shop drawings to all other Division 21, 22, and 23 Contractors.
 - 2. Automatic Temperature Controls and Testing, Adjusting and Balancing Contractors shall be provided with equipment product data and shop drawings from other Division 21, 22, 23 and 26 Contractors and shall furnish the same information involving control devices to the appropriate Division 21, 22, and 23 Contractor.

1.05 coordination with other divisions:

- A. General:
 - 1. Coordinate all work to conform to the progress of the work of other trades.
 - 2. Complete the entire installation as soon as the condition of the building will permit. No extras will be allowed for corrections of ill-timed work, when such corrections are required for proper installation of other work.
- B. Coordinate ceiling cavity space carefully with all trades. In the event of conflict, install mechanical and electrical systems within the cavity space allocation in the following order of priority:
 - 1. Equipment and required clearances.
 - 2. Plumbing waste, cooling coil drain piping and roof drain mains and leaders.
 - 3. Ductwork mains
 - 4. Plumbing vent piping
 - 5. Low pressure ductwork and air devices.
 - 6. Electrical and communication conduits, raceways and cabletray.
 - 7. Domestic hot and cold water
 - 8. Fire sprinkler mains, branch piping and drops (locate as tight to structure as possible).
 - 9. DDC control wiring and other low voltage systems.
 - 10. Fire alarm systems.
- C. Chases, Inserts and Openings:
 - 1. Provide measurements, drawings and layouts so that openings, inserts and chases in new construction can be built in as construction progresses.
 - 2. Check sizes and locations of openings provided. Including the access panels for equipment in hard lid ceilings and wall cavities.
 - 3. Any cutting and patching made necessary by failure to provide measurements, drawings and layouts at the proper time shall be done at no additional cost in contract sum.

- D. Modifications required as result of failure to resolve interferences, provide correct coordination drawings or call attentions to changes required in other work as result of modifications shall be paid for by responsible Contractor/Subcontractor.
- E. Coordination with Electrical Work: Refer to Division 1 and 26.

1.06 design work required by contractor:

- A. The construction of this project requires the Contractor to include the detailing and design of several systems and/or subsystems. All such design work associated with the development of coordination shall be the complete responsibility of the Contractor.
- B. The Contractor shall take the full responsibility to develop and complete routing strategies which will allow fully coordinated system to be installed in a fully functional manner. The Engineers contract drawings shall be for system design intent and general configurations.
- C. Systems or subsystems which require design responsibility by the contractor include but are not limited to:
 - 1. Final coordinated distribution of duct, plumbing and other systems within the ceiling cavity.
 - 2. Any system not fully detailed
 - 3. Fire protection systems
 - 4. Equipment supports, hangers, anchors and seismic systems not fully detailed nor specified in these documents, or catalogued by the manufacturer.
 - 5. Temperature controls systems
 - 6. Refrigeration systems
 - 7. Seismic restraint systems
- D. Design Limitations:
 - 1. The Contractor shall not modify the Engineers design intent in any way.
 - 2. The Contractor shall not change any pipe size or equipment size without prior written approval from the Engineer.
 - 3. The Contractor shall conform to the SMACNA Duct Construction Standards when modifying the ductwork layout to avoid collisions.

1.07 SAFETY:

- A. Refer to Division 1.

1.08 EQUAL EMPLOYMENT OPPORTUNITY REQUIREMENTS:

- A. Refer to Division 1 and conform with the Owners requirements.

1.09 REQUIREMENTS OF REGULATORY AGENCIES:

- A. Refer to Division 1.

- B. Execute and inspect all work in accordance with all Underwriters, local and state codes, rules and regulations applicable to the trade affected as a minimum, but if the plans and/or specifications call for requirements that exceed these rules and regulations, the greater requirement shall be followed. Follow recommendations of NFPA, SMACNA, EPA, OSHA and ASHRAE.
- C. Comply with the local and state codes adopted by the Authorities Having Jurisdictions at the time of permit application, including referenced standards, amendments and policies. See code declaration information on the drawings.
- D. Comply with standards in effect at the date of these Contract Documents, except where a standard or specific date or edition is indicated.
- E. After entering into contract, Contractor will be held to complete all work necessary to meet these requirements without additional expense to the Owner.

1.10 REQUIREMENTS OF LOCAL UTILITY COMPANIES:

- A. Comply with rules and regulations of local utility companies. Include in bid the cost of all valves, valve boxes, meter boxes, meters and such accessory equipment which will be required but not provided by Local Utility Company for the project.
- B. Utility Connections:
 - 1. Coordinate connection of mechanical systems with exterior underground and overhead utilities and services. Comply with requirements of governing regulations, franchised service companies and controlling agencies. Provide required connection for each service.
 - 2. The contract documents indicate the available information on existing utilities and services and on new services (if any) to be provided to the project by utility companies and agencies. Notify Engineer immediately if discrepancies are found.

1.11 PERMITS AND FEES:

- A. Refer to Division 1.
- B. The Contractor shall pay all tap, development, meter, etc., fees required for connection to municipal and public utility facilities, unless directed otherwise by the General Contractor/Owner – IN WRITING.
- C. Contractor shall arrange for and pay for all inspections, licenses and certificates required in connection with the work.

1.12 PROJECT SEISMIC REQUIREMENTS:

- A. Installation shall comply with the local seismic requirements for the area of installation. Provide restraints, bracing, anchors, vibration isolation, seismic snubbers, and all other components required for the installation.

- B. All systems shall be installed to meet NFPA and IBC Seismic requirements.
 - 1. Where any conflicts arise the more stringent requirements shall be applicable.
 - 2. The design of the seismic requirements shall be the full responsibility of the Contractor.

1.13 TEMPORARY FACILITIES:

- A. Light, Heat, Power, Etc.: Responsibility for providing temporary electricity, heat and other facilities shall be as specified in Division 1.
- B. Use of Permanent Building Equipment for Temporary Heating or Cooling: Permanent building equipment shall not be used without written permission from the Owner. If this equipment is used for temporary heating or cooling, it shall be adequately maintained per manufacturer's instructions and protected with filters, controls, reliefs, etc. Ductwork and air moving equipment shall be cleaned to an "AS New" condition. All filters required for the construction period shall be equivalent to the filters required for the final installation. All filters shall be replaced at the time of substantial completion. The guarantee period of all equipment used shall not start until the equipment is turned over to the Owner for his use. A written record of maintenance, operation and servicing shall be turned over to the owner prior to final acceptance.

1.14 PRODUCT OPTIONS AND SUBSTITUTIONS:

- A. Refer to the Instructions to Bidders and Division 1.
- B. The burden of proof that proposed equipment is equal in size, capacity, performance, and other pertinent criteria for this specific installation, or superior to that specified is up to the Contractor. If substitutions are not granted, the specified materials and equipment must be installed. Where substituted equipment is allowed, it shall be the Contractor's responsibility to notify all related trades of the accepted substitution and to assume full responsibility for all costs caused as a result of the substitution.
- C. Materials and equipment of equivalent quality shall be submitted for substitution prior to bidding. This may be done by submitting to the Architect/Engineer at least ten (10) working days prior to the bid date requesting prior review. This submittal shall include all data necessary for complete evaluation of the product.
 - 1. Substitutions shall be allowed only upon the written approval of the Architect/Engineer NO EXCEPTIONS.
 - 2. The Contractor shall be responsible for removal, replacement and remedy of any system or equipment which has been installed which does not meet the specifications and scheduled performance or which does not have prior approval.
- D. Bidders opting to bid or propose comparable products (either a product by a listed acceptable manufacturer in the respective specification section or a substitution request) are responsible for:
 - 1. Confirming the equipment they are bidding will fit in the space available, incorporating equipment's clearance requirements.

2. Coordination of any variance from basis-of-design in weight, electrical requirements, other utility requirements, etc. with other trades.
3. Inclusion in the bid of any applicable costs for changes in prime bidder's and their sub bidders' work required to accommodate the utilization of the comparable product.
4. The contractor shall bear any and all responsibility including any changes to mechanical, plumbing, electrical, structural or architectural design. These changes shall be clearly identified and presented to the Design Team.

1.15 MECHANICAL SUBMITTALS:

A. General

1. Refer to the Conditions of the Contract (General and Supplementary), Division 1.
2. Contractor shall provide a submittal schedule appropriate for the size and schedule of the project. Limit the number of large submittals being reviewed at one time and coordinate timing of sections that are dependent on each other.
3. The Contractor shall identify any "long lead time" items which may impact the overall project schedule. If these submittal requirements affect the schedule, the Contractor shall identify the impacts and confer with the Engineer within two weeks of entering into the contract.
4. The front of each submittal package shall be identified with the specification section number, job name, Owner's project number, date, Prime Contractor and Sub-Contractor's names, addresses, and contact information, etc. Each Specification Section shall be submitted individually and submittal shall be tabbed for the equipment/materials/etc. within the section. Submittals that are not complete with the required information will not be reviewed and will be sent back to be corrected.
5. Submittals shall be provided electronically. All electronic submittals need to be complete with all design information and stamped for conformity by the contractor. Submittals will be reviewed, marked appropriately and returned by the same means received.
6. An index shall be provided which includes:
 - a. Product
 - b. Plan Code (if applicable)
 - c. Specification Section
 - d. Manufacturer and Model Number
7. Submittal schedule shall be provided for review within four (4) working weeks from award of contract to successful bidder or as required by Division 1.

B. Basis of Design: The manufacturer's material or equipment listed in the schedule or identified by name on the drawings are the basis of design and provided for the establishment of size, capacity, grade and quality. If the contractor proposes alternates or substitutions in lieu of the scheduled names, the cost of any changes in construction required by their use shall be borne by Contractor.

C. All equipment shall conform to the State and/or local Energy Conservation Standards.

D. Contractor Review: Submittal of shop drawings, product data and samples will be accepted only when submitted by and stamped by the General Contractor. Each submittal shall be reviewed by the contractor for general conformance with contract requirements and stamped by the

respective contractor prior to submittal to the Architect/Engineer. Any submittal not stamped or complete will be sent back. Data submitted from Subcontractors and material suppliers directly to the Engineer will not be processed unless prior written approval is obtained by the Contractor.

- E. Submittal Review Process: Before starting work, prepare and submit to the Architect/Engineer shop drawings and descriptive equipment data required for the project. Continue to submit in the stated format after each Architect/Engineer's action until a "No Exception Taken" or "Make Correction Noted" action is received. When a "Make Corrections Noted" is received, make the required corrections for inclusion in the Operating and Maintenance Manual (O&M). Submittals marked "Make Corrections Noted" shall not be resubmitted during the submittal process. Unless each item is identified with specification section and sufficient data to identify its compliance with the specifications and drawings, the item will be returned "Revise and Resubmit". Where an entire submittal package is returned for action by the Contractor, the Engineer may summarize comments in letter format and return the entire set. Submittals shall be prepared per the MECHANICAL SUBMITTAL CHECKLIST, at the end of this section; supplemental requirements are listed in each Division 21, 22, and 23 Sections.
- F. The Design Professional's review and appropriate action on all submittals and shop drawings is only for the limited purpose of checking for conformance with the design concept and the information expressed in the contract documents. This review shall not include:
 - 1. Accuracy or completeness of details, such as quantities, dimensions, weights or gauges, fabrication processes
 - 2. Construction means or methods.
 - 3. Coordination of the work with other trades
 - 4. Construction safety precautions
- G. The Design Professional's review shall be conducted with reasonable promptness while allowing sufficient time in the Design Professional's judgment to permit adequate review. Review of a specific item shall not indicate that the Design Professional has reviewed the entire assembly of which the item is a component.
- H. The Design Professional shall not be responsible for any deviations from the contract documents not brought specifically to the attention of the Design Professional in writing by the Contractor. This shall clearly identify the design and the specific element which vary from the Design. The Contractor shall be responsible for all remedy for lack of strict conformance associated with this criteria.
- I. The Design Professional shall not be required to review partial submissions or those for which submissions of correlated items have not been received.
- J. If more than two submittals (either for product data, shop drawings, record drawings, or test and balance reports) are made by the Contractor, the Owner reserves the right to charge the Contractor for subsequent reviews by their consultants. Such extra fees shall be deducted from payments by the Owner to the Contractor.

- K. The contractor shall cloud all changes made on submittals that are marked "Revise and Resubmit."
- L. Required Submittals: Provide submittals for each item of equipment specified or scheduled in the contract documents. See table at the end of this section.

1.16 SPECIFIC CATEGORY SUBMITTAL REQUIREMENTS:

- A. Product Listing:
 - 1. Prepare listing of major mechanical equipment and materials for the project, within (2) two weeks of signing the Contract Documents and transmit to the Architect. A sample schedule is included at the end of this section to complete this requirement.
 - a. Provide all information requested.
 - b. Submit this listing as a part of the submittal requirement specified in Division 1, "PRODUCTS AND SUBSTITUTION."
 - 2. Unless otherwise specified, all materials and equipment shall be of domestic (USA) manufacture and shall be of the best quality used for the purpose in commercial practice.
 - 3. When two or more items of same material or equipment are required (air conditioning units, etc.) they shall be of the same manufacturer. Product manufacturer uniformity does not apply to raw materials, bulk materials, pipe, tube, fittings, sheet metal, wire, steel bar stock, welding rods, solder, fasteners, motors for dissimilar equipment units and similar items used in work, except as otherwise indicated.
 - a. Provide products which are compatible within systems and other connected items.
- B. Schedule of Values
 - 1. Provide preliminary schedule of values with product data submittal, within three (3) weeks from award of contract to successful bidder. Provide according to the following descriptions:
 - a. Site Utilities
 - b. Plumbing
 - 1) Underground rough-in
 - 2) Aboveground rough-in
 - 3) Fixtures
 - 4) Insulation
 - 5) Aboveground finish
 - 6) Fixture set
 - 7) Insulation
 - c. Fire Protection
 - d. HVAC
 - 1) Equipment
 - 2) Sheet Metal
 - 3) Piping
 - 4) Insulation
 - 5) Test and Balancing
 - 6) Specialty Systems
 - 7) Temperature Controls
 - e. Miscellaneous

2. Provide a final Schedule of Values at close-out of project including updated values based on actual installation.
- C. Product Data:
1. Where pre-printed data covers more than one distinct product, size, type, material, trim, accessory group or other variation, mark submitted copy with black pen to indicate which of the variations is to be provided.
 2. Delete or mark-out portions of pre-printed data which are not applicable.
 3. Where operating ranges are shown, mark data to show portion of range required for project application.
 4. For each product, include the following:
 - a. Sizes.
 - b. Weights.
 - c. Speeds.
 - d. Capacities.
 - e. Piping and electrical connection sizes and locations.
 - f. Statements of compliance with the required standards and regulations.
 - g. Performance data.
 - h. Manufacturer's specifications.
- D. Shop Drawings:
1. Shop Drawings are defined as mechanical system layout drawings prepared specifically for this project, or fabrication and assembly type drawings of system components to show more detail than typical pre-printed materials.
 2. Prepare Mechanical Shop Drawings, except diagrams, to accurate scale, min 1/8"-1'-0", unless otherwise noted.
 - a. Show clearance dimensions at critical locations.
 - b. Show dimensions of spaces required for operation and maintenance.
 - c. Show interfaces with other work, including structural support.
- E. Test Reports:
1. Submit test reports which have been signed and dated by the accredited firm or testing agency performing the test.
 2. Prepare test reports in the manner specified in the standard or regulation governing the test procedure (if any) as indicated.
 3. Submit test reports as required for O & M manuals.
- F. Operation and Maintenance Data: See separate paragraph of this specification section.
- G. Software Licenses: Provide documentation of ownership under the owner's corporate name (coordinate with owner's representative for exact ownership wording) for Software Licenses provided as part of the work. Include information for updates, subscription requirements if applicable, backup, support, login, passwords, date when purchased, expiration date if applicable, version, etc. Include in the O & M Manual after review and "No Exceptions Taken" has been accomplished.
- H. Record Drawings: See separate paragraph of this specification section.

1.17 DELIVERY, STORAGE, AND HANDLING:

- A. Refer to Division 1 Sections on Transportation and Handling and Storage and Protection.
- B. Deliver products to project properly identified with names, model numbers, types, grades, compliance labels and similar information needed for distinct identifications; adequately packaged and protected to prevent damage or contamination during shipment, storage, and handling.
- C. Check delivered equipment against contract documents and submittals.
- D. Store equipment and materials at the site, unless off-site storage is authorized in writing. Protect stored equipment and materials from damage, dirt, dust, freezing, heat and moisture.
- E. Coordinate deliveries of mechanical materials and equipment to minimize construction site congestion. Limit each shipment of materials and equipment to the items and quantities needed for the smooth and efficient flow of installations.
- F. Provide factory-applied plastic end-caps on each length of pipe and tube. Maintain end-caps through shipping, storage and handling to prevent pipe-end damage and prevent entrance of dirt, debris and moisture.
- G. Protect stored ductwork, pipes and tubes. Elevate above grade and enclose with durable, waterproof wrapping. When stored inside, do not exceed structural capacity of the floor.
- H. Protect flanges, fittings and specialties from moisture and dirt by inside storage and enclosure, or be packaging with durable, waterproof wrapping.
- I. Protect sheet metal ductwork and fittings. Elevate and store above grade and cover ends with waterproof wrapping.

1.18 ROUGH-IN:

- A. Verify final locations for rough-ins with field measurements and with the requirements of the actual equipment to be connected.
- B. Refer to equipment shop drawings and manufacturer's requirements for actual provided equipment for rough-in requirements.
- C. Work through all coordination before rough-in begins.

1.19 ACCESSIBILITY:

- A. Install equipment and materials to provide required access for servicing and maintenance. Coordinate the final location of concealed equipment and devices requiring access with final location of required access panels and doors. Allow ample space for removal of all parts that require replacement or servicing.

1.20 EXCAVATING AND BACKFILLING:

A. General:

1. Provide all necessary excavation and backfill for installation of mechanical work in accordance with Division 2.
2. In general, follow all regulations of OSHA as specified in Part 1926, Subpart P, "Excavations, Trenching and Shoring." Follow specifications of Division 23 as they refer specifically to the mechanical work.

B. Contact Owners of all underground utilities to have them located and marked, at least 2 business days before excavation is to begin. Also, prior to starting excavation brief employees on marking and color codes and train employees on excavation and safety procedures for natural gas lines. When excavation approaches gas lines, expose lines by carefully probing and hand digging.

C. Pipe Trenching:

1. Provide all necessary pumping, cribbing and shoring.
2. Walls of all trenches shall be a minimum of 6 inches clearance from the side of the nearest mechanical work. Install pipes with a minimum of 6 inches clearance between them when located in same trench.
3. Dig trenches to depth, width, configuration, and grade appropriate to the piping being installed. Dig trenches to 6 inches below the level of the bottom of the pipe to be installed. Install 6 inches bed of pea gravel or squeegee, mechanically tamp to provide a firm bed for piping, true to line and grade without irregularity. Provide depressions only at hubs, couplings, flanges, or other normal pipe protrusions.

D. Backfilling shall not be started until all work has been inspected, tested and accepted. All backfill material shall be reviewed by the soils engineer. In no case shall lumber, metal or other debris be buried in with backfill.

1. Provide warning tape for marking and locating underground utilities. Tape shall be specifically manufactured for this purpose and shall be polyethylene film, 6 inches wide, 0.004 inches thick and have a minimum strength of 1750 psi. Tape shall carry continuous inscription naming the specific utility.
 - a. Tape shall have magnetic strip and be used for exterior underground system only.

E. Trench Backfill:

1. Backfill to 12 inches above top of piping with pea gravel or squeegee, the same as used for piping bed, compact properly.
2. Continue backfill to finish grade, using friable material free of rock and other debris. Install in 6 inch layers, each properly moistened and mechanically compacted prior to installation of ensuing layer. Compaction by hydraulic jetting is not permissible.

F. After backfilling and compacting, any settling shall be refilled, tamped, and refinished at this contractor's expense.

G. This contractor shall repair and pay for any damage to finished surfaces.

- H. Use suitable excavated material to complete the backfill, installed in 6 inch lifts and mechanically compacted to seal against water infiltration. Compact to 95 percent for the upper, 30 inches below paving and slabs and 90 percent elsewhere.

1.21 NAMEPLATE DATA:

- A. Provide permanent operational data nameplate, refer to the section on Mechanical Identification, on each item of mechanical equipment, indicating manufacturer, product name, model number, serial number, capacity, operating and power characteristics, labels of tested compliances, and similar essential data. Locate nameplates in an accessible location. Coordinate with Owner for specific requirements.

1.22 LUBRICATION OF EQUIPMENT:

- A. Refer to Division 1. The following paragraphs supplement the requirements of Division 1.
- B. Contractor shall properly lubricate all mechanical pieces of equipment which he provided before turning the building over to the Owner. He shall attach a linen tag or heavy duty shipping tag on the piece of equipment showing the date of lubrication and the type and brand of lubricant used.
- C. Furnish the Engineer with a typewritten list included in the O&M manuals of each item lubricated and type of lubricant used, no later than two (2) weeks before completion of the project, or at time of acceptance by the Owner of a portion of the building and the mechanical systems involved.

1.23 CLEANING:

- A. Refer to Division 1.
- B. Refer to Division 23, "TESTING, ADJUSTING AND BALANCING" for requirements for cleaning filters, and mechanical systems prior to final acceptance.

1.24 RECORD DOCUMENTS:

- A. Refer to Division 1. The following paragraphs supplement the requirements of Division 1.
- B. Keep a complete set of record document prints in custody during entire period of construction at the construction site. Documents shall be updated on a weekly basis.
- C. Mark Drawing Prints to indicate revisions to piping and ductwork, size and location both exterior and interior; including locations of coils, dampers and other control devices, filters, boxes, and similar units requiring periodic maintenance or repair; actual equipment locations, dimensioned from column lines; actual inverts and locations of underground piping; concealed equipment, dimensioned to column lines; mains and branches of piping systems, with valves and control devices located and numbered, concealed unions located, and with items requiring maintenance located; Change Orders; concealed control system devices. Changes to be noted

on the drawings shall include final location of any piping or ductwork relocated more than 1foot-0inches from where shown on the drawings.

- D. Mark shop drawings to indicate approved substitutions; Change Orders; actual equipment and materials used.
- E. Mark equipment and fixture schedules on drawings to indicate manufacturer and model numbers of installed equipment and fixtures.
- F. Reference to change order numbers, RFIs, etc., are not acceptable as-builts.
- G. Revisions to the Contract Documents shall be legible and shall be prepared using the following color scheme:
 - 1. Red shall indicate new items, deviations and routing.
 - 2. Green shall indicate items removed or deleted.
 - 3. Blue shall be used for relevant notes and descriptions.
- H. At the completion of the project, obtain from the Architect a complete set of the Mechanical Contract Documents in a read-only electronic format (.pdf unless otherwise noted). This set will include all revisions officially documented through the Architect/Engineer. Using the above color scheme, transfer any undocumented revisions from the construction site record drawings to this complete set. Submit completed documents to the Architect/Engineer. This contract will not be considered completed until these record documents have been received and reviewed by the Architect/Engineer.
- I. Contractor may propose methods of maintaining record documents on electronic media. Obtain approval of Engineer and Owner prior to proceeding. Marked-up .pdf format readable by Bluebeam is preferred.

1.25 OPERATION AND MAINTENANCE DATA:

- A. Refer to Division 1.
- B. No later than four (4) weeks prior to the completion of the project provide one complete set of Operating and Maintenance Manuals, or as specified in Sections of Division 1 (whichever is more stringent).
- C. The testing and balancing report shall be submitted and received by the Engineer at least fifteen calendar days prior to the contractor's request for final observation time frame requirements. Include in the O & M Manual after review with "No Exceptions Taken" has been accomplished.
- D. In addition to the information required by Division 1 for Maintenance Data, include the following information:
 - 1. The job name and address and contractor's name and address shall be identified at the front of the electronic submittal.
 - 2. Description of mechanical equipment, function, normal operating characteristics and limitations, performance curves, engineering data and tests, and complete nomenclature and commercial numbers of all replaceable parts.

3. Manufacturer's printed operating procedures to include start-up, break-in, routine and normal operating instructions; regulation, control, stopping, shut-down, and emergency instructions; and summer and winter operating instructions. Provide any test reports and start-up documents.
4. Maintenance procedures for routine preventative maintenance and troubleshooting; disassembly, repair, and reassembly; aligning and adjusting instructions.
5. Servicing instructions, lubrication charts and schedules, including Contractor lubrication reports.
6. Manufacturer's service manuals for all mechanical equipment provided under this contract.
7. Name, Address and Telephone numbers of the Sub-contractors and local company and party to be contacted for 24-hour service and maintenance for each item of equipment.
8. Starting, stopping, lubrication, equipment identification numbers and adjustment clearly indicated for each piece of equipment.
9. Complete recommended spare parts list.
10. Mechanical System and Equipment Warranties.
11. Copies of all test reports shall be included in the manuals.
12. Provide manuals with dividers for major sections and special equipment. Mark the individual equipment when more than one model or make is listed on a page. Provide detailed table of contents.
13. Final schedule of values with all mechanical change order costs included and identified.
14. Contractor may propose methods of maintaining record documents on electronic media. Obtain approval of Engineer and Owner prior to proceeding. Marked-up PDF format readable by Bluebeam is preferred.

1.26 PROJECT CLOSEOUT List:

- A. In addition to the requirements specified in Division 1, complete the requirements listed below.
- B. The Contractor shall be responsible for the following Mechanical Submittal Checklist either by performing and/or coordinating such items prior to applying for certification of substantial completion. Refer to individual specification sections for additional requirements. (Checklist is located at the end of this section.)

1.27 WARRANTIES:

- A. Refer to the Division 1 for procedures and submittal requirements for warranties. Refer to individual equipment specifications for warranty requirements. In any case the entire mechanical system shall be warranted no less than one year from the time of acceptance by the Owner.
- B. Compile and assemble the warranties specified in Division 21, 22, and 23, into the Operating and Maintenance Manuals.
- C. Provide complete warranty information for each item to include product or equipment to include date or beginning of warranty or bond; duration of warranty or bond; and names,

addresses, and telephone numbers and procedures for filing a claim and obtaining warranty services.

1.28 CONSTRUCTION REQUIREMENTS:

- A. The contractor shall maintain and have available at the jobsite current information on the following at all times:
1. Up to date record drawings.
 2. Submittals
 3. Site observation reports with current status of all action items.
 4. Test results; including recorded values, procedures, and other findings.

1.29 MECHANICAL SUBMITTAL CHECKLIST:

Spec Section	Item	Requirements							
		Submittals			Supplemental		Factory Rep Super-Vision At Site	Training Req'd At Site	Extra Material
		Shop Drawings	Product Data	Include In O & M	Test ³	Report ³			
23 0500	Preliminary Schedule Of Values					X			
23 0500	Final Schedule Of Values			X		X			
23 0500	Equipment Warranties			X					
23 0500	O&M Manuals		X	X		X			X
23 0500	Record Drawings	X	X	X					
230507	Motors, Drives, Motor Controllers	X	X	X					
230509	Mechanical Fire Stopping	X	X	X				X	
230510	Basic Piping Materials And Methods		X	X	X	X			
230529	Hangers and Supports	X	X	X					
230548	Vibration and Seismic Control	X	X	X	X	X			
230553	Mechanical Identification		X	X					X
230593	Testing ,Adjusting and Balancing	X		X	X	X			
230700	Mechanical Insulation		X	X					
230800	Mechanical Commissioning			X		X			

Spec Section	Item	Requirements							
		Submittals			Supplemental		Factory Rep Super-Vision At Site	Training Req'd At Site	Extra Material
		Shop Drawings	Product Data	Include In O & M	Test ³	Report ³			
230900	Instrumentation and Control for Mechanical	X	X	X		X	X	X	
230993	Sequence Of Operation			X					
233113	Metal Ducts	X	X	X	X	X			
233300	Air Duct Accessories		X	X		X			X
233400	HVAC Fans		X	X				X	X
233600	Air Terminals Units		X	X					
233713	Diffusers, Registers & Grilles		X	X					X
238000	Decentralized HVAC Equipment		X	X					X
238126	Split Systems		X	X					
Notes: ¹ For Starters and Variable Frequency Drives ² Requires Review & Approval of calibrated balance valves from T & B Contractor ³ See Specific Specification Section for Test & Certification Requirements									

1.30 mechanical EQUIPMENT CONNECTION SCHEDULES:

A. Mechanical Equipment:

1. Refer to Mechanical Equipment Schedules on the drawings.
2. All equipment motors and control shall be furnished, set in place, and wired in accordance with the schedule coordinated by the contractor and submitted prior to bid. The exact furnishing and installation of the equipment is left to the Contractors involved and manufacturers installation instructions. Contractor should note that the intent of this schedule is to have the Contractor responsible for coordinating all wiring as outlined, whether or not specifically called for by the Division 23 or Division 26 drawings and specifications. Comply with the applicable requirements of Division 26 for all electrical work which is not otherwise specified. No extras will be allowed for contractor's failure to provide for these required items. Contractor shall refer to the Division 26 and Division 23 specifications and plans for all power and control wiring and shall advise the Architect/Engineer of any discrepancies prior to bidding.

ITEM SUBMITTAL TO BE FILLED OUT BY CONTRACTOR PRIOR TO BID	FURNISHED BY	SET BY	CONTROL WIRING (non-load voltage)
1. Mechanical Equipment Motors			

ITEM SUBMITTAL TO BE FILLED OUT BY CONTRACTOR PRIOR TO BID	FURNISHED BY	SET BY	CONTROL WIRING (non-load voltage)
2. Special Equipment (i.e., elevators, etc.) a. Motors b. Magnetic Motor Starters c. Disconnect Switches d. Thermal OL Switches e. Manual Operating Switches			
3. Motor Starters, combination motor starter/disconnect and Variable Frequency Drives a. Automatically controlled, with or without HOA switches. b. Manually controlled. c. Starters integral with motor control center including control relays and transformers. d. Combination Starter/Disconnects			
4. Pushbutton stations, pilot lights			
5. Disconnect switches, thermal overload switches, manual operating switches.			
6. Multi-speed switches			
7. Control relays, transformers.			
8. Non-load voltage control items.			
9. Electric thermostats, remote bulb thermostats, motor valves, float controls, etc., which are an integral part of mechanical equipment or directly attached to ducts, pipes, etc.			
10. Motor valves, damper motor, solenoid valves, EP and PE switches, VAV box controls, actuators, etc.			
11. Control circuit outlets			
a. Load voltage control items such as line voltage thermostats not connected to control panel systems.			
b. Non-load voltage control items.			
c. Electric thermostats, remote bulb thermostats, motor valves, float controls, etc., which are an integral part of mechanical equipment or directly attached to ducts, pipes, etc.			
d. Motor valves, damper motor, solenoid valves, EP and PE switches, VAV box controls, actuators, etc.			
e. Control circuit outlets			

ITEM SUBMITTAL TO BE FILLED OUT BY CONTRACTOR PRIOR TO BID	FURNISHED BY	SET BY	CONTROL WIRING (non-load voltage)
12. Electric thermostats, remote bulb thermostats, motor valves, float controls, etc., which are an integral part of mechanical equipment or directly attached to ducts, pipes, etc.			
13. Fire protection controls (Including flow switches)			
14. Duct smoke detectors, including relays for fan shutdown.			
15. Temperature Control Panel			
16. Interlocks			

G = General, Division 13 or 14
 M = Mechanical, Division 23
 E = Electrical, Division 26
 V = Vendor or Factory – Installed wiring

END OF SECTION 23 0500

SECTION 23 0507 – MOTOR, DRIVES, MOTOR CONTROLLERS AND ELECTRICAL REQUIREMENTS FOR MECHANICAL EQUIPMENT

PART 1 - GENERAL

1.01 DESCRIPTION OF WORK:

- A. This section specifies the basic requirements for electrical components which are either separate components or are an integral part of all mechanical equipment. These components include, but are not limited to starters, variable frequency drives and disconnect switches.
- B. It is the intent of this specification that one "General" Contractor enters an agreement with the Owner. The use and coordination of subcontractors is at the option of the General Contractor. All mechanical equipment, motors and controls shall be furnished, set in place, and wired. The schedule contained in Division 1 / 26 is provided as a guide only. The exact furnishing and installation of the equipment is left to the Contractors involved. Contractor should note that the intent of the schedule is to have the Division 23 and 26 Contractors responsible for coordinating all control wiring as outlined, whether or not specifically called for by the mechanical or electrical drawings and specifications. Comply with the applicable requirements of Division 26 for all electrical work which is not otherwise specified. No extras will be allowed for Contractor's failure to provide for these required items. The Contractor shall refer to the Division 26 and Division 23 specifications and plans for all power and control wiring and shall advise the Architect/Engineer of any discrepancies prior to bidding.
- C. Starters and disconnecting means are required for all mechanical equipment provided under Divisions 22 and 23. Equipment with built in starters and disconnects shall be sized and provided with the equipment. For equipment that required external starters and disconnecting means these shall be sized and provided with the equipment. Coordinate with Electrical Contractor.
- D. Wiring of field-mounted switches and similar mechanical-electrical devices provided for mechanical systems, to equipment control panels.
- E. Refer to electrical drawings and specifications for specific electrical requirements pertaining to mechanical equipment scheduled on the Electrical Drawings. In case of conflict, Electrical Drawings shall take precedence. Do not purchase motors or electrical equipment until power characteristics available at building site location have been confirmed by Contractor. Provide equipment that meets all of the electrical requirements including but not limited to:
 - 1. Voltage and number of phases
 - 2. Circuit Ampacity,
 - 3. Maximum Overcurrent protection
 - 4. Short Circuit Current Rating.
 - 5. Wire size listed. Provide lugs with the ability to terminate the provided wire size at each piece of equipment.

As a minimum provide nameplate with the above information for each piece of equipment.

- F. SCCR at incoming terminals and throughout the equipment shall be rated for the available fault current at the equipment as indicated and/or required. In addition to meeting NEC requirements, including 450.52 and 450.53, provide one of the following two options based on the equipment configuration:
 - 1. Provide individual fused disconnects rated for the available short circuit current at the disconnect with current limiting fuses supplying mechanical equipment and packaged equipment (for example; a single piece of equipment or starter, a packaged piece of equipment such as a rooftop unit, etc.). See Division 26 requirements for disconnects, fuses, available short circuit values, etc. SCCR of the equipment can be rated for the let thru of the fuse WHEN the equipment does not have a main or other circuit breaker that provides additional levels of branch circuit/short circuit protection AND if acceptable to the authority having jurisdiction.
 - 2. Provide fully rated devices with the appropriate interrupting rating above the available fault current levels for circuits feeding equipment that contain an overcurrent device such as a main or other circuit breakers that provide additional levels of branch circuit or short circuit protection (for example: circuit breakers provided for multiple motors, VFD's, etc. The nameplate on this type of equipment shall indicate an SCCR above the available fault level at the equipment.
 - 3. Equipment protection schemes shall be submitted with equipment cutsheets/shop drawings.
- G. Refer to Table in Division 26 for Mechanical/Electrical coordination.
- H. See other sections of Division 23 for vibration and seismic control requirements.
- I. Starters and disconnecting means are required for all mechanical equipment provided under Divisions 22 and 23. Equipment with built in starters and disconnects shall be sized and provided by unit manufacturer with the equipment. For equipment that requires external starters and disconnecting means these shall be sized and provided with the equipment. Coordinate with Electrical Contractor.

1.02 QUALITY ASSURANCE:

- A. Manufacturers: Firms regularly engaged in manufacture of motors, motor starters and drives of types, ratings and characteristics required, whose products have been in satisfactory use in similar service for not less than 5 years.
- B. Single Manufacturer: All variable frequency drives and starters for the project shall be by a single manufacturer, including packaged equipment.
- C. Installer's Qualifications: Firm with at least 3 years of successful installation experience on projects utilizing motors, motor starters, capacitors and drives similar to that required for this project.

- D. NEC Compliance: Comply with NEC as applicable to wiring methods, construction and installation of motors, motor starters, capacitors and drives.
 - E. NFPA Compliance: Comply with applicable requirements of NFPA 70E, "Standard for Electrical Safety Requirements for Employee Workplaces".
 - F. UL Compliance: Comply with applicable requirements of UL 486A, "Wire Connectors and Soldering Lugs for Use with Copper Conductors", and UL 508, "Electrical Industrial Control Equipment" pertaining to installation of motor starters.
 - G. UL Compliance: Provide equipment and components which are UL-listed and labeled.
 - H. ETL Compliance: Provide equipment and components which are ETL-listed and labeled.
 - I. IEEE Compliance: Comply with applicable requirements of IEEE including Std 241, "Recommended Practice for Electric Power Systems in Commercial Buildings" pertaining to motor starters and Std 519.
 - J. NEMA Compliance: Comply with applicable requirements of NEMA including Standard ICS 2, "Industrial Control Devices, Controllers and Assemblies", and Pub No. 250, "Enclosures for Electrical Equipment (1000 Volts Maximum)", pertaining to motor controllers/starters and enclosures.
 - K. In addition comply with the following standards:
 - 1. NEMA Standards MG 1: Motors and Generators.
 - 2. NEMA Standard ICS 2: Industrial Control Devices, Controllers, and Assemblies.
 - 3. NEMA Standard 250: Enclosures for Electrical Equipment.
 - 4. NEMA Standard KS 1: Enclosed Switches.
 - L. Comply with National Electrical Code (NFPA 70).
 - M. Coordination with Electrical Work: Wherever possible, match elements of electrical provisions of mechanical work with similar elements of electrical work specified in Division 26 sections. Comply with applicable requirements of Division 26 sections for electrical work of this section which are not otherwise specified.
- 1.03 SUBMITTALS:
- A. Product Data: Submit in accordance with Section 23 0500 "Common Work Results for Mechanical".
 - B. Shop Drawings: Submit dimensional drawings of VFD's and starters showing accurately scaled equipment layouts. Drawings shall include, as a minimum: physical dimensions of each unit; general arrangements with incoming and outgoing conduit locations, schematic; connection diagram sufficient to install system, and enclosure details.
 - C. Wiring Diagrams: Submit schematic power and control wiring diagrams, prepared for this project, of complete VFD and starter assemblies. General wiring diagrams with various non-

applicable options shown are not acceptable. Clearly differentiate between factory and field wiring.

- D. Listing, Motors of Mechanical Work: Concurrently, with submittal of mechanical products listing, submit separate listing showing rating, power characteristics, efficiencies, power factors, application and general location of every motor to be provided with mechanical work. Submit updated information promptly when and if initial data is revised.
 - 1. Include in listing of motors, notations of whether motor starter is furnished or installed integrally with equipment containing motor or separately from equipment.
- E. Electrical coordination listing. Provide the following information for each field wired electrical power connection. Information shall use nameplate data and nomenclature of actual installed nameplates. Information should list as a minimum:
 - 1. Field connection details such as maximum/minimum wire size lugs can accommodate. Include number of lugs per phase.
 - 2. Number and location of field connections.
 - 3. Field interconnection wiring.
 - 4. Nameplate Information, as a minimum include:
 - a. Operating voltage and phase.
 - b. Maximum fuse size (MFS) or maximum overcurrent protection size (MOP)(as applies).
 - c. Minimum circuit ampacity (MCA).
 - d. Full load amperes (FLA).
 - e. Short Circuit Current Rating (SCCR).
 - 5. Locked rotor current (LRA) and duration for high inertia equipment.
 - 6. Manufacturers recommended overload setting (if applicable).
- F. The contractor shall fully coordinate these items with all subcontractors prior to submittal.
- G. Equipment provided shall match electrical equipment and protection/distribution sizes and be rated for available short circuit currents as shown on the drawings.

1.04 PRODUCT STORAGE:

- A. All variable frequency drives, starters, etc. shall be protected from dirt, debris, and moisture at all times. Variable frequency drives shall be wrapped air and water tight with dust-tight and moisture proof material until factory start-up of variable frequency drives is initiated.
 - 1. Exception: Drives may be opened only during wiring terminations by temperature control contractor and/or electrical contractors.
- B. All motors not designed for exposure to water or moisture shall be protected at all times.

PART 2 - PRODUCTS

2.01 MANUFACTURERS:

- A. Subject to compliance with requirements, provide products by one of the following manufacturers for each type of product:
1. Motors
 - a. Century/MagneTek
 - b. Baldor
 - c. Reliance
 - d. Westinghouse
 - e. Siemens
 - f. General Electric
 - g. Louis Allis
 - h. Lincoln
 - i. U.S. Motors
 - j. Square D
 2. Starters
 - a. Cutler Hammer
 - b. Allen-Bradley
 - c. Sprecher & Schuh
 - d. Square D
 - e. Eaton
 - f. Siemens
 - g. GE
 - h. Greenheck
 - i. Schneider Electric
 3. Variable Frequency Drives
 - a. Robicon
 - b. ABB
 - c. Reliance
 - d. Allen-Bradley
 - e. Square D
 - f. Toshiba
 - g. Graham
 - h. Eaton
 - i. Cutler Hammer
 - j. Siemens
 - k. Yaskawa
 - l. Danfoss

2.02 MOTORS:

- A. The following are basic requirements for simple or common motors.
1. Torque characteristics shall be sufficient to satisfactorily accelerate the driven loads with a time limit acceptable to the motor manufacturer. Motors shall be capable of starting the driven equipment while operating at 90 percent rated terminal voltage.

2. Motor sizes shall be large enough so that the driven load will not require the motor to operate in the service factor range.
3. Temperature Rating: Rated for 40 degrees C environment with maximum 80 degrees C temperature rise for continuous duty at full load (Class B Insulation). Provide Class F insulation for variable frequency drive motors.
4. Starting capability: Frequency of starts as indicated by automatic control system, and not less than 5 evenly timed spaced starts per hour for manually controlled motors.
5. Service Factor: 1.15 for poly-phase motors, 1.35 for single phase motors, and 1.0 for inverter duty motors.
6. Motor construction: NEMA Standard MG 1, general purpose, continuous duty, Design "B", except "C" where required for high starting torque. Design "E" shall not be used.
 - a. Frames: NEMA Standard No. 48 or 54; Use driven equipment manufacturer's standards to suit specific application.
 - b. Bearings:
 - Ball bearings with inner and outer shaft seals.
 - Re-greasable, except permanently sealed where motor is normally inaccessible for regular maintenance.
 - Bearings shall be rated for minimum L-10 life of 40,000 hours.
 - Designed to resist thrust loading where belt drives or other drives produce lateral or axial thrust in motor.
 - For fractional horsepower, light duty motors, sleeve type bearings are permitted.
 - c. Enclosure Type:
 - Open drip-proof motors for indoor use where satisfactorily housed or remotely located during operation.
 - d. Overload protection: Built-in thermal overload protection for all single phase motors and, where indicated, internal sensing device suitable for signaling and stopping motor at starter.
 - e. Noise rating: "Quiet".
 - f. Efficiency: All motors shall be NEMA premium efficiency motors, in accordance with Table 12-11 and Table 12-12 of NEMA MG 1-2011 and the US-DOE Premium Efficiency Motor Selection and Application Guide.
 - g. Nameplate: indicate the full identification of manufacturer, ratings, characteristics, construction, special features and similar information.
7. Phases and Current Characteristics: Unless indicated otherwise, provide squirrel-cage induction polyphase motors for 3/4 hp and larger, and provide capacitor-start single-phase motors for 1/2 hp and smaller, except 1/6 hp and smaller may, at equipment manufacturer's option, be split-phase type. Tri-voltage motors are not acceptable. Coordinate current characteristics with power specified in Division 26 sections. Do not purchase motors until power characteristics available at building site have been confirmed by contractor.
8. The Contractor shall be responsible for all additional electrical and other costs involved to accommodate any motors which differ from the scheduled horsepower sizes or correct any motor which does not meet the listed efficiency as called for in mechanical or electrical plans and specifications.

9. Motors shall be of the same manufacturer, except those that are an integral part of a factory assembled packaged unit. These motors shall likewise meet the conditions of the specification in this section except motors which are part of a motor/compressor assembly are exempted from this requirement.
10. All equipment specified to operate with variable frequency drives shall be provided with inverter-duty motors specifically designed for variable speed operation with high efficiency at part load conditions and constructed with Class F inverter grade insulation. Inverter duty motors shall meet requirements of NEMA MG-1 Part 31.
11. All motors which will be operated by a variable frequency drive shall be warranted against any damage or defects as a result of being used with a variable frequency drive.

2.03 STARTERS, ELECTRICAL DEVICES AND WIRING:

A. Motor Starter Characteristics:

1. Coordinate with the Electrical Contractor for motor control center starters provided by Division 26.
2. Enclosures: NEMA 1, general purpose enclosures with padlock ears, except in wet locations shall be NEMA 3R with conduit hubs, or units in hazardous locations which shall have NEC proper class and division.
3. Type and size of starter shall be as recommended by motor manufacturer and the driven equipment manufacturer for applicable protection and start-up condition.

B. Manual Switches:

1. See Division 26 for electrical requirements, provide control devices as required for sequence of operation and/or equipment specifications.

C. Combination Magnetic Starters:

1. Unless otherwise indicated, provide magnetic starters including disconnects, fuses, overloads, contacts and coils for all 1-phase motors where interlock or automatic operation is indicated or required:
 - a. Provide equipment with Short Circuit Current Rating (SCCR) above available fault current.
 - b. Adjustable motor overload. Select range so that upper limit is no more than 150 percent of the connected motor full load amps.
 - c. Interlocks, auxiliary contacts, and similar devices as required for coordination with control requirements of Division-23 Controls sections.
 - d. H-O-A selector
 - e. Pilot lights for "power on" and "run" status.
 - f. Mount starter and all appurtenances in a NEMA enclosure suitable for the environment.
2. Unless otherwise indicated, provide NEMA style, sized and rated 75 degrees C combination magnetic starters including disconnects, overloads, fuses, contacts and coils for all 3-phase motors. In addition to the requirements listed above for 1-phase motors provide the following features:
 - a. Built-in 120 volt control circuit transformer, fused from line side, where service exceeds 120 volts.

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- b. Maintained contact H-O-A push buttons or selector switch, and pilot lights shall be located on the cover of the enclosure, properly arranged for single speed or multi-speed operation as indicated. H-O-A shall be suitable to provide a monitor point to the Building Automation System where required.
- c. Electronic motor overload protection including thermal modeling type thermal protection, Ground fault protection, individual monitoring of motor current in each phase, and a wide FLA adjustment with selectable trip.
- d. Each starter shall be provided with a minimum of (4) four sets of auxiliary contacts, (2) two normally open & (2) two normally closed.
- e. All 3-phase motors shall be protected against loss of phase wired into the starter utilizing a solid state 3 phase monitor that senses each phase and is capable of automatic restart of equipment when adverse condition clears.
- f. All 3-phase motors shall be provided with Over and Under voltage protection. The ability for automatic re-start of equipment shall be provided. Settings shall be 110% for overvoltage and 80-90% for under voltage unless stated otherwise on the motor data sheets
- g. All 3-phase motors shall be protected against Voltage and current unbalance. Settings shall be 10-15% of FLA for current unbalance alarm with 5-10 second delay and 20-25% of FLA for current unbalance trip with 2-5 second delay unless otherwise stated on the motor data sheets,
- h. HOA switch

D. Motor connections:

- 1. PVC jacketed liquid-tight flexible metallic conduit with liquid tight connectors., except where plug-in electrical cords are specifically indicated.

2.04 DISCONNECT SWITCHES:

- A. See Division 26 for electrical requirements, coordinate disconnect switch selection, installation, and wiring for equipment being provided.

2.05 VARIABLE FREQUENCY DRIVES:

- A. The drive package as specified herein and defined on the drive schedule shall be enclosed in a UL Type enclosure (enclosures with only NEMA ratings are not acceptable), completely assembled and tested by the manufacturer to ISO9001 standards.
- B. The drive shall provide full rated output from a line of +10% to -15% of nominal voltage. The drive shall continue to operate without faulting from a line of +25% to -35% of nominal voltage.
 - 1. Drives shall be capable of continuous full load operation under the following environmental operating conditions:
 - a. Ambient Temperature: 5 to 104°F
 - b. Altitude 0 to 3,300 ft above sea level.
 - c. Humidity 5 to 95° non-condensing.
 - 2. Drive sizes shall be adjusted as required to meet the project site elevation.
- C. All drives shall utilize the same Advance Control Panel (keypad) user interface.

1. Plain English Text
 - a. The display shall be in complete English words for programming and fault diagnostics. (alpha-numeric codes are not acceptable)
 - b. Safety interlock and run permissive status shall be displayed using predetermined application specific nomenclature, such as: Damper end switch, smoke alarm, vibration trip and overpressure.
 - c. Safety interlock, run permissive, and external fault status shall have the option of additional customized project specific terms, such as: AHU-1 End Switch, Office Smoke Alarm, CT-2 Vibration.
2. The control panel shall include at minimum the followings controls:
 - a. Four navigation keys (Up, Down, Left, Right) and two soft keys to simplify operation and programming.
 - b. Hand-Off-Auto selections and manual speed control without having to navigate to a parameter.
 - c. Fault Reset and Help keys. The Help key shall include assistance for programming and troubleshooting.
3. Multiple Home View screens shall be capable of displaying up to 21 points of information. Customizable modules shall include bar charts, graphs, meters, and data lists. Displays shall provide real time graphical trending of output power, frequency, and current within selectable intervals of 15/30/60 minutes and 24 hours.
4. The control panel shall display the following items on a single screen; output frequency, output current, reference signal, drive name, time, and operating mode (Hand vs Auto, Run vs Stop). Bi-color (red/green) status LED shall be included. Drive (equipment) name shall be customizable.
5. There shall be a built in time clock in the control panel. The clock shall have a battery backup with 10 years minimum life span. Daylight savings time shall be selectable.
6. I/O Summary display with a single screen shall indicate and provide:
 - a. The status/values of all analog inputs, analog outputs, digital inputs, and relay outputs. Drive that require access to internal or live components to measure these values, are not acceptable.
 - b. The programmed function of all analog inputs, analog outputs, digital inputs, and relay outputs.
 - c. The ability to force individual digital I/O high or low and individual analog I/O to desired value, for increased personal protection during drive commissioning and troubleshooting. Drives that require access to internal or live components to perform these functions, are not acceptable.
7. The drive shall automatically backup parameters to the control panel. In addition to the automatic backup, the drive shall allow two additional unique backup parameter sets to be stored. Backup files shall include a time and date stamp. In the event of a drive failure, the control panel of the original drive can be installed on the replacement drive, and parameters from that control panel can be downloaded into the replacement drive.
8. The control panel shall display local technical support contract information as part of drive fault status.
9. The control panel shall be removable, capable of remote mounting.
10. The control panel shall have the ability to store screen shots, which are downloadable via USB.

11. The control panel shall have the ability to display a QR code for quick access to drive information.
 12. The LCD screen shall be backlit with the ability to adjust the screen brightness and contrast with inverted contrast mode. A user selectable timer shall dim the display and save power when not in use.
 13. The control panel shall include assistants specifically designed to facilitate start up. Assistants shall include: First Start Assistant, Basic Operation, Basic Control, and PID Assistant.
 14. Primary settings for HVAC shall provide quick set up of all parameters and customer interfaces to reduce programming time.
 15. The drive shall be able to operate with the control panel removed.
 16. The drive shall be able to support a Bluetooth Advanced Control Panel. The Bluetooth control panel shall be FCC and QDL (Qualified Design Listing) certified.
 - a. A fee app (iOS and Android) shall replicate the control panel on a mobile device or tablet. The control panels programming and control functionality shall function on the device. Customizing text, such as AHU-1 End Switch, shall be supported by the devices; keyboard.
 - b. Bluetooth connectivity shall allow uploading, downloading, and emailing of parameter sets.
 - c. Bluetooth connectivity shall include two pairing modes: Always discoverable with a fixed passcode, and manual discovery with a unique generated passcode every pairing.
 - d. The Bluetooth antenna shall be in the control panel. Antennas that are integrated in the drives control board, must include an external antenna, on all drives mounted inside cabinets.
 - e. Bluetooth connectivity shall be capable of being switched off.
- D. All drives shall have the following hardware features/characteristics as standard:
1. Two (2) programmable analog inputs shall accept current or voltage signals. Current or Voltage selection configured via control panel. Drives that require access to internal components to perform these functions, are not acceptable.
 2. Two (2) programmable analog outputs. At least one of the analog outputs shall be adjustable for current or voltage signal, configured via control panel. Drives that require access to internal components to perform these functions, are not acceptable.
 3. Six (6) programmable digital inputs. All digital inputs shall be programmable to support both active high and active low logic and shall include adjustable on/off time delays. The digital input shall be capable of accepting both 24 VDC and 24 VAC.
 4. Three (3) programmable Form-C relay outputs. The relay outputs shall include programmable on/off time delays. The relays shall be rated for a continuous current rating of 2 Amps. Maximum switching voltage of 250 VAC/30 VDC. Open collector and Form-A relays are not acceptable. Drives that have less than (3) Form-C relay outputs shall provide an option card to provide additional relay outputs.
 5. Drive terminal blocks shall be color coded for easy identification of function
 6. The drive shall include an isolated USB port for interface between the drive and a laptop. A non-isolated USB port is not acceptable.
 7. An auxiliary power supply rated at 24 VDC, 250 mA shall be included.

8. At a minimum, the drives shall have internal impedance equivalent to 5% to reduce the harmonics to the power line. 5% impedance may be from dual (positive and negative DC link) chokes, or AC line reactor. Drives with only one DC link choke shall add an AC line choke integral to the drive enclosure. Refer to schedules to determine if additional harmonic mitigation is required for the system to comply with IEEE 519-2014. At minimum drive to have 5% current distortion.
 9. The drive shall have cooling fans that are designed for field replacement. The primary cooling fan shall operate only when required and be variable speed for increased longevity and lower noise levels. Drives whose primary cooling fans are not variable speed, shall include a spare cooling fan.
 10. The overload rating of the drive shall be 110% of its normal duty current rating for 1 minute every 10 minutes, 130% overload for 2 seconds every minute. The minimum current rating shall meet or exceed the values in the NEC/UL table 430.250 for 4-pole motors.
 11. The input current rating of the drive shall not be greater than the output current rating. Per NFPA 70 430.122, drives with higher input current ratings may require the upstream wiring, protection devices, and source transformers to be upsized.
 12. Circuit boards shall be coated per IEC 60721-3-3; Chemical gasses Class 3C2 and Solid particles Class 3S2.
 13. Earth (ground) fault detection shall function in both modulating (running) and non-modulating modes.
 14. Coordinated AC transient surge protection system consisting of 4 MOVs (phase-to-phase and phase-to-ground), a capacitor clamp, and internal chokes. The MOVs shall comply with UL 1449 4th Edition. Drives that do not include coordinated AC transient surge protection shall include an external TVSS/SPD (Transient Voltage Suppressor/Surge Protection Device).
 15. The drive shall include a robust DC bus to provide short term power-loss ride through. The DC bus Joule to drive kVA rating shall be 4.5 J/kVA or higher. An inertia-based ride through function should help maintain the DC bus voltage during power loss events. Drives with control power ride through only, are not acceptable.
- E. All drives shall have the following software features as standard:
1. A Fault Logger that stores the last 16 faults in non-volatile memory
 - a. The most recent 5 faults save at least 9 data points, including but not limited to: Time/date, frequency, DC bus voltage, motor current, DI status, temperature and status words.
 - b. The date and time of each fault and fault reset attempt shall be stored in the Fault Logger.
 2. An Event Logger that stores the last 16 warnings or events that occurred, in non-volatile memory
 - a. Events shall include, but not limited to: Warning messages, checksum mismatch, run permissive open, start interlock open and automatic reset of a fault.
 - b. The date and time of each event's start and completion points shall be stored in the Event Logger.
 3. Programmable start method. Start method shall be selectable based on the application: Flying-start, Normal-start, and Brake-on-start.

4. Programmable loss of load (broken belt/coupling) indication. Indication shall be selectable as a control panel warning, relay output, or over network communications. This function to include a programmable time delay to eliminate false loss of load indications.
5. Motor heating function to prevent condensation build up in the motor. Motor heating adjustment, via parameter, shall be in "Watts." Heating functions based only on "percent current" are not acceptable.
6. Advanced power metering abilities shall be included in the drive. Drives without these data points, must include a separate power meter with each drive.
 - a. Instantaneous output power (kW)
 - b. Total power, broken down by kWh, MWh, and GWh units of measurement. Power meters that only display kWh and roll over or "max out" once the maximum kWh value is reached, are not acceptable. There shall be resettable and non-resettable total power meters within the drive.
 - c. Time based kWh metering for: current hour, previous hour, current day, and previous day.
 - d. Energy saving calculation shall be included that shows the energy and dollars saved by the drive.
7. The drive shall include a motor flux optimization circuit that will automatically reduce applied motor voltage to the motor to optimize energy consumption and reduce audible motor noise.
8. Run permissive circuit – There shall be a run permissive circuit for damper or valve control. Regardless of the source of a run command, the Drives shall provide a dry contact closure that will signal the damper to open. When the damper is fully open, an end switch shall close, allowing the drive to run the motor.
 - a. The drive shall also include a programmable start delay, for when an end-switch is not provided.
9. Start interlock circuit – Four separate start interlock (safety) inputs shall be provided. When any safety is opened, the motor shall be commanded to stop. The control panel will display the specific safety(s) that are open. The status of each safety shall be transmitted over the network communications. Wiring multiple safeties in series is not acceptable.
10. External fault circuit – Three separate external fault inputs shall be provided. This circuit shall have the same features and functionality as the start interlock circuit, except it shall require a manual reset before the drive is allowed to operate the motor.
11. The drive shall include a switching frequency control circuit that reduces the switching frequency based on actual drive temperature, and allows higher switching frequency settings without derating the drive. It shall be possible to set a minimum and a target switching frequency.
12. Visual function block adaptive programming allowing custom control schemes, minimizing the need for external controllers. I.e. cooling tower staging logic. A free software tool shall be used to configure adaptive programming.
13. The ability to automatically restart after an over-current, over-voltage, under-voltage, external fault, or loss of input signal protective trip. The number of restart attempts, trial time, and time between attempts shall be programmable. Each of these faults may have automatic restart individually disable via a parameter selection.

14. Three (3) programmable critical frequency lockout ranges to prevent the drive from operating the load continuously at an unstable speed/load.
15. Seven (7) programmable preset frequencies/speeds.
16. Two independently adjustable accel and decel ramps with 1=1800 seconds adjustable time ramps.
17. PID Functionality shall be included in the drive
 - a. Programmable "Sleep" and "Wake Up" functions to allow the drive to be started and stopped based on the level of a process feedback signal.
 - b. The drive shall include an independent PID loop for customer use, assigned to an analog Output. This PID loop may be used for cooling tower bypass valve control, chilled water valve, etc.
18. At least 4 parameter user sets that can be saved to the permanent memory and recalled using a digital input, timed function or supervision function.
19. Drive shall be compatible with an accessory that allows the control board to be powered from an external 24 VDC/VAC source, allowing the drive control to remain powered by a UPS during an extended power outage.
20. A computer based software tool shall be available to allow a laptop to program the drive. The drive shall be able to support programming without the need for line voltage. All necessary power shall be sourced via the laptop USB port.
21. The drive shall include a fireman's override mode. Upon receipt of a contact closure from the Fire Alarm Life Safety system, the drive shall operate in a dedicated Override mode distinct and separate from the drives Normal operation mode. The following features will be available in the drive override function:
 - a. The Override mode shall be secured by password to prevent changes once programmed.
 - b. The drive shall ignore external inputs and commands not defined as part of the override function.
 - c. Override operation mode shall be selectable between: single frequency, multiple fixed frequencies, follow an analog input signal, PID control, or come to a forced stop.
 - d. High priority safeties shall stop the drive and lower priority safeties shall be ignored in Override mode.
 - e. Drive faults shall be defined in Critical and Low priority safeties shall be ignored in override mode.
 - f. The drive shall be configurable to receive from 1 to 3 discrete digital input signals and operate at up to three discrete speeds.

F. Security Features

1. The drive manufacture shall clearly define cybersecurity capabilities for their products.
2. The drive shall include password protection against parameter changes.
 - a. There shall be multiple levels of password protection including: End User, Service, Advanced, and Override
 - b. The drive shall support a customer generated unique password between 0 and 99,999,999.
 - c. The drive shall log an event whenever the drive password has been entered.

- d. The drive shall provide a security selection that prevents any “back door” entry. This selection even prevents the drive manufacturer from being able to bypass the security of that drive.
- e. A security level shall be available that prevents the drive from being flashed with new firmware.
3. A checksum feature shall be used to notify the owner of unauthorized parameter changes made to the drive. The checksum feature includes two unique values assigned to a specific programming configuration.
 - a. One checksum value shall represent all user editable parameters in the drive except communication setup parameters. A second checksum value shall represent all user editable parameters except communication setup, energy, and motor data parameters.
 - b. Once the drive has been commissioned the two values can be independently saved in the drive.
 - c. The drive shall be configurable to either: Log an Event, Provide a Warning or Fault upon a parameter change when the current checksum value does not equal the saved checksum value.
4. The “Hand” and “Off” control panel buttons shall have the option to be individually disabled (via parameter) for drives mounted in public areas.
5. The capability to disable Bluetooth on control panels that include Bluetooth functionality shall be provided.

G. Network Communications

1. The drive shall have an EIA-485 port with removable terminal blocks. The onboard protocols shall be BACnet MS/TP, Modbus, and Johnson Controls N2. Optional communication cards for BACnet/IP, LonWorks, Profibus, profinet, EtherNet/IP, Modbus TCP, and DeviceNet shall be available. The use of third party gateways are not acceptable.
2. The drive shall have the ability to communicate via two protocols at the same time, one onboard protocol and one option card based protocol. Once installed, the drive shall automatically recognize any optional communication cards without the need for additional programming.
3. The drive shall not require a power cycle after communication parameters have been updated.
4. The embedded BACnet connection shall be a MS/TP interface. The drive shall be BTL Listed to Revision 14 or later. Use of non-BTL Listed drives are not acceptable.
5. The drive shall be classified as an Applications Specific Controller (B-ASC). The interface shall support all BIBBs defined by the BACnet standard profile for a B-ASC including, but not limited to:
 - a. Data Sharing: Read Property Multiple-B, Write Property Multiple B, COV-B
 - b. Device Management: Time Synchronization-B
 - c. Object Type Support: MSV, Loop
6. The drive’s relay output status, digital input status, analog input/output values, Hand-Auto status, warning and fault information shall be capable of being monitored over the network. The drive’s start/stop command, speed reference command, relay outputs and analog outputs shall be capable of being controlled over the network. Remote drive fault reset shall be possible.

- H. Disconnect: A disconnect switch shall be provided with each drive. The disconnect shall be door interlocked and padlockable. Drive input fusing shall be included on all packaged units that include a disconnecting means. All disconnect configuration shall be UL Listed by the drive manufacturer as a complete assembly and carry a UL508 label. Disconnect packages manufactured by anyone other than the drive manufacturer, are not acceptable.

2.06 EQUIPMENT FABRICATION:

- A. General: Fabricate mechanical equipment for secure mounting of motors and other electrical items included in work. Provide either permanent alignment of motors with equipment, or adjustable mountings as applicable for belt drives, special couplings and similar indirect coupling of equipment. Provide safe, secure, durable, and removable guards for motor drives, arranged for lubrication and similar running-maintenance without removal of guards.

PART 3 - EXECUTION

3.01 INSTALLATION:

- A. Install motors on motor mounting systems in accordance with motor manufacturer's instructions, securely anchored to resist torque, drive thrusts, and other external forces inherent in mechanical work. Secure sheaves and other drive units to motor shafts with keys and Allen set screws, except motors of 1/3 hp and less may be secured with Allen set screws on flat surface of shaft. Unless otherwise indicated, set motor shafts parallel with machine shafts.
- B. Install power and control connections for motors to comply with NEC and applicable provisions of Division 26 sections. Install grounding except where non-grounded isolation of motor is indicated.

3.02 VFD START-UP SERVICES:

- A. Provide field start-up service by an authorized factory trained service representative. The factory representative shall be trained in the maintenance and troubleshooting of the equipment as specified herein. Start-up services shall include system check-out, start-up and system run.
- B. Start-up adjustments shall include optimizing frequency, optimizing volts/Hz ratio, identifying and avoiding resonant speeds, setting accel/decel ramps, and setting overload and circuit breaker trip points.

3.03 VFD NOISE TEST:

- A. Measure the dBa sound level of the motor with the drive in by-pass mode, and with the drive operating at 25 percent, 75 percent, and 100 percent speed output.
- B. If the measurements exceed the limits specified in part 2, correct as required at no cost to the Owner, and retake measurements.

- C. Report all tests to the Engineer.

3.04 INSTALLATION COORDINATION:

- A. Furnish equipment requiring electrical connections to operate properly and to deliver full capacity at electrical service available.
- B. All control wiring to be in accordance with manufacturer's recommendations; all wiring shall be color coded to facilitate checking.

END OF SECTION 23 0507

SECTION 23 0509 – MECHANICAL FIRE STOPPING

PART 1 - GENERAL

1.01 DESCRIPTION OF WORK:

- A. Extent of firestopping required by this section is indicated on the drawings and by the requirements of this section. Refer to architectural plans and specifications for additional information.
- B. Types of firestopping systems specified in this section include:
 - 1. Bare metal pipe
 - 2. Insulated metal pipe
 - 3. Metal conduit

1.02 QUALITY ASSURANCE:

- A. Manufacturer's Qualifications: Firms regularly engaged in the manufacturing of firestopping systems for mechanical/electrical penetrations, whose products have been in satisfactory use for not less than 5 years, with published application data for all types of penetrations to be encountered on this job, and with local representation capable of providing training and technical assistance at the job site.
- B. Installer's Qualifications: Personnel installing firestopping systems shall have been specifically trained by the manufacturer in the application of the materials to comply with the listing of the tested assembly.
- C. Codes and Standards: Comply with the applicable codes pertaining to firestopping. Firestopping systems shall be tested and listed in accordance with the following:
 - 1. Underwriter's Laboratory:
 - a. UL 1479 test method for fire tests of through-penetration firestops.
 - b. UL Fire Resistance Directory
 - 2. American Society for Testing and Materials: ASTM E814-88 standard test method for fire tests of through-penetration firestops and ASTM E2174 standard practice for onsite inspection of fire stop systems.

1.03 SUBMITTALS:

- A. Product Data: Manufacturer's specifications and technical data including the following:
 - 1. Detailed specification of construction and fabrication.
 - 2. Manufacturer's installation instructions.
- B. Shop Drawings: Indicate dimensions, description of materials and finishes, general construction, specific modifications, component connections, anchorage methods, hardware and installation procedures, plus the following specific requirements:

1. Details of each proposed assembly, for all types of fire rated construction and penetrating items encountered, identifying intended products and applicable UL System Number, or UL classified devices.
2. Manufacture or manufacturer's representative shall provide qualified engineering judgments and drawings relating to non-standard applications as needed.

1.04 DELIVERY, STORAGE AND HANDLING:

A. Packing and Shipping:

1. Deliver products in original, unopened packaging with legible manufacturer's identification.
2. Coordinate delivery with scheduled installation date, allow minimum storage at site.

B. Storage and Protection: Store materials in a clean, dry ventilated location. Protect from soiling, abuse, moisture and freezing when required. Follow manufacturer's instructions.

1.05 PROJECT CONDITIONS:

A. Inspection:

1. Examine areas, conditions, and substrates before starting work. Correct unsatisfactory conditions before proceeding.
2. Proceed with installation only after penetrations of the substrate and supporting brackets have been installed.

B. Environmental Requirements:

1. Furnish adequate ventilation if using solvent.
2. Furnish forced air ventilation during installation if required by manufacturer.
3. Keep flammable materials away from sparks or flame.
4. Provide masking and drop cloths to prevent contamination of adjacent surfaces by firestopping materials.
5. Comply with manufacturing recommendations for temperature and humidity conditions before, during and after installation of firestopping.

PART 2 - PRODUCTS

2.01 MANUFACTURERS:

A. Subject to compliance with the requirements of this specification, provide products by one of the following:

1. 3M, Fire Protection Products
2. Nelson Firestop Products
3. TREMCO Construction Products
4. Metalines
5. Hilti Corporation
6. Specified technologies, Inc. (STI)

2.02 GENERAL:

- A. Provide fire stop systems listed in the UL Fire Resistance Directory. Provide systems with fire resistance "F" ratings equal to the fire resistance rating of the wall or floor assembly for all penetrations. Provide systems with fire resistance "T" ratings equal to the fire resistance rating of the floor assembly for all penetrations that aren't within the cavity of the wall assembly.

2.03 ACCESSORIES:

- A. Provide forming and damming materials and sleeves as required by the firestopping system installation instructions.

PART 3 - EXECUTION

3.01 GENERAL:

- A. Review all project drawings, Owner's records and existing conditions to determine location, rating, and construction of all fire resistive construction.
- B. Coordinate location of penetrations to allow for the maximum and minimum annular space around the penetrating item. Allow a minimum of 1" undisturbed building material between penetrations, or provide a firestopping system listed for multiple penetrations. Penetrating items shall be centered in hole as much as practical, unless firestopping system is listed for point contact between the wall/floor assembly and the penetrating item.
- C. Neatly form, saw cut, hole saw or core drill openings. Size openings to conform with the maximum and minimum annular space requirements of the firestopping system.

3.02 APPLICATION:

- A. The Contractor shall determine the most appropriate firestopping system which complies with these specifications and requirements for systems being installed.
- B. All insulation shall be continued through the penetration. Provide intumescent caulk or collar firestopping systems.
- C. Anchor wiring not within conduit on each side of a penetration to prevent it from being pulled out of the firestopping system.
- D. See Section 23 0500 for sleeves. The use of sleeves may affect the rating of the firestopping system. Coordinate use of sleeves with firestopping.

END OF SECTION 23 0509

SECTION 23 0510 – BASIC PIPING MATERIALS AND METHODS

PART 1 - GENERAL

1.01 SUBMITTALS:

- A. Refer to Division 1 and Section 23 0500 “Common Work Results for Mechanical” for administrative and procedural requirements for submittals.
- B. Product Data: Submit industry standards and manufacturer's technical product data, installation instructions, and dimensioned drawings for each type of pipe and pipe fitting. Submit piping schedule showing pipe or tube weight, fitting type, and joint type for each piping system.
- C. Brazing Certifications: Submit reports as required for piping work.

1.02 QUALITY ASSURANCE:

- A. Manufacturer's Qualifications: Firms regularly engaged in manufacturer of pipes and pipe fittings of types and sizes required, whose products have been in satisfactory use in similar service for not less than 5 years.
- B. Soldering and Brazing procedures shall conform to ANSI Standard Safety Code for Mechanical Refrigeration.

PART 2 - PRODUCTS

2.01 GENERAL:

- A. Piping Materials: Provide pipe and tube of type, pressure and temperature ratings, capacities, joint type, grade, size and weight (wall thickness or Class) indicated for each service. Where type, grade or class is not indicated, provide proper selection as determined by Installer for installation requirements, and comply with governing regulations and industry standards.
- B. Pipe/Tube Fittings: Provide factory-fabricated fittings of type, materials, grade, class and pressure rating indicated for each service and pipe size. Provide sizes and types matching pipe, tube, valve or equipment connection in each case. Where not otherwise indicated, comply with governing regulations and industry standards for selections, and with pipe manufacturer's recommendations where applicable.

2.02 COPPER TUBE AND FITTINGS:

- A. DWV Copper Tube: ASTM B 306.
- B. ACR Copper Tube: ASTM B 280.

- C. Wrought-Copper Solder-Joint Fittings: ANSI B16.22.
- D. Wrought-Copper Solder-Joint Drainage Fittings: ANSI B16.29.
- E. Bronze Pipe Flanges/Fittings: ANSI B16.24 (Class 150 and 300).

PART 3 - EXECUTION

3.01 EXAMINATION:

- A. Verify all dimensions by field measurements. Verify that all water distribution piping may be installed in accordance with pertinent codes and regulations, and original design, and the referenced standards.
- B. Examine rough-in requirements for equipment having piping connections to verify actual locations of piping connections prior to installation.
- C. Do not proceed until unsatisfactory conditions have been corrected.

3.02 PIPING INSTALLATION:

- A. General: Install pipes and pipe fittings in accordance with recognized industry practices which will achieve permanently-leakproof piping systems, capable of performing each indicated service without piping failure. Install each run with minimum joints and couplings. Align piping accurately at connections, within 1/16 inch misalignment tolerance.
 - 1. Comply with ANSI B31 Code for Pressure Piping.
 - 2. Electrical Equipment Spaces: Do not run piping through electrical or electronic equipment spaces and enclosures. Only piping serving this type of equipment space shall be allowed.
 - 3. Locations and Arrangements: Drawings (plans, schematics, and diagrams) indicate the general location and arrangement of piping systems. Locations and arrangements of piping take into consideration pipe sizing and friction loss, expansion, pump sizing, and other design considerations. So far as practical, install piping as indicated.
 - 4. Use fittings for all changes in direction and all branch connections.
 - 5. Install piping at right angles or parallel to building walls. Diagonal runs are not permitted, unless expressly indicated.
 - 6. Conceal all pipe installations in walls, pipe chases, utility spaces, above ceilings, below grade or floors, unless indicated to be exposed to view.
 - 7. Install piping tight to slabs, beams, joists, columns, walls, and other permanent elements of the building. Provide space to permit insulation applications, with 1 inch clearance outside the insulation. Allow sufficient space above removable ceiling panels to allow for panel removal.
 - 8. Locate groups of pipes parallel to each other, spaced to permit applying insulation and servicing of valves.
 - 9. Install piping free of sags or bends and with ample space between piping to permit proper insulation applications.

10. Fire and Smoke Wall Penetrations: Where pipes pass through fire and smoke rated walls, partitions, ceilings, and floors, maintain the fire and smoke rated integrity. Refer to Division 23, Sections 23 05 18 and 23 05 09 for materials.

B. Refrigerant Piping:

1. General: Install refrigerant piping in accordance with ASHRAE Standard 15 - "The Safety Code for Mechanical Refrigeration."
2. Install piping in as short and direct arrangement as possible to minimize pressure drop.
3. Install piping for minimum number of joints using as few elbows and other fittings as possible.
4. Arrange piping to allow normal inspection and servicing of compressor and other equipment. Install valves and specialties in accessible locations to allow for servicing and inspection.
5. Provide adequate clearance between pipe and adjacent walls and hanger, or between pipes for insulation installation. Use sleeves through floors, walls, or ceilings, sized to permit installation of full thickness insulation.
6. Insulate suction lines. Liquid line are not required to be insulated, except where they are installed adjacent and clamped to suction lines, where both liquid and suction lines shall be insulated as a unit.
 - a. Do not install insulation until system testing has been completed and all leaks have been eliminated.
7. Install branch tie-in lines to parallel compressors equal length, and pipe identically and symmetrically.
8. Install copper tubing in rigid or flexible conduit in locations where copper tubing will be exposed to mechanical injury.
9. Slope refrigerant piping as follows:
 - a. Install horizontal hot gas discharge piping with 1/2 inch per 10 feet downward slope away from the compressor.
 - b. Install horizontal suction lines with 1/2 inch per 10 feet downward slope to the compressor, with no long traps or dead ends which may cause oil to separate from the suction gas and return to the compressor in damaging slugs.
 - c. Install traps and double risers where indicated, and where required to entrain oil in vertical runs.
 - d. Liquid lines may be installed level.

C. Condensate Drain Piping:

1. Condensate drain piping from air conditioning unit coil condensate drain pan shall be of the sizes shown on the drawings.

3.03 PIPING SYSTEM JOINTS:

- A. General: Provide joints of type indicated in each piping system.
- B. Braze copper tube-and-fitting joints in accordance with ASME B31.
- C. Solder copper tube-and-fitting joints with silver solder or 95-5 tin-antimony. Cut tube ends squarely, ream to full inside diameter, and clean outside of tube ends and inside of fittings.

Apply solder flux to joint areas of both tubes and fittings. Insert tube full depth into fitting, and solder in manner which will draw solder full depth and circumference of joint. Wipe excess solder from joint before it hardens.

D. Refrigerant Piping:

1. Ream ends of pipe and tubes and remove burrs.
2. Fill pipe with dry nitrogen and purge during brazing to prevent scale buildup.
3. Braze joint per AWS Brazing handbook.
 - a. Use Type BCuP (copper phosphorus) alloy for copper to copper joints
 - b. Use BAG (cadimun silver) to join copper to bronze or steel.
4. Leak Test:
 - a. Comply with ASME 331-5 Chapter VI
 - b. Test high and low side piping separately.
 - 1) Fill system with dry nitrogen to test pressure.
 - 2) Test joints and fittings with leak detector at all joints
 - 3) Remove leaking joints with new materials and retest. Once test is correct and system holds pressure for 24 hours evacuate to 500 micrometers and hold for 12 hours. Break vacuum with nitrogen and re-evacuate to 500 micrometers and hold for 2 hours. Break vacuum with refrigerant and charge per manufacturer requirements.

3.04 PIPING APPLICATION:

- A. Equipment Drains and Overflows, Cooling Coil Drain Pan Piping, Condensate Drains:
1. Type "M" or "DWV" copper.
- B. Refrigerant Piping:
1. Type ACR copper, cleaned, dehydrated and capped at the factory. Wrought copper fittings, brazed joints with nitrogen purge.

3.05 PIPING TESTS:

- A. General: Provide temporary equipment for testing, including pump and gauges. Test piping system before insulation is installed wherever feasible. Test each section of each piping system independently.
- B. Test all piping systems as specified. Correct leaks by remaking joints. Remove equipment not able to withstand test procedure during test.
- C. Work to be installed shall remain uncovered until the required tests have been completed.
- D. Piping which is to be concealed shall be tested before being permanently enclosed.
- E. As soon as work has been completed, conduct preliminary tests to ascertain compliance with specified requirements. Make repairs or replacements as required.
- F. Give a minimum of twenty-four hours notice to Engineer of dates when acceptance test will be conducted. Conduct tests as specified for each system in presence of representative of owner,

agency having jurisdiction or his representative. Submit three (3) copies of successful tests to the Engineer for his review. Report shall state system tested and date of successful test.

- G. Contractor shall obtain certificates of approval, acceptance and compliance with regulations of agencies having jurisdiction. Work shall not be considered complete until such certificates have been delivered by the Engineer to the Owner.
- H. All costs involved in these tests shall be borne by Contractor.
- I. System Tests
 - 1. Test all refrigerant piping systems with nitrogen at 300 psig pressure on high side of system, and at 150 psig pressure on low side of system. Maintain pressure without loss for a time period of not less than 4 hours. After test has been completed, the piping shall be evacuated by means of a vacuum pump for a period of not less than 24 hours or until system has been completely evacuated.
 - 2. Repair piping systems sections which fail required piping test, by disassembly and re-installation, using new materials to extent required to overcome leakage.

3.06 ADJUSTING AND CLEANING:

- A. General: Clean exterior surfaces of installed piping systems of superfluous materials. Inspect each run of each system for completion of joints, supports and accessory items.
 - 1. Inspect pressure piping in accordance with procedures of ASME B31.

END OF SECTION 23 0510

SECTION 23 0529 – HANGERS AND SUPPORTS FOR MECHANICAL PIPING AND EQUIPMENT

PART 1 - GENERAL

1.01 QUALITY ASSURANCE:

- A. Manufacturer's Qualifications: Firms regularly engaged in manufacture of supports and anchors, of types and sizes required, whose products have been in satisfactory use in similar service for not less than 5 years.
- B. Codes and Standards:
 - 1. Regulatory Requirements: Comply with applicable codes pertaining to product materials and installation of supports and anchors.
 - 2. Duct Hangers: SMACNA Duct Manuals
 - 3. MSS Standard Compliance:
 - a. Provide pipe hangers and supports of which materials, design, and manufacture comply with MSS SP-69.

1.02 SUBMITTALS:

- A. Product Data: Submit manufacturer's technical product data, including installation instructions for each type of support and anchor. Submit pipe hanger and support schedule showing Manufacturer's figure number, size, location, and features for each required pipe hanger and support.
- B. Shop Drawings: Submit manufacturer's assembly-type shop drawings for each type of support and anchor, indicating dimensions, weights, required clearances, and methods of assembly of components.
- C. Product certificates signed by the manufacturer of hangers and supports certifying that their products meet the specified requirements.
- D. Maintenance Data: Submit maintenance data and parts list for each type of support and anchor. Include this data, product data, and shop drawings in maintenance manual; in accordance with requirements of Division 23.

PART 2 - PRODUCTS

2.01 MANUFACTURERS:

- A. Manufacturer: Subject to compliance with requirements, provide products by one of the following:
 - 1. Pipe Hangers and Supports:
 - a. B-Line Systems Inc.
 - b. ANVIL International

- c. PHD Manufacturing, Inc.
- d. Unistrut Metal Framing Systems
- e. Erico
- f. Grinnell
- 2. Protection Shields:
 - a. ANVIL International
 - b. Pipe Shields, Inc.
 - c. B-Line
 - d. Snapp Itz
 - e. Erico
 - f. Value Engineered Products, Inc.
 - g. Grinnell

2.02 PIPE HANGERS & SUPPORTS:

- A. Hangers and support components shall be factory fabricated of materials, design, and manufacturer complying with MSS SP-69.
 - 1. Components shall have galvanized coatings where installed for piping and equipment that will not have field-applied finish.
 - 2. Pipe attachments shall have nonmetallic coating for electrolytic protection where attachments are in direct contact with copper tubing.
 - 3. Comply with MSS_SP58 types 1 through 58
 - 4. Oversize hanger for insulated piping
- B. Adjustable Clevis Hanger: MSS Type.
 - 1. Steel and Copper Pipe, size 3/8" thru 30", Type 1.
 - 2. Non-insulated Copper Pipe, size 1/2" thru 4", Type 1. (PVC Coated)
 - 3. Insulated pipe oversize hanger to accommodate insulation.
- C. Adjustable Swivel Ring for Non-insulated Pipe: MSS Type.
 - 1. Steel Pipe, size 1/2" thru 8", Type 7, 9 or 10.
 - 2. Copper Pipe, size 1/2" thru 4", Type 7 (PVC Coated)
 - 3. Insulated pipe oversize hanger to accommodate insulation.
- D. Pipe Clamps: MSS Type .
 - 1. Steel Pipe, size 3/4" thru 24", Type 8, 3 or 42.
 - 2. Copper Pipe, size 1/2" thru 4", Type 8, 3 or 42 (PVC Coated).
- E. U Bolts: MSS Type.
 - 1. Steel Pipe, size 1/2" thru 30" Type 24
 - 2. Copper Pipe, size 1/2" thru 8", Type 24 (PVC Coated).
- F. Straps: MSS Type 26.
- G. Hanger Rods: Continuous threaded steel, sizes as specified.
- H. Hangers:

1. Cold Pipes:
 - a. 1/2" through 1-1/2": Adjustable wrought steel ring.
 - b. 2" and Over: Adjustable wrought steel clevis.
 2. Multiple or Trapeze: Structural steel channel (with web vertical and engineered for the specific applications), with welded spacers and hanger rods.
- I. Upper Attachments:
1. For attaching hanger rods to structural steel I-beams:
 - a. Provide adjustable beam clamp, MSS-Type 20, 21, 28, 29, or 30. Attach to bottom flange of beam.
 2. For attaching hanger rods to bar joists:
 - a. When bottom chord is constructed of structural steel angles, provide square washer. Place hanger rod between backs of the two angles and support with the washer and dual locking nuts on top of the angles. Spot weld washer to angles.
 - b. When bottom chord is constructed of round bars, provide Elcen No. 137 bar joint washer or equal.
- 2.03 Protection SHIELDS:
- A. Protection Saddles: MSS Type 39; fill interior voids with segments of insulation matching adjoining insulation.
- 2.04 MISCELLANEOUS MATERIALS:
- A. Steel Plates, Shapes, and Bars: ASTM A 36.

PART 3 - EXECUTION

- 3.01 INSPECTION:
- A. Examine areas and conditions under which supports and anchors are to be installed. Do not proceed with work until unsatisfactory conditions have been corrected in manner acceptable to Installer.
- 3.02 PREPARATION:
- A. Proceed with installation of hangers, supports only after required building structural work has been completed in areas where the work is to be installed.
- 3.03 INSTALLATION OF BUILDING ATTACHMENTS:
- A. Install building attachments on structural steel. Space attachments within maximum piping span length indicated in MSS SP-69. Install additional attachments at concentrated loads, and at changes in direction of piping.

3.04 INSTALLATION OF HANGERS AND SUPPORTS:

- A. Install hangers, supports, clamps and attachments to support piping properly from building structure; comply with MSS SP-69. Arrange for grouping of parallel runs of horizontal piping to be supported together on field fabricated, trapeze hangers where possible. Install supports with maximum spacings complying with MSS SP-69. Where piping of various sizes is supported together by trapeze hangers, space hangers for smallest pipe size or install intermediate supports for smaller diameter pipe. Do not use wire or perforated metal to support piping, and do not support piping from other piping.
- B. Install hangers and supports complete with necessary inserts, bolts, rods, nuts, washers and other accessories.
- C. Support fire-water piping independently from other piping systems.
- D. Prevent electrolysis and abrasion in support of copper tubing by use of hangers and supports which are plastic coated, or with EPDM isolation strips. Duct tape or copper coated hangers are not acceptable.
- E. Load Distribution: Install hangers and supports so that piping live and dead loading and stresses from movement will not be transmitted to connected equipment.
- F. Pipe Slopes: Install hangers and supports to provide indicated pipe slopes, and so that maximum pipe deflections allowed by ANSI B31.9 Building Services Piping Code is not exceeded.
- G. Insulated Piping: Comply with the following installation requirements.
 - 1. Clamps: Attach clamps, including spacers (if any), to piping with clamps projecting through insulation; do not exceed pipe stresses allowed by ANSI B31.
 - 2. Shields: Install galvanized steel protection shields, on all insulated piping 2 inches and less, except where required to be clamped. Where necessary to prevent dislocation, strap shield to pipe with wire ties or "Zip Strips".
- H. Install steel natural gas piping with the following minimum rod size and maximum spacing:

SIZE (NPS)	MAX. SPAN IN FEET	MIN. ROD SIZE - INCHES
1/2	6	3/8
3/4 TO 1	8	3/8
1-1/4 1-1/2	10	3/8
2	10	3/8

- I. Place a hanger within one foot of each horizontal elbow.
- J. Use hangers which are vertically adjustable 1-1/2 inch minimum after piping is erected.

- K. Where several pipes can be installed in parallel and at same elevation, provide trapeze hangers. Provide rubber oversized inserts on pipe clamps to allow movement.
- L. Where practical, support riser piping independently of connected horizontal piping.
- M. Each pipe drop to equipment shall be adequately supported.
- N. Prevent copper tubes from making contact with steel brackets/hangers using fire retardant poly inserts or other dielectric material. Duct tape is not allowed.

3.05 SHEET METAL DUCT HANGERS AND SUPPORTS:

- A. Provide in accordance with SMACNA HVAC duct construction standards.
- B. Additional Hanger Requirements:
 - 1. 2" to 24" from flexible connections of fans.
 - 2. 2" to 24" from the outlets or flexible connections of VAV control units or mixing boxes.
 - 3. 12" to 36" from the main duct to the first hanger of long branch ducts.
 - 4. 2" to 12" from the ends of all branch ducts and linear diffuser plenums.
 - 5. 2" to 24" from fire damper break-away joints.

3.06 METAL FABRICATION:

- A. Cut, drill, and fit miscellaneous metal fabrications for pipe anchors and equipment supports. Install and align fabricated anchors in indicated locations.
- B. Fit exposed connections together to form hairline joints. Field weld connections that cannot be shop welded because of shipping size limitations.
- C. Field Welding: Comply with AWS D1.1 for procedures of manual shielded metal-arc welding, appearance and quality of welds made, methods used in correcting welding work, and the following:
 - 1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
 - 2. Obtain fusion without undercut or overlap.
 - 3. Remove welding flux immediately.
 - 4. Finish welds at exposed connections so no roughness shows after finishing and contours at welded surfaces match adjacent contours.

3.07 ADJUSTING:

- A. Hanger Adjustment: Adjust hangers to distribute loads equally on attachments and to achieve indicated slope of pipe. Cut off the bottom of threaded rods so they are no more than one rod diameter below the bottom nut.
- B. Touch-Up Painting: Immediately after erection of anchors and supports, clean field welds and abraded areas of shop paint and paint exposed areas with same material as used for shop painting to comply with SSPC-PA-1 requirements for touch-up of field-painted surfaces.

1. Apply by brush or spray to provide a minimum dry film thickness of 2.0 mils.

END OF SECTION 23 0529

SECTION 23 0548 – VIBRATION AND SEISMIC CONTROLS FOR MECHANICAL SYSTEMS AND EQUIPMENT

PART 1 - GENERAL

1.01 DESCRIPTION OF WORK:

- A. Extent of vibration control work required by this section is indicated on drawings and schedules, and/or specified in other Division-23 sections.
 - 1. All mechanical equipment, piping and ductwork as noted or in the specification shall be mounted on vibration isolators to prevent the transmission of vibration and mechanically transmitted sound to the building structure. Vibration isolators shall be selected in accordance with the weight distribution so as to produce reasonably uniform deflections.
 - 2. It is the intent of the seismic portion of this specification to keep all mechanical and electrical building system components in place during a seismic event.
 - 3. All such systems must be installed in strict accordance with seismic codes, component manufacturer's and building construction standards. Whenever a conflict occurs between the manufacturers or construction standards, the most stringent shall apply.
 - 4. This specification is considered to be minimum requirements for seismic consideration and is not intended as a substitute for legislated, more stringent, national, state or local construction requirements.
 - 5. Any variance or non-compliance with these specification requirements shall be corrected by the contractor in an approved manner.
 - 6. Seismic restraints shall be designed in accordance with seismic force levels as detailed in Section 1.7.

- B. The work in this section includes, but is not limited to the following:
 - 1. Vibration isolation for piping, ductwork and equipment.
 - 2. Equipment isolation bases.
 - 3. Flexible piping connections.
 - 4. Seismic restraints for isolated equipment.
 - 5. Seismic restraints for non-isolated equipment.
 - 6. Certification of seismic restraint designs and installation supervision.
 - 7. Certification of seismic attachment of housekeeping pads.
 - 8. All mechanical and electrical systems (installed by Division 23, e.g., Temperature Controls). Equipment buried underground is excluded but entry of services through the foundation wall is included. Equipment referred to below is typical. (Equipment not listed is still included in this specification).
 - a. Air Terminal Units
 - b. Cable Trays
 - c. Condensing Units
 - d. Conduit
 - e. Control Panels
 - f. Ductwork
 - g. Fans (All types)
 - h. Piping
 - i. Pumps (All types)
 - j. Rooftop Units
 - k. Unit Heaters
 - l. Water Heaters

1. Fire protection systems are excluded from this section; see under separate fire protection sections.
 - C. Vibration control products furnished as integral part of factory-fabricated equipment shall comply with the requirements of this section.
 - D. For additional and supplemental requirements, refer to other Division 23 sections for equipment foundations; hangers; sealants; gaskets; requirements of electrical connections to equipment isolated on vibration control products; requirements of duct connections to air handling equipment isolated on vibration control products.
 - E. Definitions
 1. Life Safety Systems:
 - a. All systems involved with fire protection including sprinkler piping, fire pumps, jockey pumps, fire pump control panels, service water supply piping, water tanks, fire dampers and smoke exhaust systems. See separate section(s) for fire protection requirements.
 - b. All systems involved with and/or connected to emergency power supply including all generators, transfer switches, transformers and all flowpaths to fire protection and/or emergency lighting systems.
 - c. Fresh air relief systems on emergency control sequence including air handlers, conduit, duct, dampers, etc.
 - d. All life safety equipment has an asterisk on the equipment schedule.
 2. Positive Attachment:
 - a. A positive attachment is defined as a cast-in anchor, a drill-in wedge anchor, a double sided beam clamp loaded perpendicular to a beam, or a welded or bolted connection to structure. Single sided "C" type beam clamps for support rods of overhead piping, ductwork, fire protection, electrical conduit, bus duct, or cable trays, or any other equipment are not acceptable on this project as seismic anchor points.
 3. Transverse Bracing:
 - a. Restraint(s) applied to limit motion perpendicular to the center line of the pipe, duct or conduit.
 4. Longitudinal Bracing:
 - a. Restraint(s) applied to limit motion parallel to the centerline of the pipe, duct or conduit.
- 1.02 QUALITY ASSURANCE:
- A. Manufacturer's Qualifications: Firms regularly engaged in manufacture of vibration and seismic control products, of type, size, and capacity required, whose products have been in satisfactory use in similar service for not less than 5 years.
 1. Except as otherwise indicated, vibration and seismic control products shall be obtained from single manufacturer and shall be certified by the manufacturer.
 2. Engage manufacturer to provide technical supervision of installation of support isolation and seismic units produced, and of associated inertia bases (if any).

1.03 SUBMITTALS:

- A. Product Data: Submit manufacturer's technical product data and installation instructions for each type of vibration and seismic control product. Submit schedule showing size, type, deflection, and location for each product furnished.
 - 1. Include data for each type and size of unit, showing specific restraints, isolation efficiency, stiffness, natural frequency and transmissibility at lowest operating speed of equipment detailing compliance with the specification.
 - 2. For spring units, show wire size, spring diameter, free height, solid-compression height, operating height, fatigue characteristics, ratio of horizontal to vertical stiffness and bases of spring-rated selection for range of loading weights.
 - 3. Detailed schedules of flexible and rigidly mounted equipment, showing vibration isolators and seismic restraints by referencing numbered descriptive drawings.
 - 4. Include performance certifications from manufacturers.

- B. Shop Drawings: Submit manufacturer's assembly-type shop drawings indicating dimensions, weights, required clearances, and method of assembly of components. Detail bases, and show location of equipment anchoring points and seismic restraints coordinated with equipment manufacturer's shop drawings.
 - 1. Shop drawings showing structural design and details of inertia bases, steel beam bases and other custom-fabricated work not covered by manufacturer's submitted data.
 - a. Furnish templates, anchor bolts and sleeve for equipment bases, seismic restraints, foundations and other support systems for coordination of vibration isolation and seismic control units with other work.
 - b. Provide all details of suspension and support for ceiling hung equipment.
 - c. Where walls, floors, slabs or supplementary steel work are used for seismic restraint locations, details of acceptable attachment methods for ducts, conduit and pipe must be included and approved before the condition is accepted for installation. Submittals shall include riser diagrams and calculations showing anticipated expansion and contraction at each support point, initial and final loads on the building structure, spring deflection changes and seismic loads. Submittal data shall include certification that the riser system has been examined for excessive stresses and that none will exist in the proposed design.
 - d. Provide specific details of seismic restraints and anchors; include number, size and locations for each piece of equipment.
 - 2. Submit shop drawings indicating scope of vibration isolation work and locations of units and flexible connections. Include support isolation points for piping and ductwork including risers and inertia bases.
 - a. Include schedule of units, showing size or manufacturer's part number, and weight supported and resulting deflection of each unit.

- C. Maintenance Data: Submit maintenance data for each type of vibration and seismic control product. Include this data, product data and shop drawings in maintenance manual; in accordance with requirements of Divisions 23.

- D. Seismic Certification and Analysis:

1. Seismic restraint calculations must be provided for all connections of equipment to the structure. Calculations must be stamped by a registered professional engineer with at least five years of seismic design experience, licensed in the state of the job location.
2. All restraining devices shall have a preapproval number from California OSHPD or some other recognized government agency showing maximum restraint ratings. Preapprovals based on independent testing are preferred to preapprovals based on calculations. Where preapproved devices are not available, submittals based on independent testing are preferred. Calculations (including the combining of tensile and shear loadings) to support seismic restraint designs must be stamped by a registered professional engineer with at least five years of seismic design experience and licensed in the state of the job location. Testing and calculations must include both shear and tensile loads as well as one test or analysis at 45 degrees to the weakest mode.
3. Analysis must indicate calculated dead loads, static seismic loads and capacity of materials utilized for connections to equipment and structure. Analysis must detail anchoring methods, bolt diameter, embedment and-or welded length. All seismic restraint devices shall be designed to accept, without failure, the forces detailed in Section 1.7 acting through the equipment center of gravity. Overturning moments may exceed forces at ground level.

1.04 CODE AND STANDARDS REQUIREMENTS:

- A. Applicable Codes and Standards
 1. International Building Code (IBC), currently adopted version.
 2. All State and Local Codes.
 3. ASHRAE HVAC Applications Handbook Sound and Vibration Control.
 4. SMACNA Seismic Restraint Manual Guidelines for Mechanical Systems, latest edition.

1.05 MANUFACTURER'S RESPONSIBILITY:

- A. Manufacturer of vibration isolation and seismic control equipment shall have the following responsibilities:
 1. Determine vibration isolation and seismic restraint sizes and locations.
 2. Provide vibration isolation and seismic restraints as scheduled or specified.
 3. Provide calculations and materials if required for restraint of un-isolated equipment.
 4. Provide installation instructions, drawings and trained field supervision to insure proper installation and performance.

1.06 RELATED WORK:

- A. Housekeeping Pads
 1. Housekeeping pad reinforcement and monolithic pad attachment to the structure details and design shall be prepared by the restraint vendor if not already indicated on the drawings.
 2. Housekeeping pads shall be coordinated with restraint vendor and sized to provide a minimum edge distance of ten (10) bolt diameters all around the outermost anchor bolt to allow development of full drill-in wedge anchor ratings. If cast-in anchors are to be

used, the housekeeping pads shall be sized to accommodate the American Concrete Institute requirements for bolt coverage and embedment.

- B. Supplementary Support Steel
 - 1. Contractor shall supply supplementary support steel for all equipment, piping, ductwork, etc. including roof mounted equipment, as required or specified.
- C. Attachments
 - 1. Contractor shall supply restraint attachment plates cast into housekeeping pads, concrete inserts, double sided beam clamps, etc. in accordance with the requirements of the vibration vendor's calculations.

1.07 performance requirements:

- A. Wind-Restraint Loading:
 - 1. Basic Wind Speed: 120 MPH
 - 2. Building Classification Category: IV.
 - 3. Minimum 10 pounds per square foot multiplied by the maximum area of the HVAC component projected on a vertical plane that is normal to the wind direction, and 45 degrees either side of normal.
- B. Seismic-Restraint Loading:
 - 1. Site Class as Defined in the IBC: C.
 - 2. Assigned Seismic Use Group or Building Category as Defined in the IBC: IV.
 - a. Component Importance Factor: 1.5.
 - b. Component Response Modification Factor: 6.5.
 - c. Component Amplification Factor: 1.0.
 - 3. Design Spectral Response Acceleration at Short Periods (0.2 Second): Per ASCE
 - 4. Design Spectral Response Acceleration at 1-Second Period: Per ASCE
 - 5. Refer to Structural plans and specifications to confirm information shown above and for additional information not presented above.

PART 2 - PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS:

- A. Manufacturer: Subject to compliance with requirements, provide products by:
 - 1. Vibration and Seismic Control Products:
 - a. Mason Industries, Inc.
 - b. Kinetics Noise Control.
 - c. Vibration Mountings & Controls.
- B. Alternate Manufacturer: All vibration isolators and seismic restraints described in this section shall be the product of a single manufacturer. Mason Industries products are the basis of these specifications; products of other manufacturers are acceptable provided their systems strictly comply with the specification and have been reviewed by the Engineer. Submittals and certification sheets shall be in accordance with Section 1.3.

- C. For the purposes of this project, failure is defined as the discontinuance of any attachment point between equipment or structure, vertical permanent deformation greater than 1/8 inch and/or horizontal permanent deformation greater than 1/4 inch.

2.02 PRODUCT DESCRIPTIONS:

A. Vibration Isolators and Seismic Restraints:

1. Two layers of 3/4 inch thick neoprene pad consisting of 2 inches square waffle modules separated horizontally by a 16 gauge galvanized shim. Load distribution plates shall be used as required.
 - a. Basis of Design: Mason Type Super W.
2. Bridge-bearing neoprene mountings shall have a minimum static deflection of 0.2 inches and all directional seismic capability. The mount shall consist of a ductile iron casting containing two separated and opposing molded neoprene elements. The elements shall prevent the central threaded sleeve and attachment bolt from contacting the casting during normal operation. The shock absorbing neoprene materials shall be compounded to bridge-bearing specifications. Mountings shall have an Anchorage Preapproval "OPA" Number from OSHPD in the State of California verifying the maximum certified horizontal and vertical load ratings.
 - a. Basis of Design: Mason Type BR.
3. Sheet metal panels shall be bolted to the walls or supporting structure by assemblies consisting of a neoprene bushing cushioned between 2 steel sleeves. The outer sleeve prevents the sheet metal from cutting into the neoprene. Enlarge panel holes as required. Neoprene elements pass over the bushing to cushion the back panel horizontally. A steel disc covers the inside neoprene element and the inner steel sleeve is elongated to act as a stop so tightening the anchor bolts does not interfere with panel isolation in 3 planes. Bushing assemblies can be applied to the ends of steel cross members where applicable. All neoprene shall be bridge bearing quality.
 - a. Basis of Design: Mason Type PB.
4. A one piece molded bridge bearing neoprene washer/bushing. The bushing shall surround the anchor bolt and have a flat washer face to avoid metal to metal contact.
 - a. Basis of Design: Mason Type HG.
5. Spring isolators shall be free standing and laterally stable without any housing and complete with a molded neoprene cup or 3/4 inch neoprene acoustical friction pad between the baseplate and the support. All mountings shall have leveling bolts that must be rigidly bolted to the equipment. Spring diameters shall be no less than 0.8 of the compressed height of the spring at rated load. Springs shall have a minimum additional travel to solid equal to 50 percent of the rated deflection. Submittals shall include spring diameters, deflection, compressed spring height and solid spring height.
 - a. Basis of Design: Mason Type SLF.
6. Restrained spring mountings shall have an SLF mounting as described in the spring hangers above, within a rigid housing that includes vertical limit stops to prevent spring extension when weight is removed. The housing shall serve as blocking during erection. A steel spacer shall be removed after adjustment. Installed and operating heights are equal. A minimum clearance of 1/2 inch shall be maintained around restraining bolts and between the housing and the spring so as not to interfere with the spring action. Limit stops shall be out of contact during normal operation. Since housings will be bolted or

welded in position there must be an internal isolation pad. Housing shall be designed to resist all seismic forces. Mountings shall have Anchorage Preapproval "OPA" Number from OSHPD in the state of California certifying the maximum certified horizontal and vertical load ratings.

- a. Basis of Design: Mason Type SLR.
7. Hangers shall consist of rigid steel frames containing minimum 1-1/4 inches thick neoprene elements at the top and a steel spring with general characteristics as the spring hangers above seated in a steel washer reinforced neoprene cup on the bottom. The neoprene element and the cup shall have neoprene bushings projecting through the steel box. To maintain stability the boxes shall not be articulated as clevis hangers nor the neoprene element stacked on top of the spring. Spring diameters and hanger box lower hole sizes shall be large enough to permit the hanger rod to swing through a 30 degrees capability.
 - a. Basis of Design: Mason Type 30N.
8. Precompressed hangers shall be as described the hangers above, but they shall be pre-compressed and locked at the rated deflection by means of a resilient seismic up-stop to keep the piping or equipment at a fixed elevation during installation. The hangers shall be designed with a release mechanism to free the spring after the installation is complete and the hanger is subjected to its full load. Deflection shall be clearly indicated by means of a scale. Submittals shall include a drawing of the hanger showing the 30 degrees capability.
 - a. Basis of Design: Mason Type PC30N.
9. Seismic cable restraints shall consist of galvanized steel aircraft cables sized to resist seismic loads with a minimum safety factor of two and arranged to provide all-directional restraint. Cable end connections shall be steel assemblies that swivel to final installation angle and utilize two clamping bolts to provide proper cable engagement. Cables must not be allowed to bend across sharp edges. Cable assemblies shall have an Anchorage Preapproval "OPA" Number from OSHPD in the State of California verifying the maximum certified load ratings.
 - a. Basis of Design: Mason Type SCB at the ceiling and at the clevis bolt, SCBH between the hanger rod nut and the clevis or SCBV if clamped to a beam.
10. Seismic solid braces shall consist of steel angles or channels to resist seismic loads with a minimum safety factor of 2 and arranged to provide all directional restraint. Seismic solid brace end connectors shall be steel assemblies that swivel to the final installation angle and utilize two through bolts to provide proper attachment. Seismic solid brace assembly shall have Anchorage Preapproval "OPA" Number from OSHPD in the state of California verifying the maximum certified load ratings.
 - a. Basis of Design: Mason Type SSB.
11. Steel angles, sized to prevent buckling, shall be clamped to pipe or equipment rods utilizing a minimum of three ductile iron clamps at each restraint location when required. Welding of support rods is not acceptable. Rod clamp assemblies shall have an Anchorage Preapproval "OPA" Number from OSHPD in the state of California.
 - a. Basis of Design: Mason Type SRC.
12. Pipe clevis cross bolt braces are required in all restraint locations. They shall be special purpose preformed channels deep enough to be held in place by bolts passing over the

- cross bolt. Clevis cross braces shall have an Anchorage Preapproval "OPA" Number from OSHPD in the state of California.
- a. Basis of Design: Mason Type CCB,
 13. All-directional seismic snubbers shall consist of interlocking steel members restrained by a one-piece molded neoprene bushing of bridge bearing neoprene. Bushing shall be replaceable and a minimum of ¼ inch thick. Rated loadings shall not exceed 1000 psi. A minimum air gap of 1/8 inch shall be incorporated in the snubber design in all directions before contact is made between the rigid and resilient surfaces. Snubber end caps shall be removable to allow inspection of internal clearances. Neoprene bushings shall be rotated to insure no short circuits exist before systems are activated. Snubbers shall have an Anchorage Preapproval "OPA" Number from OSHPD in the state of California verifying the maximum certified horizontal and vertical load ratings.
 - a. Basis of Design: Mason Type Z-1225.
 14. All directional seismic snubbers shall consist of interlocking steel members restrained by shock absorbent rubber materials compounded to bridge bearing specification. Elastomeric materials shall be replaceable and a minimum of ¾ inch thick. Rated loadings shall not exceed 1000 psi. Snubbers shall be manufactured with an air gap between hard and resilient material of not less than 1/8 inch nor more than ¼ inch. Snubbers shall be installed with factory set clearances. The capacity of the seismic snubber at 3/8 inch deflection shall be equal or greater than the load assigned to the mounting grouping controlled by the snubber multiplied by the applicable "G" force. Submittals shall include the load deflection curves up to ½ inch deflection in the x, y and z planes. Snubbers shall have an Anchorage Preapproval "OPA" Number from OSHPD in the state of California verifying the maximum certified horizontal and vertical load ratings.
 - a. Basis of Design: Mason Type Z-1011.
 15. Stud wedge anchors shall be manufactured from full diameter wire, not from undersized wire that is "rolled up" to create the thread. The stud anchor shall also have a safety shoulder which fully supports the wedge ring under load. The stud anchors shall have an evaluation report number from the I.C.B.O. Evaluation Service, Inc. verifying its allowable loads.
 - a. Basis of Design: Mason Type SAS.
 16. Female wedge anchors are preferred in floor locations so isolators or equipment can be slid into place after the anchors are installed. Anchors shall be manufactured from full diameter wire, and shall have a safety shoulder to fully support the wedge ring under load. Female wedge anchors shall have an evaluation report number from the I.C.B.O. Evaluation Service, Inc. verifying to its allowable loads.
 - a. Basis of Design: Mason Type SAB.
 17. Vibration isolation manufacturer shall furnish integral structural steel bases. Rectangular bases are preferred for all equipment. Centrifugal refrigeration machines and pump bases may be T or L shaped where space is a problem. Pump bases for split case pump shall include supports for suction and discharge elbows. All perimeter members shall be steel beams with a minimum depth equal to 1/10 of the longest dimension of the base. Base depth need not exceed 14 inches provided that the deflection and misalignment is kept within acceptable limits as determined by the manufacturer. Height saving brackets shall be employed in all mounting locations to provide a base clearance of 1 inch.
 - a. Basis of Design: Mason Type WF.

18. Vibration isolation manufacturer shall furnish rectangular steel concrete pouring forms for floating and inertia foundations. Bases for split case pumps shall be large enough to provide for suction and discharge elbow. Bases shall be a minimum of 1/12 of the longest dimension of the base but not less than 6 inches. The base depth need not exceed 12 inches unless specifically recommended by the base manufacturer for mass or rigidity. Forms shall include minimum concrete reinforcing consisting of ½ inch bars welded in place on 6 inches centers running both ways in a layer 1-1/2 inch above the bottom. Forms shall be furnished with steel templates to hold the anchor bolts sleeves and anchors while concrete is being poured. Height saving brackets shall be employed in all mounting locations to maintain a 1 inch clearance below the base. Wooden formed bases leaving a concrete rather than a steel finish are not acceptable.
 - a. Basis of Design: Mason Type BMK or K.
19. Curb mounted rooftop equipment shall be mounted on spring isolation curbs. The lower member shall consist of a sheet metal Z section containing adjustable and removable steel springs that support the upper floating section. The upper frame must provide continuous support for the equipment and must be captive so as to resiliently resist wind and seismic forces. All directional neoprene snubber bushing shall be a minimum of ¼ inch thick. Steel springs shall be laterally stable and rest on ¼ inch thick neoprene acoustical pads. Hardware must be plated and the springs provided with a rust resistant finish. The curbs waterproofing shall consist of a continuous galvanized flexible counter flashing nailed over the lower curbs waterproofing and joined at the corners by EPDM bellows. All spring locations shall have access ports with removable waterproof covers. Lower curbs shall have provision for 2 inches of insulation. The roof curbs shall be built to seismically contain the rooftop unit. The unit must be solidly fastened to the top floating rail, and the lower Z section anchored to the roof structure. Curb shall have Anchorage Preapproval "OPA" from OSHPD in the state of California attesting to the maximum certified horizontal and vertical load rating.
 - a. Basis of Design: Mason Type RSC
20. Flexible spherical expansion joints shall employ peroxide cured EPDM throughout with Kevlar® tire cord reinforcement. Substitutions must have certifiable equal or superior characteristics. The raised face rubber flanges must encase solid steel rings to prevent pull out. Flexible cable wire is not acceptable. Sizes 1-1/2 inch through 14 inch shall have a ductile iron external ring between the two spheres. Sizes 16 inch through 24 inch may be single sphere. Sizes ¾ inch through 1-1/4 inch may have one sphere, bolted threaded flange assemblies and cable retention. Minimum ratings through 14 inch shall be 250psi at 170°F and 215psi at 250°F, 16 inch through 24 inch 180psi at 170°F and 150psi at 250°F. Safety factors shall be a minimum of 3/1. All expansion joints must be factory tested to 150% of maximum pressure for 12 minutes before shipment. Concentric reducers to the above specifications may be substituted for equal ended expansion joints.
 - a. Expansion joints shall be installed in piping gaps equal to the length of the expansion joints under pressure. Control rods shall be used in unanchored piping locations where the manufacturer determines the installation exceeds the pressure requirement without control rods, as control rods are not desirable in seismic work. If control rods are used, they must have 1/2-inch thick neoprene washer bushings large enough in area to take the thrust at 1000 psi maximum on

the washer area. Expansion joints shall be installed on the equipment side of the shut off valves.

- b. Submittals shall include two test reports by independent consultants showing minimum reductions of 20 dB in vibration accelerations and 10 dB in sound pressure levels at typical blade passage frequencies on this or a similar product by the same manufacturer.
 - 1) Basis of Design: Mason SAFEFLEX SFDEJ, SFEJ, SFDCR or SFU and Control Rods CR.

- 21. Flexible stainless steel hose shall have stainless steel braid and carbon steel fittings. Sizes 3 inch and larger shall be flanged. Smaller sizes shall have male nipples. Minimum lengths shall be as tabulated:

Flanged (Inches)		Male Nipples (Inches)	
3 x 14	10 x 26	1/2 x 9	1-1/2 x 13
4 x 15	12 x 28	3/4 x 10	2 x 14
5 x 19	14 x 30	1 x 11	2-1/2 x 18
6 x 20	16 x 32	1-1/4 x 12	----
8 x 22	----	----	----

- a. Hoses shall be installed on the equipment side of the shut-off valves horizontally and parallel to the equipment shafts wherever possible.
 - 1) Basis of Design: Mason Type BSS.
- 22. All-directional acoustical pipe anchor, consisting of two sizes of steel tubing separated by a minimum ½ inch thick 60 durometer neoprene. Vertical restraint shall be provided by similar material arranged to prevent vertical travel in either direction. Allowable loads on the isolation material should not exceed 500 psi and the design shall be balanced for equal resistance in any direction.
 - a. Basis of Design: Mason Type ADA.
- 23. Pipe guides shall consist of a telescopic arrangement of two sizes of steel tubing separated by a minimum ½ inch thickness of 60 durometer neoprene. The height of the guides shall be preset with a shear pin to allow vertical motion due to pipe expansion or contraction. Shear pin shall be removable and reinsertable to allow for selection of pipe movement. Guides shall be capable of ± 1-5/8 inch motion, or to meet location requirements.
 - a. Basis of Design: Mason Type VSG.
- 24. Split Wall Seals consist of two bolted pipe halves with minimum ¾ inch thick neoprene sponge bonded to the inner faces. The seal shall be tightened around the pipe to eliminate clearance between the inner sponge face and the piping. Concrete may be packed around the seal to make it integral with the floor, wall or ceiling if the seal is not already in place around the pipe prior to the construction of the building member. Seals shall project a minimum of 1 inch past either face of the wall. Where temperatures exceed 240 degrees F, 10 pound density fiberglass may be used in lieu of the sponge.
 - a. Basis of Design: Mason Type SWS.
- 25. The horizontal thrust restraint shall consist of a spring element in series with a neoprene molded cup as described in Specification 5 with the same deflection as specified for the mountings or hangers. The spring element shall be designed so it can be preset for thrust at the factory and adjusted in the field to allow for a maximum of ¼ inch movement at

start and stop. The assembly shall be furnished with 1 rod and angle brackets for attachment to both the equipment and the duct work or the equipment and the structure. Horizontal restraints shall be attached at the centerline of thrust and symmetrical on either side of the unit.

- a. Basis of Design: Mason Type WBI/WBD.

PART 3 - EXECUTION

3.01 INSPECTION:

- A. Examine areas and conditions under which vibration control units are to be installed. Do not proceed with work until unsatisfactory conditions have been corrected.

3.02 PERFORMANCE OF ISOLATORS:

- A. General: Comply with minimum static deflections recommended by ASHRAE, for selection and application of vibration isolation materials and units as indicated.
- B. Manufacturer's Recommendations: Except as otherwise indicated, comply with manufacturer's recommendations for selection and application of vibration isolation materials and units to achieve minimum static deflection and displacement requirements.

3.03 APPLICATIONS:

- A. General: Except as otherwise indicated, select vibration control products in accordance with ASHRAE Applications Handbook 2019, Table 47, Chapter 49 Noise and Vibration Control and Chapter 56 Seismic- and Wind-Resistant Design.

3.04 GENERAL:

- A. Except as otherwise indicated, comply with manufacturer's instructions for installation and load application to vibration isolation materials and units. Adjust to ensure that units do not exceed rated operating deflections or bottom out under loading, and are not short-circuited by other contacts or bearing points. Remove space blocks and similar devices (if any) intended for temporary protection against overloading during installation.
- B. All vibration isolators and seismic restraint systems must be installed in strict accordance with the manufacturer's written instructions and all certified submittal data.
- C. Installation of vibration isolators and seismic restraints must not cause any change of position of equipment, piping or duct work resulting in stresses or misalignment.
- D. No rigid connections between equipment and the building structure shall be made that degrades the noise and vibration control system herein specified.

- E. The contractor shall not install any equipment, piping, duct or conduit which makes rigid connections with the building unless isolation is not specified. "Building" includes, but is not limited to, slabs, beams, columns, studs and walls.
- F. Coordinate work with other trades to avoid rigid contact with the building.
- G. Any conflicts with other trades which will result in rigid contact with equipment or piping due to inadequate space or other unforeseen conditions should be brought to the architect's/engineer's attention prior to installation. Corrective work necessitated by conflicts after installation shall be at the responsible contractor's expense.
- H. Bring to the architect's/engineer's attention any discrepancies between the specifications and the field conditions or changes required due to specific equipment selection, prior to installation. Corrective work necessitated by discrepancies after installation shall be at the responsible contractor's expense.
- I. Correct, at no additional cost, all installations which are deemed defective in workmanship and materials at the contractor's expense.
- J. Overstressing of the building structure must not occur because of overhead support of equipment. Contractor must submit loads to the structural engineer of record for approval. Generally bracing may occur from:
 - 1. Flanges of structural beams.
 - 2. Upper truss cords in bar joist construction.
- K. Seismic cable restraints shall be installed slightly slack to avoid short-circuiting the isolated suspended equipment, piping or conduit.
- L. Seismic cable restraint assemblies are installed taut on non-isolated systems. Seismic solid braces may be used in place of cables on rigidly attached systems only.
- M. At locations where seismic cable restraints or seismic solid braces are located, the support rods must be braced when necessary to accept compressive loads with Specification 14 braces.
- N. At all locations where seismic cable restraints or seismic solid braces restraints are attached to pipe clevis's, the clevis cross bolt must be reinforces with pipe clevis cross bolt braces.
- O. Drill-in concrete anchors shall be female wedge anchors for floor mounted equipment.
- P. Vibration isolation manufacturer shall furnish integral structural steel bases as required. Independent steel rails are not permitted on this project.
- Q. Install units between substrate and equipment as required for secure operation and to prevent displacement by normal forces.
- R. Where piping passes through walls, floors or ceilings the vibration isolation manufacturer shall provide split wall seals.

- S. Locate isolation hangers as near to the overhead support structure as possible.
- T. Adjust leveling devices as required to distribute loading uniformly onto isolators. Shim units as required where substrate is not level.
- U. For air handling equipment, install thrust restraints as indicated, and also wherever thrust exceeds 10 percent of equipment weight.
- V. Weld riser isolator units in place as required to prevent displacement from loading and operations.
- W. Flexible Pipe Connectors: Install on equipment side of shutoff valves, horizontally and parallel to equipment shafts wherever possible.

3.05 VIBRATION ISOLATION OF PIPING:

- A. Seismic Restraint of Piping
 1. Seismically restrain all piping listed as a or b below. Use seismic cable restraints if isolated. Seismic cable restraints or seismic solid braces may be used on un-isolated piping.
 - a. Gas piping and compressed air piping that is 1 inch I.D. or larger.
 - b. All other piping 2-1/2 inch diameter and larger.
 2. Transverse piping restraints shall be at 40 feet maximum spacing for all pipe sizes, except where lesser spacing is required to limit anchorage loads.
 3. Longitudinal restraints shall be 80 feet maximum spacing for all pipe sizes, except where lesser spacing is required to limit anchorage loads.
 4. For all gas piping transverse restraints shall be at 20 feet maximum and longitudinal restraints at 40 feet maximum spacing.
 5. Transverse restraint for one pipe section may also act as a longitudinal restraint for a pipe section of the same size connected perpendicular to it if the restraint is installed within 24 inches of the elbow or tee or combined stresses are within allowable limits at longer distances.
 6. Hold down clamps must be used to attach pipe to all trapeze members before applying restraints in a manner similar to clevis supports.
 7. Branch lines may not be used to restrain main lines.
 8. Cast iron pipe of all types joined with a four band shield and clamp assembly shall be braced in accordance with seismic product manufacturer's recommendations and SMACNA Seismic Restraint Manual Guidelines for Mechanical Systems.
- B. Seismic Restraint of Ductwork
 1. Seismically restrain all duct work with seismic cable restraints or seismic solid braces as listed below:
 - a. Restrain rectangular ducts with cross sectional area of 6 sq. feet or larger.
 - b. Restrain round ducts with diameters of 28 inches or larger.
 2. Transverse restraints shall occur at 30 foot intervals or at both ends of the duct run if less than the specified interval. Transverse restraints shall be installed at each duct turn and at each end of a duct run.

3. Longitudinal restraints shall occur at 60 foot intervals with at least one restraint per duct run. Transverse restraints for one duct section may also act as a longitudinal restraint for a duct section connected perpendicular to it if the restraints are installed within 4 feet of the intersection of the ducts and if the restraints are sized for the larger duct. Duct joints shall conform to SMACNA duct construction standards.
 4. The ductwork must be reinforced at the restraint locations. Reinforcement shall consist of an additional angle on top of the ductwork that is attached to the support hanger rods. Ductwork is to be attached to both upper angle and lower trapeze.
 5. A group of ducts may be combined in a larger frame so that the combined weight and dimensions of the duct for which bracing details are selected.
 6. Walls, including gypsum board non-bearing partitions, which have ducts running through them may replace a typical transverse brace. Provide channel framing around ducts and solid blocking between the duct and frame.
- C. Seismic Restraint of Electrical Services (Applicable To All Division 26 Electrical Wiring Requirements):
1. All electrical conduit 2-1/2 feet in diameter and larger shall be restrained with seismic cable restraints or seismic solid brace restraints.
 2. All electrical bus ducts, cable trays and ladder trays shall be restrained with seismic cable restraints or seismic solid braces.
 3. Transverse restraints shall occur at 30 foot intervals or both ends if the electrical run is less than the specified interval. Transverse restraints shall be installed at each electrical services turn and at each end of the electric run.
 4. Longitudinal restraints shall occur at 60 foot intervals with at least one restraint per electric run. Transverse restraints for one electric section may also act as a longitudinal restraint for a duct for an electric section connected perpendicular to it if the restraints are installed within 4' of the intersection of the electric run and if the restraints are sized for the larger electric run.
 5. All rigid floor mounted equipment must have a resilient media between the equipment mounting hole and the anchor bolt. Anchor bolts shall be designed in accordance with Section 1.06 seismic forces. Utilize bridge bearing neoprene bushings and anchor bolts shall be stud or female wedge anchors.
- D. All mechanical equipment shall be vibration isolated as per the tables in Part 4 of this specification.
- 3.06 SEISMIC RESTRAINT EXCLUSIONS:
- A. Piping
1. All piping less than 2-1/2 Inches in diameter except those listed below.
 2. All gas piping, fuel oil piping less than 1 inch I.D.
 3. All clevis or trapeze supported piping suspended from hanger rods where the point of attachment is less than the 12 inches in length from the structure to the structural connection of the clevis or trapeze.
 4. All PVC suspended vent pipe 6 inches in diameter and smaller.
- B. Duct Work

1. Rectangular or square ducts less than 6 sq. feet in cross sectional area.
 2. Round duct less than 28 inches in diameter.
 3. Duct supported by hanger rods where the point of attachment is less than 12 inches in length from the structure to the structural connection of the duct work.
- C. Electrical
1. All conduit less than 2-1/2 inches in diameter suspended by individual hanger rods.
 2. All clevis or trapeze supported conduits suspended by hanger rods where the point of attachment is less than 12 inches in length from the structure to the structural connection of the clevis or trapeze.
- D. Suspended Equipment
1. VAV boxes and fan powered equipment weighing less than 50 lbs. and rigidly connected to the supply side of the duct system and supported with a minimum of 4 hanger rods.
- 3.07 EXAMINATION OF RELATED WORK:
- A. Installer of vibration isolation work shall observe installation of other work related to vibration isolation work, including work connected to vibration isolation work; and, after completion of other related work (but before equipment startup), shall furnish written report to Engineer listing observed inadequacies for proper operation and performance of vibration isolation work. Report shall cover, but not necessarily be limited to the following:
1. Equipment installations (performed as work of other sections) on vibration isolators.
 2. Piping connections including flexible connections.
 3. Ductwork connections including provisions for flexible connections.
 4. Passage of piping and ductwork which is to be isolated through walls and floors.
- B. Do not start-up equipment until inadequacies have been corrected.
- 3.08 ADJUSTING AND CLEANING:
- A. Clean each vibration control unit, and verify that each is working freely, and that there is no dirt or debris in immediate vicinity of unit that could possibly short- circuit unit isolation.
- 3.09 DEFLECTION MEASUREMENTS:
- A. Upon completion of vibration isolation work, prepare report showing measured equipment deflections theoretical floor deflection and isolation efficiency for each major item of equipment.

PART 4 - SCHEDULES

4.01 EQUIPMENT VIBRATION ISOLATION TABLE:

- A. The following Base and Isolator Types are for these tables only. Refer to Part 2 and Part 3 for additional information.

Base Type Legend:	Isolator Type Legend:
A = No base, isolators attached directly to equipment	1 = Pad, rubber or glass fiber
B = Structural steel rails or base	2 = Rubber floor isolator or hanger
C = Concrete inertia base	3 = Spring floor isolator or hanger
D = Curb-mounted base	4 = Restrained spring isolator
N/A = Not Applicable	5 = Thrust restraint

Equipment Type	Slab On Grade			Up To 20-FT Floor Span		
	Base Type	Isol Type	Min. Defl. (Inches)	Base Type	Isol Type	Min. Defl. (Inches)
Air Compressors and Vacuum Pumps						
Tank-Mounted, Horizontal, 10 HP and smaller	A	3	0.75	A	3	0.75
Heat Pumps, Fan Coils						
All Types and Sizes	A	3	0.75	A	3	0.75
Condensing Units						
All Types and Sizes	A	1	0.25	A	4	0.75
Packaged Rooftop Air Conditioning Unit						
All Types and Sizes	A/D	1	0.25	D	3	0.75

Equipment Type	20 to 30-FT Floor Span			30 to 40-FT Floor Span		
	Base Type	Isol Type	Min. Defl. (Inches)	Base Type	Isol Type	Min. Defl. (Inches)
Propeller Fans						
Wall-Mounted	A	1	0.25	A	1	0.25
Heat Pumps, Fan Coils, Computer Room Units						
All Types and Sizes	A	3	0.75	A/D	3	1.50
Condensing Units						
All Types and Sizes	A	4	1.50	A/D	4	1.50
Packaged Rooftop Air Conditioning Unit						
All Types and Sizes	Special Vibration Methods Required by Isolation Mfr					

END OF SECTION 23 0548

SECTION 23 0553 – IDENTIFICATION FOR MECHANICAL SYSTEMS

PART 1 - GENERAL

1.01 QUALITY ASSURANCE:

- A. Manufacturer's Qualifications: Firms regularly engaged in manufacturer of identification devices of types and sizes required, whose products have been in satisfactory use in similar service for not less than 5 years.
- B. Codes and Standards:
 - 1. ANSI Standards: Comply with ANSI A13.1 for lettering size, length of color field, colors, and viewing angles of identification devices.

1.02 SUBMITTALS:

- A. Product Data: Submit manufacturer's technical product data and installation instructions for each identification material and device required.

PART 2 - PRODUCTS

2.01 MANUFACTURERS:

- A. Manufacturer: Subject to compliance with requirements, provide products by one of the following:
- B. Mechanical Identification: Equipment signs, pipe labels, and duct labels.
 - 1. Allen Systems, Inc.
 - 2. Brady (W.H.) Co.; Signmark Div.
 - 3. Brimar Industries, Inc.
 - 4. Carlton
 - 5. Industrial Safety Supply Co., Inc.
 - 6. Kolbi
 - 7. Seton Name Plate Corp.
 - 8. PVC Specialties
 - 9. Marking Services, Inc. (MSI)

2.02 MECHANICAL IDENTIFICATION MATERIALS:

- A. General: Provide manufacturer's standard products of categories and types required for each application as referenced in other Division-23 sections. Where more than single type is specified for application, selection is Installer's option, but provide single selection for each product category.

2.03 PLASTIC TAPE:

- A. General: Provide manufacturer's standard color-coded pressure-sensitive (self-adhesive) vinyl tape, not less than 3 mils thick.
- B. Lettering: Comply with piping system nomenclature as specified, scheduled, shown, or to match existing building lettering nomenclature system and abbreviate only as necessary for each application length.
- C. Width: Provide 1-1/2inches wide tape markers on pipes with outside diameters (including insulation, if any) of less than 6inches, 2-1/2inches wide tape for larger pipes.
- D. Arrows: Print each pipe marker with arrows indicating direction of flow, either integrally with piping system service lettering (to accommodate both directions), or as separate unit of plastic.
- E. Color: Comply with ANSI A13.1, except where another color selection is indicated.
- F. Nomenclature: Include the following:
 - 1. Direction of air flow
 - 2. Duct service (supply, return, exhaust, etc).

2.04 ENGRAVED PLASTIC-LAMINATE SIGNS:

- A. General: Provide manufacturer's standard engraved 2-ply bonded plastic, in the sizes and thicknesses indicated, engraved with engraver's standard letter style of the sizes and wording indicated, black with white core (letter color) except as otherwise indicated, punched for mechanical fastening except where adhesive mounting is necessary because of substrate.
- B. Thickness: 1/16-inch, except as otherwise indicated.
- C. Fasteners: Self-tapping stainless steel screws, except contact-type permanent adhesive where screws cannot or should not penetrate the substrate.

2.05 PLASTICIZED TAGS:

- A. General: Manufacturer's standard pre-printed or partially pre-printed accident-prevention tags, of plasticized card stock with matt finish suitable for writing, approximately 3-1/4-inch x 5-5/8-inch, with brass grommets and wire fasteners, and with appropriate pre-printed wording including large- size primary wording (as examples; DANGER, CAUTION, DO NOT OPERATE).

2.06 LETTERING AND GRAPHICS:

- A. General: Coordinate names, abbreviations and other designations used in mechanical identification work, with corresponding designations shown, specified, scheduled and approved by the Owner/Engineer. Provide numbers, lettering and wording as indicated and approved by the Owner/Engineer for proper identification and operation/ maintenance of mechanical systems and equipment.

- B. Multiple Systems: Where multiple systems of same generic name are shown and specified, provide identification which indicates individual system number as designated on the drawings or schedule as well as service.

PART 3 - EXECUTION

3.01 GENERAL INSTALLATION REQUIREMENTS:

- A. Coordination: Where identification is to be applied to surfaces which require insulation, painting or other covering or finish including valve tags in finished mechanical spaces, install identification after completion of covering and painting. Install identification prior to installation of acoustical ceilings and similar removable concealment.

3.02 DUCTWORK IDENTIFICATION:

- A. General: Install markers to identify air supply, return, and exhaust ductwork and duct access doors with duct markers and arrows, showing ductwork service and direction of flow, in black or white (whichever provides most contrast with ductwork color).
- B. Location: In each space where ductwork is exposed, or concealed only by removable ceiling system, locate signs near points where ductwork originates or continues into concealed enclosures, and at 50 foot spacing along exposed runs.
- C. Access Doors: Provide duct markers on each access door in ductwork, indicating purpose of access (to what equipment), other maintenance and operating instructions, and appropriate safety and procedural information.
- D. Concealed Doors: Where access doors are concealed above acoustical ceilings or similar concealment, plasticized tags may be installed for identification in lieu of specified signs, at Installer's option.

3.03 PIPING SYSTEM IDENTIFICATION:

- A. General: Install pipe markers and identification for all piping installed on project. Use nomenclature and abbreviations as listed on drawings, in the schedules and legends. Submit list with product submittal for review.
- B. General: Install pipe markers of the following type on each system indicated to receive identification, and include arrows to show normal direction of flow. Existing building identification shall match the existing method in the building.
- C. Plastic pipe markers, color per ASME A13.1, with application system as indicated under "Materials" in this section. Install on pipe insulation segment where required for hot non- insulated pipes.

- D. Locate pipe markers and color bands as follows wherever piping is exposed to view in occupied spaces, machine rooms, accessible maintenance spaces (shafts, tunnels, plenums) and exterior non-concealed locations.
- E. Near each valve and control device.
- F. Near locations where pipes pass through walls or floors/ceilings.
- G. Near major equipment items and other points of origination and termination.
- H. Spaced intermediately at maximum spacing of 25 feet along each piping run, except reduce spacing to 15' in congested areas of piping and equipment.
- I. On piping above removable acoustical ceilings.
- J. Install identification and label the following piping systems:
 - 1. Fuel Oil supply and return
 - 2. Refrigerant piping
 - 3. Cooling coil drain pan piping
 - 4. "All" piping installed in project. Use name as listed in legends and schedules.

3.04 MECHANICAL EQUIPMENT IDENTIFICATION:

- A. General: Install minimum 2 inch x 4 inch engraved plastic laminate equipment marker on each individual items of mechanical equipment. Provide marker for the following general categories of equipment.
 - 1. Main building systems.
 - 2. Room thermostats, except gun tag labels are acceptable for room thermostats.
 - 3. Pumps, compressors, chillers, condensers and similar motor-driven units.
 - 4. Rooftop units and heat recovery units.
 - 5. Fans and blowers.
 - 6. Air terminal units.
- B. Lettering Size: Minimum 1/4 inch high lettering for name of unit.
- C. Text of Signs: In addition to the identified unit, inform operator of operational requirements, indicate safety and emergency precautions, and warn of hazards and improper operations.
- D. Hand-Lettered Equipment Identification Option: If proposed to and accepted by the Owner in writing, the Contractor shall have the option of providing hand-lettered equipment identification above accessible ceilings for the following equipment:
 - 1. Air Terminal Units: Identification shall be provided on left and right sides and on the bottom of the unit. Letters shall be clear and concise, minimum 1" high, in color contrasting with that of the unit.

3.05 ADJUSTING AND CLEANING:

- A. Adjusting: Relocate any mechanical identification device which has become visually blocked by work of this division or other divisions.
- B. Cleaning: Clean face of identification devices.

END OF SECTION 23 0553

SECTION 23 0593 – TESTING, ADJUSTING AND BALANCING FOR MECHANICAL SYSTEMS

PART 1 - GENERAL

1.01 DESCRIPTION OF WORK:

- A. This section covers testing and balancing of environmental systems described herein and specified under Division 23. The testing and balancing of all environmental systems shall be the responsibility of one Testing, Balancing and Adjusting firm.
 - 1. Test, adjust and balance the following mechanical systems and the mechanical equipment associated with these systems:
 - a. General Systems and Equipment Procedures.
 - b. Air Side Systems and Equipment
 - 1) Supply/Return Air Systems
 - 2) General Exhaust/Supply Fans
 - 3) Furnace/Air Conditioning Unit
 - 4) General Exhaust Systems
 - c. Plumbing
 - 1) General
 - 2) Water heaters
 - d. Refrigeration Systems and Equipment
 - 1) General
 - 2) Condensing units
 - 3) Evaporator coils
 - e. Gas Fired Systems and Equipment
 - 1) General
 - f. Electrical Components
 - 1) Electric resistance heating
 - 2) Manual and magnetic starters
 - g. Control Systems and Equipment
 - 1) General
 - h. Life Safety Systems and Equipment
 - 1) Apparatus bay evacuation (purge) mode

1.02 QUALIFICATIONS OF CONTRACTOR:

- A. The Mechanical Contractor shall procure the services of an independent testing and balancing agency specializing in the testing, adjusting and balancing of environmental systems to perform the above mentioned work. An independent contractor is defined as an organization that is not engaged in engineering design or is not a division of a mechanical contractor entity, which installs mechanical systems.
- B. The actual fieldwork shall be performed by qualified technicians who are currently certified by the Testing, Adjusting and Balancing Bureau (TABB), the National Environmental Balancing Bureau (NEBB), or the Associated Air Balance Council (AABC) certification agencies.

- C. The Testing & Balancing Contractor shall have a minimum of three years experience in testing and balancing mechanical systems.

1.03 APPROVAL OF CONTRACTOR:

- A. The following firms are preferred contractors to complete the work. Any Testing and Balancing firm desiring to offer their services for this work and who are not listed below, shall submit their qualifications to the Architect or Engineer, not less than seven (7) working days before the bid date. Approval or disapproval will be given on each request and this action will be given in writing prior to bidding the work.
 - 1. Blue Sky
 - 2. NWESI
 - 3. Evolve
 - 4. Accurate Air
 - 5. BST
- B. Firms who are not listed, or who have not received prior approval shall not be approved to complete work on this project.

1.04 CODES AND STANDARDS:

- A. ASHRAE: ASHRAE Handbook, Applications Volume, Testing, Adjusting, and Balancing Chapter.
- B. NEBB: "Procedural Standards for Testing, Adjusting and Balancing of Environmental Systems."
- C. SMACNA: "HVAC Systems-Testing, Adjusting & Balancing."

1.05 PRELIMINARY SUBMITTALS:

- A. Within ten (10) days of award of the contract the Mechanical Contractor shall submit the name of the Test and Balance Contractor who will be performing the work. The submittal shall include a complete list of all technicians who will be performing the field work and include a photocopy of their current certification by either NEBB, AABC, or TABB certification agencies. Only those technicians included in the submittal shall perform the work. Any personnel or staff used to perform the work without prior approval of the Engineer, who are not included in the submittal, shall be grounds for rejecting the test and balance report and the project in whole.
- B. Meet all requirements of Section 23 0500 "Common Work Results for Mechanical" as applicable.
- C. Submit a list of all instrumentation to be used on an individual project and include calibration dates. Submit calibration curves. If more than one instrument of a similar type is used, a comparison of individual readings should be made. The variation between instrument readings should not exceed plus or minus 5%.

1.06 FINAL REPORTS:

- A. Refer to Division 1 for supplemental requirements.

- B. The Testing and Balancing Contractor shall submit six (6) bound copies of the final testing and balancing report at least fifteen (15) calendar days prior to substantial completion, unless noted otherwise in Division 1. Report contents shall be per Part 3 of this Section.
- C. Meet all requirements of Section 23 0500 "Common Work Results for Mechanical" as applicable.
- D. If more than two reports are made by the contractor, the Owner reserves the right to charge the contractor for subsequent reviews by their consultants. Such extra fees shall be deducted from payments by the Owner to the contractor.

1.07 SEQUENCING AND SCHEDULING:

- A. Notify Contractor/Engineer/Architect in writing of conditions detrimental to the proper completion of the test and balance work. Provide the Contractor/Architect/Engineer with a copy of the notification.
- B. Prepare a project schedule. Schedule shall indicate critical path of the balancing process and shall incorporate both requirements of other contractors necessary to meet test and balance commitments and process flow of test and balance work. Coordinate with general and mechanical contractors and insert critical steps into project master schedule.

PART 2 - NOT USED

PART 3 - EXECUTION

3.01 PRELIMINARY PROCEDURES:

- A. Testing and balancing shall not begin until the system has been completed and is in full working order and the following project conditions have been determined suitable for start of work.
 - 1. Preliminary Testing & Balancing Contractor requirements shall be ascertained prior to the commencement of work through a review of the project plans and specifications. In addition, visual observations at the site during construction shall be made to determine the location of required balancing devices, that they are being installed properly, and in an accessible location for the need. Report in writing any deficiencies to the Contractor/Engineer/Architect immediately.
 - 2. Before any air balance work is done, the system shall be checked for duct leakage (obtain pressure test results), assure filters are installed, verify filters are changed if they are dirty, check for correct fan rotation, equipment vibration, and check automatic dampers for proper operation. All volume control dampers and outlets shall be wide open at this time.
 - 3. Before any domestic water system balancing work is done, the system shall be checked for plugged strainers, proper pump rotation, air locks, and check valve installation. All throttling devices and control valves shall be open at this time.
 - 4. Verify systems do not exhibit excessive sound and/or vibration levels. Report in writing any deficiencies to the Engineer immediately.

3.02 GENERAL SYSTEM AND EQUIPMENT PROCEDURES:

- A. Balance all air at terminals within +10% to -5% of design flow quantities. Notify Engineer in writing of conditions detrimental to the proper completion of the test and balance work. Provide the Engineer with a copy of the notification.
- B. Mark equipment settings with paint, including damper control positions, balancing cocks, circuit setters, valve indicators, fan speed control settings and similar controls and devices, to show final settings at completion of test-adjust-balance work.
- C. Patch holes in insulation, ductwork and housings, which have been cut or drilled for test purposes, in a manner recommend by the original installer.
- D. Measure, adjust and report equipment running motor amps and power factor, KW, rated motor amperage, listed motor power factor, voltage, and all nameplate data. Perform these measurements for all equipment operational modes.
- E. Check and adjust equipment belt tensioning.
- F. Check keyway and setscrew tightness. Report any loose screws and notify Mechanical Contractor prior to equipment balancing.
- G. Record and include in report all equipment nameplate data.
- H. Verify that all equipment safety and operating controls are in place, tested, adjusted and set prior to balancing.
- I. Verify that manufacturer start-up has occurred per specification prior to balancing.

3.03 AIR SIDE SYSTEMS AND EQUIPMENT PROCEDURES:

- A. In addition to the procedures identified under each specific heading below, provide general data required by 3.3 above.
- B. Filters shall be restricted to increase pressure drop to 50% of span between initial pressure drop and final recommended pressure drop for setting final airflows for fans. Check fan motor amps with clean filters and simulated loaded filters, and report for each piece of equipment. Equipment shall be supplied with clean filters upon completion of balance. Balance and report air quantities.
- C. Supply/Return Air Systems:
 - 1. Balance and report supply and return diffuser/grille quantities. Air diffusion patterns shall be set as noted on drawings and to minimize objectionable drafts and noise.
 - 2. Provide full pitot traverses in duct mains downstream of supply fans. Balance and report air quantities.
 - 3. Report design air device inlet or outlet size, actual inlet or outlet size, design and actual velocity through the orifice, for each terminal in the system.

D. General Exhaust/Supply Fans:

1. Adjust CFM to system requirements. Determine the limiting fan tip speed before increasing RPM. Final fan speed setting shall allow for filter loading (as applicable) and shall establish proper duct pressures for operation of zone CFM regulators. For direct drive with electronically commutated motors: Set fan speed by adjusting the speed control After adjustment, check fans ability to re-start after powering down. Increase setting if required for proper starting.
2. Measure and report static pressures upstream and downstream of all fans.
3. Measure and report fan RPM.
4. Report design fan inlet or outlet size, actual inlet or outlet size, design and actual velocity through the orifice.

E. Furnace/Air Conditioning Units:

1. Balance and report supply and return fan CFM, upstream static pressure and downstream static pressure.
2. Measure and report static pressure upstream and downstream of all AHU components such as coils, filters (clean and simulated dirty), dampers, etc.
3. After system and fan balance is complete, perform pitot traverses on all coils in 100% heating and cooling modes.
4. Balance all air handling unit coils and report per hydronic, gas fired or refrigeration equipment portions of this section.
5. Report design fan inlet or outlet size, actual inlet or outlet size, design and actual velocity through the orifice.
6. Balance and report all temperatures of airside during normal operating modes.
7. Measure, adjust, set, balance and report outside air, return air and exhaust/relief air quantities for all air handling systems.
 - a. Air quantities shall be determined by pitot traverse/direct airflow measuring procedures where ever possible, where duct/inlet conditions do not allow for accurate direct measurement of outside air the following method shall be used:
$$\text{Outside Air CFM} = \frac{\text{Supply Fan Total CFM}}{\text{Return Fan Total CFM}}$$
 - b. In addition to the direct measuring of airflow quantities, measure and record outside air, return air and mixed air temperatures, determine thermal/mass energy balance and provide calculations to verify measured airflow quantities. Adjusting and setting the outside air quantity as a percentage of damper position will not be acceptable.

F. General Exhaust Systems:

1. Balance and report exhaust grille quantities. Report objectionable noise.
2. Provide full pitot traverses at each individual exhaust riser and at each exhaust fan. Balance and report.
3. Report design air device inlet or outlet size, actual inlet or outlet size, design and actual velocity through the orifice, for each terminal in the system.

3.04 PLUMBING SYSTEMS AND EQUIPMENT:

A. General:

1. Check, adjust and set temperature control devices to domestic hot water temperatures indicated on drawings.
2. Adjust pressure-reducing stations, report downstream system static pressure.
3. Verify proper location and operation of ASME pressure and temperature relief valves.
4. Measure and report residual pressure at full flow at most remote plumbing fixture; requiring highest operating pressure (usually flush valve water closets).
5. Verify that most remote fixture has hot water available semi-instantaneously with recirculation system operating. Report.
6. Refer to plumbing drawings for location of all balancing valves serving the Domestic Hot Water Circulation (HWC) System and Domestic Hot Water Circulation Pumps. Adjust balancing valves to indicated flow rate. Report flow rate for all balance valves. Measure, adjust and report flow rate for each pump.

B. Water Heaters:

- a. Measure, set and report inlet and outlet temperatures.
- b. Balance and report per gas portions of this section.

3.05 REFRIGERATION SYSTEMS AND EQUIPMENT:

A. General.

B. Condensing Units (Air Cooled):

1. Measure and report ambient temperature, refrigerant suction and discharge pressure, oil pressure, compressor and fan KW and compressor and fan amps.
2. Condensing units integral to the air moving equipment shall be measured at minimum outside air.
3. Perform all measurements at all stages of cooling.

C. Evaporator Coils:

1. Measure and report temperature upstream and downstream of evaporator coils at all stages of cooling at all design air quantities. Calculate and report coil face velocities.

3.06 GAS FIRED SYSTEMS AND EQUIPMENT:

A. General.

1. Record gas pressures downstream of each pressure-reducing valve. Verify that pressures match those on construction documents and report.
2. Measure and report flue temperature at all stages of heating.
3. Measure and report temperatures upstream and downstream of gas-fired coils at all stages of heating at all design air quantities.
4. Observe and report operation of all radiant gas fired heaters, at all stages of heating.
5. Record fan data.

3.07 ELECTRICAL COMPONENTS ASSOCIATED WITH MECHANICAL SYSTEMS:

- A. Electric Resistance Heating Systems and Equipment:
 - 1. Measure full load amperage at full heating and design CFM and report.
 - 2. Electric heaters in an airstreams shall have entering and leaving air temperature measured and reported for all stages of heating.
- B. Manual and Magnetic Starters:
 - 1. Check all thermal overloads. Identify improperly protected equipment in report. Furnish and exchange thermals as required for proper motor protection.
 - 2. Motor Control Center Magnetic Starters: Check for correct sizing. Notify Electrical Contractor of discrepancies.

3.08 CONTROL SYSTEMS AND EQUIPMENT:

- A. General:
 - 1. Operate all temperature control systems with the temperature control contractor's representative for proper sequence of operation. Be responsible for calibration of flow measurement devices used as input to the temperature control system. All air system flow measurement stations including VAV terminals shall be calibrated against a Pitot tube traverse or air diffuser capture hood. Balancing Contractor shall assure accuracy of all flow measurement devices or shall report their failure to be accurate.
 - 2. Work with the Controls Contractor to set minimum outside air damper positions.
 - 3. Work with the Controls Contractor to optimize VAV duct static pressure.

3.09 LIFE SAFETY SYSTEMS AND EQUIPMENT:

- A. Apparatus Bay Evacuation (Purge) Mode:
 - 1. Balance and report measurements of Section 3.3 in this operational mode.
 - 2. Verify that each exhaust fan is energized when the associated space detector (carbon monoxide or nitrogen dioxide) is tripped.
 - 3. Coordinate with the Fire Department/Authority Having Jurisdiction for additional testing requirements. Complete and submit any documentation for Fire Department/Authority Having Jurisdiction final acceptance.

3.10 SOUND AND VIBRATION:

- A. Sound Inspection:
 - 1. Report audible tonal characteristics such as whine, whistle, hum or rumble. Also report time varying sound levels or beats induced from aerodynamic instability, perform this for all rooms.
- B. Vibration Inspection and Testing:
 - 1. Report excessive vibrations from any equipment. Inspect upstream and downstream duct and piping systems and report excessive vibrations.

3.11 REPORT OF WORK:

- A. The Testing and Balancing Contractor shall submit six (6) bound copies of the final testing and balancing report at least fifteen (15) calendar days prior to the Mechanical Contractor's request for final inspection.
- B. A complete reduced set of mechanical contract drawings (showing each system) shall be included in the report with all equipment, flow measuring devices, terminals (outlets, inlets, coils, fan coil units, schedules, etc.) clearly marked and all equipment designated. The test and balance contractor can obtain drawing files from Cator, Ruma, & Associates for development of these drawings.
- C. Data shall be reported per Part 3 of this Section on standard NEBB forms. Generate custom forms that contain the information in this Section when a standard NEBB form does not exist for a piece of equipment. All NEBB forms shall be fully filled out for this report. When additional information is required by this Section, it shall be provided.
- D. The report shall include a list of all equipment used in the testing and balancing work.
- E. Report systems for excessive sound and vibration per the sound and vibration inspection portions of this specification.
- F. Substantial completion of this project will not take place until a satisfactory report is received. The Testing & Balancing Contractor shall respond and correct all deficiencies within seven (7) days of receiving the Engineer's written review of the balancing report. Failure to comply will result in holding retainage of the final payment until all items have been corrected to the satisfaction of the Engineer.
- G. The report shall be signed by the supervising registered professional engineer and affixed with their registration stamp, signed and dated in accordance with state law.

3.12 GUARANTEE OF WORK:

- A. The Testing & Balancing Contractor shall guarantee the accuracy of the tests and balance for a period of 90 days from date of final acceptance of the test and balance report. During this period, the Testing & Balancing Contractor shall make personnel available at no cost to the Owner to correct deficiencies that may become apparent in the system balance.

END OF SECTION 23 0593

SECTION 23 0700 – INSULATION FOR MECHANICAL SYSTEMS

PART 1 - GENERAL

1.01 QUALITY ASSURANCE:

- A. Manufacturer's Qualifications: Firms regularly engaged in manufacture of mechanical insulation products and systems, of types and sizes required, whose products have been in satisfactory use in similar service for not less than 3 years.
- B. Installer's Qualifications: Firm with at least 5 years successful installation experience on projects with mechanical insulations similar to that required for this project.
- C. Flame/Smoke Ratings: Provide composite mechanical insulation (insulation, jackets, coverings, sealers, mastics and adhesives) with flame-spread index of 25 or less, and smoke-developed index of 50 or less, as tested by ASTM E 84 (NFPA 255) method. In addition, the products, when tested, shall not drip flame particles, and flame shall not be progressive. Provide Underwriters Laboratories Inc. label or listing, or satisfactory certified test report from an approved testing laboratory to prove that fire hazard ratings for materials proposed for use do not exceed those specified.
- D. Definitions
 - 1. ASJ: All Surface Jacket.
 - 2. FSK: Foil Scrim Kraft.
 - 3. MRT: Mean Temperature Rating.
 - 4. NRTL: Nationally Recognized Testing Laboratory
 - 5. PCF: Pounds per Cubic Foot.
 - 6. PSF: Pounds per Square Foot.
 - 7. SSL: Self Sealing Lap
- E. Codes and Standards:
 - 1. Oregon Energy Efficiency Specialty Code, currently adopted version.
 - 2. ASHRAE 90.1, latest edition.

1.02 SUBMITTALS:

- A. Product Data: Submit manufacturer's technical product data and installation instructions for each type of mechanical insulation. Submit schedule showing manufacturer's product number, k-value, thickness, density, and furnished accessories for each mechanical system requiring insulation. Submit detail product information and installation information for all jacketing systems specified in this section.

1.03 DELIVERY, STORAGE, AND HANDLING:

- A. Deliver insulation, coverings, cements, adhesives, and coatings to site in containers with manufacturer's stamp or label, affixed showing fire hazard indexes of products.

- B. Protect insulation against dirt, water, and chemical and mechanical damage. Do not install damaged or wet insulation; remove from project site.

PART 2 - PRODUCTS

2.01 MANUFACTURERS:

- A. Manufacturer: Subject to compliance with requirements, provide product by one of the following:
 - 1. Mechanical Insulation:
 - a. Johns Manville Corp.
 - b. Owens-Corning Fiberglas Corp.
 - c. Knauf Fiber Glass
 - d. Manson
 - e. CertainTeed
 - f. Einsulation
 - g. Armacell
 - h. Aeroflex.
 - i. PABCO, Inc.
 - j. Rubatex Corp.
 - 2. Jacketing & Covering Products:
 - a. Childers
 - b. Ceel-Co
 - c. Zeston
 - d. Alpha Associates, Inc.
 - e. Venture Tape
 - f. Polyguard

2.02 PIPING INSULATION MATERIALS:

- A. Fiberglass Piping Insulation: ASTM C 547, Class I unless otherwise indicated. ASJ-SSL Jacket with tensile strength of 35 lbs/in, mullen burst 70 psi, Beach Units puncture 50 oz. in/in, permeability 0.02 perm factory applied vapor barrier jacket and adhesive self-sealing lap joint. "K" factor shall be maximum 0.23 at 75°F MRT, 0.24 at 100°F MRT, 0.29 at 200°F MRT and 0.36 at 300°F MRT.
- B. Flexible Elastomeric, Closed Cell Piping Insulation: ASTM C 534, Type I. Water vapor permeability of 0.10 perm inches or less. Insulation shall be pre-installed on piping, or un-slitted to be slipped over piping as a single piece. "K" factor shall be maximum 0.245 at 50°F MRT, 0.25 at 75°F MRT and 0.26 at 90°F MRT.
- C. Jackets for Piping Insulation:
 - 1. Aluminum Jacketing: Manufactured from T3003 (or T/5005) H14 to H19 aluminum alloy with 3/16" corrugations and shall have a factory attached 1 mil thick polyethylene moisture barrier continuously laminated across the full width of the jacketing. Jacketing shall be 0.016" thick minimum. Provide matching factory fabricated covers for 90-degree and 45-degree elbows, tee fittings, flange fittings valve bodies, blind ends, reducers and other fittings

necessary to make the covering system complete, waterproof and weatherproof. All jacketing shall be color coated baked on polyester finish, color selected by Architect.

2.

- D. Staples, Bands, Wires, and Cement: As recommended by insulation manufacturer for applications indicated.
- E. Adhesives, Sealers, and Protective Finishes: As recommended by insulation manufacturer for applications indicated and additional finishes as specified.

2.03 DUCTWORK INSULATION MATERIALS:

- A. Rigid Fiberglass Ductwork Insulation: ASTM C 612, Class I, 450°F temperature limit, density of 3 PCF. "K" value shall be maximum 0.23 at 75°F mean temperature, vapor transmission rating shall not exceed 0.02 perms, FSK facing.
- B. Round Surface Semi-Rigid Fiberglass Blanket Insulation: ATSM C 612, Class I, 450°F temperature limit, 2.5 PCF density "K" value of 0.25 max at 75°F mean temp, FSK facing. Orientation of fibers shall be perpendicular to facing to facilitate application on round surfaces.
- C. Flexible Fiberglass Ductwork Insulation: ASTM C 553, Type I, 3/4 lbs per cu. ft. density. "K" value shall be maximum 0.30 at 75°F mean temperature, 250°F temperature limit, vapor transmission rating shall not exceed 0.02 perms, FSK facing.
- D. Ductwork Insulation Accessories: Provide staples, bands, wires, tape, anchors, corner angles and similar accessories as recommended by insulation manufacturer for applications indicated.
- E. Ductwork Insulation Compounds: Provide cements, adhesives, coatings, sealers, protective finishes and similar compounds as recommended by insulation manufacturer for applications indicated.

PART 3 - EXECUTION

3.01 minimum insulation requirements

- A. All mechanical systems shall be insulated in accordance with the locally adopted energy codes or the requirements of this specification section, whichever is more stringent.

3.02 general:

- A. Examine areas and conditions under which mechanical insulation is to be installed. Do not proceed with work until unsatisfactory conditions have been corrected in manner acceptable to Installer.
- B. Insulation shall be installed to allow maintenance and replacement of system components without compromising the insulation integrity or vapor barrier on cold systems.

- C. Workmanship shall be first class and of the highest quality, poor installation or bad appearance as determined by the engineer shall be due cause to reject the entire project in whole and retainage will be withheld until corrective action is completed to the engineer's satisfaction.

3.03 HVAC PIPING SYSTEM INSULATION:

- A. Sub-Freezing Piping (39°F and Lower):
 - 1. Application Requirements: Insulate the following piping systems:
 - a. Refrigerant suction lines between evaporators and compressors.
 - 2. Insulate each piping system specified above with the following types and thicknesses of insulation:
 - a. Above Ground, Inside Building, Elastomeric:
 - 1) 1/2 inch thick insulation on pipe sizes smaller than 1 inch.
 - b. Above Ground, Exterior, Cellular Glass:
 - 1) 3/4 inch thick insulation on pipe sizes smaller than 1 inch.

3.04 DUCTWORK SYSTEM INSULATION:

- A. Insulation Omitted: Do not insulate lined ductwork unless additional wrap is required to meet Energy Code.
- B. Insulate each ductwork system specified above with the following types and thicknesses of insulation:

APPLICATION	TYPE, THICKNESS		
	RIGID FIBERGLASS	FLEXIBLE FIBERGLASS	FLEXIBLE ELASTOMERIC
Interior; concealed; cold, hot or dual temperature duct	1-1/2" minimum up to 2" as required to cover joints & reinforcements	1-1/2"	Not Allowed
USE SEMI-RIGID FIBERGLASS INSULATION FOR ROUND DUCT			
Interior; exposed within conditioned finished spaces; cold, hot, or dual temperature duct	1-1/2" minimum up to 2" as required to cover joints & reinforcements	1-1/2"	None

3.05 INSTALLATION OF PIPING INSULATION:

- A. General: Install insulation products in accordance with manufacturer's written instructions, and in accordance with recognized industry practices to ensure that insulation serves its intended purpose.
- B. Install insulation on pipe systems subsequent to testing, and acceptance of tests.

- C. Install insulation materials with smooth and even surfaces. Insulate each continuous run of piping with full-length units of insulation, with single cut piece to complete run. Do not use cut pieces or scraps abutting each other.
- D. Clean and dry pipe surfaces prior to insulating. Butt insulation joints firmly together to ensure complete and tight fit over surfaces to be covered.
- E. Maintain integrity of vapor-barrier jackets on cold pipe insulation, and protect to prevent puncture or other damage.
 - 1. Do not use staples or tacks on vapor barrier jackets.
 - 2. Seal vapor barrier penetrations with vapor barrier finish recommended by the manufacturer.
 - 3. Seal fitting covers with PVC tape.
 - 4. Cover all unions, check valves, and other in-line devices. Mark outer covering with indelible marker to identify item covered.
- F. Neatly bevel and seal insulation at all exposed edges.
- G. Cover valves, fittings and similar items in each piping system with equivalent thickness and composition of insulation as applied to adjoining pipe run. Install factory molded, precut or job fabricated units (at Installer's option) except where specific form or type is indicated.
- H. Extend piping insulation without interruption through walls, floors and similar piping penetrations, except where otherwise indicated.
- I. See Section 23 0529 for insulation shields.
- J. Flexible Elastomeric Piping Insulation:
 - 1. Install unslit, by slipping over piping prior to joining, or install pre-insulated soft copper tubing.
 - 2. Seal butt ends with adhesive.
- K. Cellular Glass Insulation:
 - 1. Apply in a single layer. Secure to pipe with ½ inch wide aluminum bands.
 - 2. For indoor applications, apply all-purpose Kraft paper/aluminum foil/vinyl coating jacket. Seal all lap and butt joints with self-seal vapor barrier tape.
 - 3. For outdoor applications, apply aluminum rubber/Tedlar jacketing as described below.
- L. Piping Exposed to Weather: Protect outdoor insulation from weather by installing aluminum jacketing.
 - 1. Aluminum jacketing shall be secured by 1/2 inch wide stainless steel bands located on 24 inch centers. All joints and seams shall be caulked with clear silicone. Locate all longitudinal seams at the bottom of piping to minimize joint exposure to weather. Contractor may propose pre-fabricated sealing and fastening systems, submit samples and product data for approval.
 - 2. Install self-adhesive laminate jacketing in accordance with the manufacturer's instructions.

3.06 INSTALLATION OF DUCTWORK INSULATION:

- A. General: Install insulation products in accordance with manufacturer's written instructions, and in accordance with recognized industry practices to ensure that insulation serves its intended purpose.
- B. Install insulation materials with smooth and even surfaces.
- C. Clean and dry ductwork prior to insulating. Butt insulation joints firmly together to ensure complete and tight fit over surfaces to be covered.
- D. Maintain integrity of vapor-barrier on ductwork insulation, and protect it to prevent puncture and other damage.
 - 1. Avoid the use of staples on vapor barrier jackets.
 - 2. Seal vapor barrier penetrations with vapor barrier tape recommended by the manufacturer.
- E. Extend ductwork insulation without interruption through walls, floors and similar ductwork penetrations, except where otherwise indicated.
- F. Lined Ductwork: Omit insulation on ductwork where internal insulation has been installed. If R Value of lining meets code.
- G. Flexible Fiberglass Insulation: Cut back insulation to provide a 2 inch facing overlap at all seams. Seams shall be stapled approximately 6 inches on center with outward clinching staples, then sealed with pressure-sensitive tape matching the facing and designed for use with duct insulation. The underside of ductwork 24 inches or greater shall be secured with mechanical fasteners and speed clips spaced approximately 18 inches on center. The protruding ends of the fasteners should be cut off flush after the speed clips are installed, and then sealed with the same tape as specified above. Install with a maximum of 25% compression to maintain the manufacturer published installed R-value.

3.07 PROTECTION AND REPLACEMENT:

- A. Replace damaged insulation which cannot be repaired satisfactorily, including units with vapor barrier damage and moisture saturated units.
- B. Protection: Insulation Installer shall advise Contractor of required protection for insulation work during remainder of construction period, to avoid damage and deterioration.

END OF SECTION 23 0700

SECTION 23 0800 – MECHANICAL COMMISSIONING

PART 1 - GENERAL

1.01 DESCRIPTION:

A. Purpose:

1. Verify operation and functional performance of central mechanical HVAC systems, controls & and electrical systems for compliance with "Design Intent", as defined by the Contract Documents.
2. Document Mechanical and Electrical system test and inspections.
3. Verify application of operation and maintenance manuals, as-built (record) documents, spare parts lighting, special tools, controls and other items as may be specified herein for support of Mechanical and Electrical systems and equipment.
4. Provide indirect support of the training of personnel for operation and maintenance of Mechanical and Electrical equipment and systems.

B. General:

1. Furnish labor and material to accomplish complete mechanical and electrical system commissioning as specified herein. Complete interim commissioning of HVAC systems during initial season operation.

C. Job Conditions: The commissioning contractor shall become familiar with the contract documents, all addenda, and change orders issued for this project prior to commencing the commissioning work.

1.02 QUALITY ASSURANCE:

A. Reference: ASHRAE

1. Guideline 0-2013 – The Commissioning Process.
2. Guideline 1.1-2007 – HVAC&R Technical Requirements for the Commissioning Process.
3. Guideline 1.5-2012 – The Commissioning Process for Smoke Control Systems.
4. Standard 202-2013 – The Commissioning Process for Buildings and Systems.

B. Qualifications: The "Commissioning Authority" shall be defined as a company or agency of experienced personnel, qualified to plan & carry out the overall commissioning progress. The Commissioning Authority shall submit for owner review, an outline of the organization's personnel qualification resources, commissioning, documentation process & commissioning plan specifically prepared for this project.

1.03 DOCUMENTATION:

A. The Commissioning Authority shall obtain the following:

1. Project plans and specification (contract documents), authorized revisions, shop drawings and submittals (approved, Test and Balance report, equipment start-up and certification reports, operation and maintenance manuals, etc.

2. Records of required code authority inspections, contractor test inspections, documentation, sign-offs, etc.

1.04 SUBMITTALS:

- A. Commissioning Authority will submit the name of the commissioning project manager approval prior to starting the commissioning process.
 1. Commissioning Plan (describe extent and delivery schedule.)
 2. Commissioning Outline Plan (describe extent of plan, expected duration of observations, personnel involved, schedule, etc.)
 3. Tool List: provide a detailed list of the tools required for the commissioning process.

1.05 RESPONSIBILITIES OF OTHERS: Applicable specification sections outline trade responsibilities during the commissioning process.

- A. General Contractor:
 1. General Contractor shall verify completeness of the building envelope, perimeter and interior items, which effect proper operation, and control of HVAC equipment and systems.
 2. The General Contractor will assure participation and cooperation of specialty contractors (Mechanical, TAB, building automation system, etc.) under his jurisdiction as required for the commissioning process.
- B. Contractors Specialty:
 1. Individual mechanical and electrical sub - will be responsible for providing labor, material, equipment, etc., required within the scope of this specialty to facilitate the commissioning process. The listed Sub-Contractor will perform tests and verification procedures required by the commissioning process when requested by the Commissioning Authority and directed by the General Contractor.
- C. Owner/Operator:
 1. Owner/Operator may schedule personnel to participate in commissioning process.
 2. Owner/Operator will advise the Commissioning Authority regarding changes in building occupancy, usage, or functional requirements.

PART 2 - PRODUCTS

2.01 INSTRUMENTATION:

- A. Instrumentation will be provided by agency performing prior tests. Instruments will be operated by individual agency requested by the Commissioning Authority, as specified elsewhere herein.

PART 3 - EXECUTION

3.01 GENERAL:

- A. Commissioning Authority will participate in the final construction phase of the project to assure compliance with specific Commissioning requirements.

3.02 PROCEDURE:

- A. Attend construction meeting and establish requirements for the Commissioning process throughout construction phase.
- B. Prepare and submit to the owner's representative (name) (time) after contract award, a Commissioning plan which shall outline:
 - 1. Responsibility of each trade affected by Commissioning as required by appropriate section of this specification.
 - 2. Requirement for documentation as listed elsewhere herein.
 - 3. Requirements for documentation of tests and inspections required by code authorities.
 - 4. Requirements for the Commissioning program during specified operational seasons part and full loads as further delineated in 3.03.
- C. Periodically attend construction and coordination meetings.

3.03 MECHANICAL SYSTEMS COMMISSIONING:

- A. Mechanical System Commissioning shall begin after HVAC equipment and systems, along with related equipment; systems, structures and areas are complete.
- B. Verify TAB readings, such as:
 - 1. Supply and return air CFM quantities.
 - 2. Fan performance
 - 3. Branch duct readings
 - 4. Refrigeration side performance
- C. Verify calibration of thermostats and related controls, such as:
 - 1. VAV boxes
 - 2. Valve positions
 - 3. Damper position
- D. Verify readings of remote data and control systems, such as:
 - 1. Temperature
 - 2. Air flow
 - 3. Damper positions
- E. Verify operation of system modes, such as economizer cycle, apparatus bay evacuation (purge) mode and in specific:
 - 1. Damper and fan operation
 - 2. Carbon monoxide and nitrogen dioxide detector response

- F. Verify that total HVAC system is performing to provide conditions as outlined in the contract documents, including seasonal, part and full load conditions.

3.04 COMMISSIONING CHECKLIST

- A. The following commissioning checklists are provided to illustrate the minimum information, which should be included in the commissioning checklist final report.

3.01 COMMISSIONING CHECKLIST - VAV DEVICES AND DUCTWORK

- A. Prior to Functional Performance Test:

1. All VAV boxes are in place, ducted, connected to controls system, heating boxes connected to electrical circuits with local disconnects mounted.
2. Ductwork complete, as-built shop drawings submitted, duct pressure and leakage test complete.
3. Duct static pressure sensor installed, calibrated and transmitting 4-20 MA signal to fan speed controller. DDC controls system operational with input/output from each VAV box and thermostat verified, local controller functional and monitoring CRT functional.
4. Smoke/fire dampers installed as required with access, verify status as to open/closed position.
5. Test and balance operation is complete including each VAV box calibrated for maximum/minimum flow settings, low pressure duct and devices balanced at maximum flow conditions, heating VAV boxes fan speed setting/air flow adjusted.

- B. Personnel present during demonstration:

1. General Contractor and Mechanical, Controls and Electrical Contractor.
2. Commissioning authority.
3. Owner's representative.

- C. Functional Performance Test: Contractor shall demonstrate operation of VAV boxes as per specifications including the following:

1. Cooling/heating VAV boxes: With system as described above, perform all cooling only tests at noted. In addition, for space heating requirement demonstrate the following:
 - a. VAV box response to room temperature set point adjustment at local controller and CRT. Changes to be 78 degrees F to 68 degrees F, 72 degrees F and 82 degrees F.
 - 1) Check damper maximum/minimum flow settings.
 - 2) Verify damper actuator response to control input changes and rate of response. Record room temperature change, rate of change and overshoot/undershoot of desired temperature.
2. VAV box response to sensor call for heating via set point adjustment, local controller and CRT changes. Changes to be warm up from 55 degrees F to 68 degrees F, from 68 degrees F to 74 degrees F. Verify cooling damper closes to minimum position, fan energized to circulate air, and upon further drop in space temperature (T-stat adjustment acceptable), verify hot water reheat activation, deactivation, and shut off on loss of air flow. Loss of airflow to be demonstrated by interrupting interlock or manual air vane flow sensor

adjustment. Record room temperature change, rate of change and overshoot/undershoot of set point temperature.

D. Results:

1. The Commissioning Authority shall report results obtained in 3 above.
2. If specified equipment performance is not verified, the Commissioning Authority shall report remedial action required and re-schedule Functional Performance Test.

E. Reports:

1. Submit reports of Functional Performance Test item 3 above to the owner's representative.

3.01 COMMISSIONING CHECKLIST - AIR HANDLING UNITS including packaged rooftop units

A. Prior to Functional Performance Test:

1. Verify unit is properly installed, securely fastened to roof, access doors are operable and sealed, dampers and casing undamaged, insulation, and drain pan and interior are not damaged. Check and verify condensate drainage is unobstructed.
2. Verify power available to unit disconnect and control panel.
3. Verify control power is energized and dampers operable.
4. Verify variable speed supply fan controller is energized with control power source available (if applicable).
5. Verify shipping blocks on supply fan isolation rails are removed, fan drive and motor adjusted, check rotation.
6. Verify return fan drive and motor adjusted, check rotation.
7. Verify construction start-up T & B filters removed and replaced with new filters. During testing, completely blanket filters with filter media to simulate 0.5 in W.C. pressure drop (1/2 dirty filters).
8. Test and Balance Report submitted.

B. Personnel present during demonstration:

1. General Contractor and Mechanical, Electrical, and Controls Contractor.
2. Commissioning authority.
3. Owner's representative.

C. Functional Performance Test: Contractor shall verify operation of air handling unit (AHUS) as per specification including the following:

1. Activate AHUS using control system command.
2. The following sequence of control shall be verified:

D. Start-up

1. Minimum and economizer outside air damper closed.
2. Return air damper open.
3. Relief air damper closed. Relief /exhaust fan off.
4. Low temperature cutout allows start of fan if temperature inside unit is above 45 degrees F.
5. Multizone AHUS zone dampers motors are installed and operational.

6. Normal Day-time operation - ambient temperature above specified economizer changeover.
 - a. Minimum outside air damper open.
 - b. Economizer outside air damper closed.
 - c. Return air damper open.
 - d. Relief air damper closed. Relief/exhaust fan off.
 - e. Fan multizone controller receiving signal from temperature sensor.
 - f. Mechanical (DX) cooling is enabled and cycles to maintain 55 ^{degrees F} leaving air temperature.
7. Economizer cycle outside air temperature less than specified economizer changeover.
 - a. Minimum outside air damper open
 - b. Economizer outside air damper modulated to maintain 60 ^{degrees F} supply air.
 - c. Relief/exhaust fan modulates to relieve economizer supply air.
 - d. Mechanical (DX) cooling is off
 - e. Fan multizone controller receiving signal from temperature sensor.
8. Verify VAV fan controller calibration and maintenance of duct static pressure 1.5 in w.c. 0.2 in during 20% to 100% of design air flow.
9. Verify unit shut down during fire event initiated by smoke/heat sensors, or day room smoke purge activation.
10. Verify airflow balance, outside air/return air; during variable unit air flow conditions.

E. Results:

1. The Commissioning Authority shall report results obtained in 3 above.
2. If specified equipment performance is not verified, Commissioning Authority shall report remedial action required and re-schedule Functional Performance Test.

F. Reports:

1. Submit reports of Functional Performance Test item 3 above to owner's representative.

3.02 COMMISSIONING CHECKLIST - BAS CONTROLS SYSTEM

A. Prior to Functional Performance Test:

1. All control devices are in place, operable, calibrated, and communicating with local control panels and operator interface terminal communicating with local control panels and operator interface terminal (CRT).
2. Test and verify power supplies, wiring, low voltage transformers, allowable voltage drops, and related interlocks are available and meet specifications. Continuity has been checked.
3. Verify that control software programs have been loaded, edited and operational.
4. Controlled devices, mechanical equipment, actuators, and sensors are complete and operable.
5. Interrupt building power supply for 30 minutes, re-energize, verify software packages and programming remained intact and operable after interruption.

B. Personnel present during demonstration:

1. General, Mechanical, Electrical, and Controls Contractor.
2. Commissioning authority.

3. Owner's representative.
- C. Functional Performance Test: Contractor shall verify operation of the controls system as per specification and the following:
1. Sensing Element: Verify wall mounted sensing elements are located per plans, securely mounted on wall with protective cover. Furnish plans, securely mounted on wall with protective cover. Furnish calibrated digital thermometer 40-105 degrees F +0.5 degrees F accuracy to verify reporting temperature of each sensing element. At each sensing element compare temperature sensed vs. actual temperature. Query each sensing element from local control panel and CRT; allowable variance is 0.5 degrees F from digital thermometer.
 2. Follow procedure described in item a) above for all temperature-sensing devices.
 3. VAV box controllers, refer to demonstration procedure in VAV section.
 4. In each VAV control zone, reset set point from 72 degrees F to 60 degrees F, and then record time to achieve set point (as climatic conditions and internal loads permit).
 5. Night setback (as climatic conditions allow): Verify heating VAV boxes operate to maintain 55degrees F space temperature.
 6. Morning warm-up cycle: Verify warm-up time, trend logging function, and reset of warm-up time at different ambient conditions, i.e. 50 degrees F ambient and 30 degrees F.
 7. Air Handling Unit: Refer to demonstration procedure in applicable section. At CRT, reset leaving air temperature set point, log response of multizone AHU's zone control valves, space temperatures, VAV box reactions, and system flow in system.
- D. For all controls Functional Performance Test, Prepare report in format as follows:
1. Binary points (per specified points list):

a. Verify	YES	NO
Command issued	___	___
Command accepted	___	___
Command executed	___	___
Controlled device responded	___	___
Feedback verified response	___	___
- E. Analog points (per specified points list):
1. INITIAL* FINAL*

a. Verify	YES	NO	STATUS	STATUS
Command Issued	___	___	_____	_____
Command Accepted	___	___	_____	_____
Command Executed	___	___	_____	_____
Controlled device Responded	___	___	_____	_____
Feedback Verified Response	___	___	_____	_____

*Status/readings to be reported as follows:
 Control Signal
 Actual system effect: Air flow, temperature, pressure, etc.
 For interlocked devices, positioners, multiple points of control for each command, list effect and response on all devices.
- F. Results:

1. The Commissioning Authority shall report results obtained in 3 above.
 2. If specified equipment performance is not verified, Commissioning Authority shall report remedial action required and re-scheduled Functional Performance Test.
- G. Reports: Submit reports of Functional Performance Test item 3 above to The Owner's Representative.

END OF SECTION 23 0800

SECTION 23 0900 – INSTRUMENTATION AND CONTROL FOR MECHANICAL SYSTEMS

PART 1 - GENERAL

1.01 DESCRIPTION OF WORK:

- A. Furnish all labor, materials and services necessary for a complete, new and functional building automation system (BAS) to allow for automated control of equipment and systems as indicated on the drawings and described herein. Drawings are diagrammatic only and sequences are provided to communicate control intent. It is the responsibility of the contractor to submit on and install a controls system (control points, hardware, software, database and graphics) that will accomplish the design intent, meet safety requirements and integrate, as applicable, to packaged and 3rd party controls.
- B. The Control Contractor (BAS Contractor) will be responsible for support, commissioning, testing and performance verification. At a minimum the contractor shall plan to accomplish the following tasks in support of commissioning activities (reference the commissioning plan and associated specifications for additional requirements where applicable):
 - 1. Coordinate sequence submittal review activities with the engineer, owner and commissioning agent.
 - 2. Perform, document and submit for review calibration verifications and pre-functional testing.
 - 3. Support commissioning agent led and authored functional testing and performance verification
 - 4. Establish trends and, when applicable, configure trend databases to allow for future system evaluation
 - 5. Train the owner's personnel as required by other sections of this specification.
- C. This installation shall not be used as a test site for any new products unless explicitly approved by the Owner or Architect/Engineer in writing prior to bid. Unless approved otherwise, all products (including hardware, software and firmware revisions) used in this installation shall have been used in at least twelve (12) projects prior to this installation. The previous sites may be located anywhere in the U.S.A. This requirement is not intended to restrict the Contractor to the use of any outdated equipment. Therefore, all products used in this installation shall also be currently under manufacture and have projected availability for at least ten years after completion of the contract. If the above requirements are mutually exclusive, the Contractor shall include a specific statement to this effect in the Bid.
- D. Provide electrical work as required, complying with requirements of Division 23, Division 26 and Division 27 sections including, but not limited to conduit, raceways, wires, cables, electrical identification, supporting devices and electrical connections for equipment, redlined and not shown on electrical drawings. The demarcation of work and responsibilities is illustrated by the following table are "typical" in our experience and should be used to by bidding contractors **(unless other specific direction has been provided by the owner or GC)** to ensure that all scope

is covered. The GC will ultimately direct work on this project and the contractor shall coordinate with the GC and other divisions on the project prior to installation.

1.02 "Typical" BAS Responsibility Matrix:

Work	Furnish	Install	Low Volt. Wiring/Tube	Line Power
BAS low voltage and communication wiring	BAS	BAS	BAS	N/A
VAV box controller	BAS	23	BAS	26
BAS conduits and raceway	BAS	BAS	BAS	BAS
Automatic valves	BAS	23	BAS	N/A
VAV boxes	23	23	N/A	N/A
All BAS Nodes, equipment, housings, enclosures and panels.	BAS	BAS	BAS	BAS
Packaged RTU space mounted controls	23	BAS	BAS	26
Packaged RTU factory-mounted controls	23	23	BAS	26
Packaged RTU field-mounted controls	BAS	BAS	BAS	26

- A.
- B. Control Contractor shall review, identify and field coordinate location requirements for all necessary control sensors and devices which may be installed by others including the following, but not limited to:
 - 1. Outside Air Temperature Sensor.
 - 2. Pressure Sensors.

1.03 Definitions

- A. Analog: A continuously variable system or value not having discrete levels. Typically exists within a defined range of limiting values.
- B. Binary: A two-state system where an "on" condition is represented by one discrete signal level and an "Off" condition is represented by a second discrete signal level.
- C. BAS: The total integrated system of operational and functional elements, including equipment, software, programming, and associated materials, to be provided by this Division BAS Contractor and to be interfaced to the associated work of other related trades.
- D. BAS Contractor: The single Contractor to provide the work of this Division. This Contractor shall be the primary manufacturer, installer, commissioner and ongoing service provider for the BAS work.

- E. Control Sequence: A BAS pre-programmed arrangement of software algorithms, logical computation, target values and limits as required to attain the defined operational control objectives.
- F. Direct Digital Control: The digital algorithms and pre-defined arrangements included in the BAS software to provide direct closed-loop control for the designated equipment and controlled variables. Inclusive of Proportional, Derivative and Integral control algorithms together with target values, limits, logical functions, arithmetic functions, constant values, timing considerations and the like.
- G. BAS Network: The total digital on-line real-time interconnected configuration of BAS digital processing units, workstations, panels, sub-panels, controllers, devices and associated elements individually known as network nodes. May exist as one or more fully interfaced and integrated sub-networks, LAN, WAN or the like.
- H. Node: A digitally programmable entity existing on the BAS network.
- I. BAS Integration: The complete functional and operational interconnection and interfacing of all BAS work elements and nodes in compliance with all applicable codes, standards and ordinances to provide a single coherent BAS as required by this Division.
- J. Provide: The term "Provide" and its derivatives when used in this Division shall mean to furnish, install in place, connect, calibrate, test, commission, warrant, document and supply the associated required services ready for operation.
- K. PC: Personal Computer from a recognized major manufacturer or a virtual equivalent provided by, or with the consent of the owner.
- L. Furnish: The term "Furnish" and its derivatives when used in this Division shall mean supply at the BAS Contractor's expense to the designated third-party trade contractor for installation. BAS Contractor shall connect furnished items to the BAS, calibrate, test, commission, warrant and document.
- M. Wiring: The term "Wiring" and its derivatives when used in this Division shall mean provide the BAS wiring and terminations.
- N. Install: The term "Install" and its derivatives when used in this Division shall mean receive at the jobsite and mount.
- O. Protocol: The term "protocol" and its derivatives when used in this Division shall mean a defined set of rules and standards governing the on-line exchange of data between BAS network nodes.
- P. Software: The term "software" and its derivatives when used in this Division shall mean all programmed digital processor software, preprogrammed firmware and project specific digital process programming and database entries and definitions as generally understood in the BAS industry for real-time, on-line, integrated BAS configurations.

- Q. The use of words in the singular in these Division documents shall not be considered as limiting when other indications in these documents denote that more than one such item is being referenced.
- R. Headings, paragraph numbers, titles, shading, bolding, underscores, clouds and other symbolic interpretation aids included in the Division documents are for general information only and are to assist in the reading and interpretation of these Documents.
- S. The following abbreviations and acronyms may be used in describing the work of this Division:
- | | |
|--------|---|
| AHJ | Authority Having Jurisdiction |
| AI | Analog Input |
| AO | Analog Output |
| AWG | American Wire Gauge |
| BTL | BACnet® Testing Laboratories |
| CPU | Central Processing Unit |
| DDC | Direct Digital Control |
| DI | Digital Input |
| DO | Digital Output |
| EEPROM | Electrically Erasable Programmable Read Only Memory |
| EMI | Electromagnetic Interference |
| EOR | Engineer of Record |
| HD | High Definition |
| HOA | Hand-Off-Auto |
| I/O | Input/Output |
| IT | Information Technology |
| LAN | Local Area Network |
| LCD | Liquid Crystal Display |
| LED | Light Emitting Diode |
| MCC | Motor Control Center |
| NC | Normally Closed |
| NO | Normally Open |
| OAT | Outdoor Air Temperature |
| OEM | Original Equipment Manufacturer (Private label) |
| OWS | Operator Workstation |
| PC | Personal Computer |
| ppm | parts per million |
| RAM | Random Access Memory |
| RF | Radio Frequency |
| RFI | Radio Frequency Interference |
| RH | Relative Humidity |
| ROM | Read Only Memory |
| RTD | Resistance Temperature Device |
| TCP/IP | Transmission Control Protocol/Internet Protocol |
| UPS | Uninterruptible Power Supply |
| VAC | Volts, Alternating Current |
| VAV | Variable Air Volume |
| VDC | Volts, Direct Current |

VPN	Virtual Private Network
VSD	Variable Speed Drive
WAN	Wide Area Network

1.04 QUALITY ASSURANCE:

- A. Contractors Qualifications: Firms regularly engaged in installation and commissioning and servicing of digital control equipment, of types and sizes required, whose firm has been in business in similar service for not less than 5 years. Where Special Systems are identified in the Contract Documents, contractor shall submit (3) examples of similar projects completed within (5) years prior to the current project.
- B. Only those manufacturers specified are allowed to bid temperature controls. All bidders shall make available, upon the Owner's request, open book unit pricing of all materials and labor.
- C. All bidders must have a local office capable of supporting and servicing this installation in the area of the project site. Provide office location, staff qualifications and distance from project site as a portion of the bid package.
- D. Codes and Standards:
 - 1. All equipment and the installation shall comply with the requirements of all applicable local and national codes including but not limited to the currently enforced edition of the International Building, International Fire, International Mechanical and all applicable codes of the National Fire Protection Association including the National Electrical Code.
 - 2. Electrical Standards: Provide electrical products, which have been tested, listed and labeled by UL, C-UL and comply with NEMA standards.
 - 3. NFPA Compliance: Comply with NFPA 90A "Standard for the Installation of Air Conditioning and Ventilating Systems" where applicable to controls and control sequences.
- E. It will be the responsibility of the Contractor to work in cooperation with the Owner and with all other contractors and employees rendering such assistance and so arrange his work such that the entire project will be delivered complete in the best possible condition and in the shortest time.
- F. Contractor shall be responsible to fully test and validate their system prior to commissioning, training, or turnover. The owner shall not be responsible for additional cost incurred by the project for rework predicated by incomplete, non-operable or deficient systems.
- G. Contractor is responsible to fully support the owner's commissioning process as outlined in the applicable commissioning specifications, commissioning plans and as directed by the commissioning agent.

1.05 System Description

- A. The BAS shall be a complete system designed for use with the enterprise IT systems. This functionality shall extend into the equipment rooms. Devices residing on the automation network located in equipment rooms and similar shall be fully IT compatible devices that mount

and communicate directly on the IT infrastructure in the facility. Contractor shall be responsible for coordination with the owner's IT staff to ensure that the BAS will perform in the owner's environment without disruption to any of the other activities taking place on that LAN.

- B. Any and all components of the BAS that are connected via field bus or IP network, including the building controllers, advanced application controllers, application specific controllers, smart sensors, servers and user interface software, system and controller programming tools and software applications shall be designed, engineered, and tested to work together as a complete building management system.
- C. Where necessary and as dictated elsewhere in these Specifications, Servers shall be used for the purpose of providing a location for extensive archiving of system configuration data, and historical data such as trend data and operator transactions. All data stored will be through the use of a standard data base platform: Microsoft SQL Server Express or Microsoft SQL Server as dictated elsewhere in this specification. The contractor shall be responsible to coordinate with the OWNER to understand if an existing instance of SQL will be utilized or if the contractor is to provide and install a dedicated instance for this application.
- D. The BAS as provided shall incorporate, at minimum, the following integrated features, functions and services:
 - 1. Operator information, alarm management and control functions.
 - 2. Information management including monitoring, transmission, archiving, retrieval, and reporting functions.
 - 3. Diagnostic monitoring and reporting of BAS functions.
 - 4. Standard applications for terminal HVAC systems.
 - 5. Enterprise-wide information and control access.
 - 6. Offsite monitoring and management access.
- E. All points of typical user interface shall be on standard computing devices that do not require the purchase of any special software from the BAS manufacturer for use as a building operation terminal. The primary point of interface on these devices will be a standard Web Browser.
 - 1. Any software required to access, program, maintain or modify the various controller types that comprise the Building Automation System shall be provided to the owner at no additional costs at the conclusion of the project.

1.06 Licenses and PROPRIETARY INFORMATION:

- A. The OWNER shall be the named license holder of all software and system agreements associated with the work. The OWNER shall agree to a manufacturers standard license agreement as a condition of this contract. This agreement shall entitle the OWNER to **FULL** and **Un-Restricted** access to the software and programming associated with the system.
- B. Project Documentation: All custom software, programs, code, databases, graphic files and drawings (whether hard copy or electronic based files) prepared for this system shall be the exclusive property of the Owner and shall not be reproduced or distributed without prior written permission from the Owner.

- C. The use or reference to the Owner or any of its subsidiaries or any of the facility automation projects shall not be used by the Manufacturer or Contractor in any promotional media, including advertisements, sale brochures, annual reports and client references or endorsements, without prior written permission from the Owner. The Owner reserves the right to restrict or refuse access to any or all of its facilities.

1.07 SUBMITTALS:

- A. In addition to the requirements set forth in Division 1 and Division 23 general submittal requirements, the following must be included in the shop drawing submittals:
 - 1. Shop Drawings: Indicate dimensions, description of materials and finishes, general construction, specific modifications, component connections, anchorage methods, hardware, and installation procedures, including specific requirements indicated.
 - a. Control diagrams: Use at least one individual sheet for each major HVAC system.
 - b. HVAC system flow diagram with sensing, control and interlock devices.
 - c. Internal control panel layouts, control panel cover layouts, electrical connections inside control panels.
 - d. Ladder-type wiring diagrams showing interlock, monitoring and control wiring to and from equipment provided by Division 25 and Division 26, including control systems equipment.
 - e. Communications wiring schematic drawings indicating interconnections between controllers, servers, workstations and other peripherals.
 - f. Integration points lists which illustrate and indicate the contractor's plan to integrate to third party devices. Points list should clearly define points that required to execute the sequence of operations, points that will be monitored for information and maintenance purposes, points that will be illustrated on the graphical interface and points that will not be mapped into the database (points that return now intrinsic value to operators or the control of the equipment).
 - g. Provide a summary of all hardwired and software points (regardless of whether they appear in drawings or sequences).
 - h. Flow-chart control sequences that represent the contractor's plan to implement the operating intent defined in the drawings and specifications.
 - i. Graphics submittal illustrate representative graphics for each equipment type, device summary table, energy monitoring and other unique graphical interface as required by the project.
 - 2. Descriptive data and sequence of operations for operating user and application software, including complete operator's manual and programmer's manual.
 - 3. Proposed layout of all control transformers for valves, controllers and devices. Clearly indicate the transformer size, connected maximum load and expected operating load (accounting for diversity).
 - 4. Point to point and basic function commissioning forms to be used on site for the start, test and check of control components and systems.
 - a. List of specific personnel who will be involved in the system installation and commissioning.
 - b. Instrumentation to be used for testing and calibrating during point to point and basic function testing.

5. Pre-Functional performance test documentation and procedures to be used in commissioning control sequences.
 6. Room Schedule including a separate line for each VAV box and/or terminal unit indicating location and address.
 7. Specific locations for 110 VAC power required for control panels
- B. Contract Closeout Submittals: In compliance with Division 1.
1. Operating and Maintenance Manuals, including:
 - a. Backup software copies including system graphics.
 - b. Actual control sequence programming with comment line for each programming statement.
 - c. Shop drawings and product data in Project Record format.
 - d. One laminated, non-fading, appropriate size, not to exceed 11 inch by 17 inch copy of each air handling system and each major control system (e.g., heating water, chilled water, etc.).
 2. List of recommended spare parts and calibration tools for owner's maintenance staff. Submittal data and shop drawings shall be prepared and submitted in the following formats:
- C. The BAS contractor shall submit a list of all shop drawings with submittals dates within 30 days of contract award.
- D. Submittals shall be in defined packages. Each package shall be complete, shall only reference itself, and previously submitted packages. The packages shall be as approved by the Architect and Engineer for Contract compliance.
- E. When the Architect/Engineer requires, the Contractor will resubmit with the corrected or additional submittal data. This procedure shall be repeated until all corrections are made to the satisfaction of the Engineer and the submittals are fully reviewed.
- F. Prepare an index of all submittals and shop drawings for the installation. Index shall include a shop drawing identification number, Contract Documents reference and item description
- G. Contractor agrees that shop drawing submittals processed by the Architect/Engineer are not change orders, that the purpose of shop drawing submittals by the Contractor is to demonstrate to the Architect/Engineer that the Contractor understands the design concept, that he demonstrates his understanding by indicating which equipment and material he intends to furnish and install, and by detailing the fabrication and installation methods he intends to use. The Contractor shall be responsible for space requirements, configuration, performance, changes in bases, supports, structural members and openings in structure, and other apparatus that may be affected by their use.
- H. Contractor further agrees that if deviations, discrepancies, or conflicts between shop drawing submittals and the contract documents in the form of design drawings and specifications are discovered either prior to or after shop drawing submittals are processed by the Architect/Engineer, the design drawings and specifications shall control and shall be followed. If

alternates do not meet these requirements, it shall be this Contractor's responsibility to remove them and install material originally specified, at no cost to the Owner.

1.08 DELIVERY, STORAGE AND HANDLING:

- A. Provide factory shipping cartons for each piece of equipment, and control device. Maintain cartons through shipping, storage and handling as required to prevent any equipment damage, and to eliminate all dirt and moisture from equipment. Store all equipment and materials inside and protected from weather.

PART 2 - PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS AND CONTRACTORS:

- A. Subject to compliance with requirements, install one of the following systems:
 1. Johnson Controls, Inc.
 2. Siemens Building Technologies
 3. Alerton Technologies
 4. Automated Logic
 5. Delta
 6. Honeywell
 7. Schneider
 8. Andover
 9. KMC or Distech
 10. Aeon Control Systems
 11. Trane Tracer Summit SC+
 12. Other approved equal

2.02 GENERAL PRODUCTS DESCRIPTION:

- A. The BAS shall use an open architecture and fully support a multi-vendor environment. To accomplish this effectively, the BAS shall support open communication protocol standards and integrate a wide variety of third-party devices and applications. The system shall be designed for use on the Internet, or intranets using off the shelf, industry standard technology compatible with other owner provided networks.
- B. The BAS shall consist of the following:
 1. Building Controllers.
 2. Application Controllers.
 3. Equipment Controllers.
 4. Sensors and Actuators.
 5. Local Display Device(s).
 6. Dedicated and Mobile Distributed User Interface(s).
 7. Network processing, data storage, servers, routers and communications equipment.
 8. Other components required for a complete and working BAS.

- C. The system shall be modular in nature and shall permit expansion of both capacity and functionality through the addition of sensors, actuators, controllers and operator devices.
- D. System architectural design shall eliminate dependence upon any single device for alarm reporting and control execution.
 - 1. The failure of any single component or network connection shall not interrupt the execution of control strategies at other operational devices.
 - a. Hardware points shall not be shared across controllers
 - 2. The System shall maintain all settings and overrides through a system reboot, power outage or other non-destructive power or network disruption.

2.03 BAS System Architecture

- A. Automation Network
 - 1. The automation network shall be based on a PC industry standard of Ethernet TCP/IP. Where used, LAN controller cards shall be standard "off the shelf" products available through normal PC vendor channels.
 - 2. The BAS shall network multiple user interface clients, application and data servers, automation engines, system controllers and application-specific controllers including but not limited to:
 - a. Building Controllers.
 - b. Advanced Application Controllers.
 - c. Application Specific Controllers.
 - d. Smart Sensors.
 - e. Routers.
 - f. Data Servers.
 - g. Third Party BACnet controllers and peripheral devices with compatibility listed by BACnet International.
 - h. Additional select Field Devices as required.
- B. All BAS devices on the automation network shall be capable of operating at a minimum communication speed of 100 Mbps, with full peer-to-peer network communication.
- C. Network Security – To protect the BAS from unauthorized users and computer hackers the Automation Network shall support HTTPS with TLS 1.2 between components, including the Application and Data Server(s), Building Controllers, Mobile User Interfaces and Site Management Portals. Self-signed certificates are installed on supported products, with the option of configuring trusted certificates. Computing devices supplied by the BAS vendor will automatically shut down unused ports to deter unauthorized access.
- D. The automation network will be compatible with other enterprise-wide networks. Where indicated, the automation network shall be connected to the enterprise network and share resources with it by way of standard networking devices and practices.

2.04 Control Network

- A. Building Controllers shall provide supervisory control over the control network and shall selectively support the following communication protocols:
 - 1. BACnet Standard Master-Slave/Token-Passing (MS/TP) Bus Protocol ASHRAE SSPC-135:
 - a. The BCS shall be BTL certified and carry the BTL Label.
 - b. The BCS shall be tested and certified as a BACnet Building Controller (B-BC).
 - 2. Lon Works enabled devices using the Free Topology Transceiver (FTT-10a).
 - 3. Modbus[®] TCP and RTU.
- B. Control networks shall provide either “Peer-to-Peer”, Master-Slave, or Supervised Token Passing communications, and shall operate at a minimum communication speed of 9600 baud.
- C. Control network shall support digital controllers as indicated in plans and specifications.
- D. Default control network communication protocol for this project shall be BACnet/ IP.
- E. A BACnet Protocol Implementation Conformance Statement (PICS) shall be provided for each controller device (master or slave) that will communicate on the BACnet/IP or BACnet MS/TP Bus.
- F. The PICS will be made available on request by other trades and their vendors prior to bidding.

2.05 Network Access

- A. The Contractor shall coordinate closely with the Owner, Engineer and the Commissioning agent to establish the mechanism and ability to access the BAS from remote locations (Remote Access). In most instances the owner will provide a dedicated portal (public static IP) for the system global controller. In some instances, the owner may not accept the inherent risks of allowing the BAS to be accessible remotely or connected to their internal network.

2.06 Integration

- A. Hardwired
 - 1. Analog and digital signal values shall be passed from one system to another via hardwired connections.
 - 2. There will be one separate physical point on each system for each point to be integrated between the systems.
- B. Direct Protocol (Integrator Panel)
 - 1. The BAS system shall include appropriate hardware equipment and software to allow bi-directional data communications between the BAS system and third-party manufacturers’ control panels. The BAS shall have the ability to receive, react to, and return information from multiple building systems, including but not limited to the chillers, boilers, variable frequency drives, power monitoring system, and medical gas.
 - 2. All data required by the application shall be mapped into the Automation Engine’s database and shall be transparent to the operator.

3. Point inputs and outputs from the third-party controllers shall have real-time interoperability with BAS software features such as: Control Software, Energy Management, Custom Process Programming, Alarm Management, Historical Data and Trend Analysis, Totalization, and LAN Communications.

C. BACnet Protocol Integration – BACnet

1. The neutral protocol used between systems will be BACnet IP and comply with the ASHRAE BACnet standard 135.
2. A complete Protocol Implementation Conformance Statement (PICS) shall be provided for all BACnet system devices.
3. The ability to command, share point object data, change of state (COS) data and schedules between the host and BACnet systems shall be provided.

2.07 Field Devices

A. General

1. Field device materials and enclosure ratings shall be suitable for the environment they are exposed to. Instruments located in outdoor instruments shall be NEMA 4 or NEMA 3R.

B. Electric/Electronic

1. Temperature Sensors
 - a. Duct Mounted Sensors:

For averaging service, provide 1000 ohm RTD sensing element. Sensing element shall have a minimum of 1 foot of sensor length for each 2 square feet of duct or coil area. Sensor shall be arranged evenly across the duct or coil such that no point in the duct or coil is more than 1 foot away from the sensor.

Install stainless steel flanges where elements penetrate ducts. Support elements with appropriate clips on coil faces, or ½" conduit in open ducts and plenums.

- b. Space Temperature Sensors and Thermostats:

Electronic thermostats shall be used in conjunction with DDC VAV controllers. Each thermostat in an office, classroom, lecture hall, laboratory, or other nonpublic area shall incorporate an accessible setpoint adjustment feature. Each thermostat in a corridor, lobby, atrium, stairwell, lounge, restroom or other public area should incorporate a blank cover with no adjustment feature. Each thermostat must digitally display the current setpoint and temperature.

- c. Outdoor Air Temperature shall be a 1000 Ohm Platinum RTD sensor, preferably located on the north side of the building and shaded with sun shield. Sensor shall be located above grade away from window wells and exhaust openings.

2. Pressure Transducers

- a. General:

Select device suitable for intended application; air, static or differential.

Select for appropriate range, including negative if applicable. Must be able to withstand all pressures expected in installed location without need for recalibration.

Pressure sensor shall be a loop-powered device fed from a 24 VDC power supply.

- b. Static Pressure:
Air:

100 percent solid state device, temperature compensated, suitable for pressures of 200 percent rated range with averaging to stabilize output, accuracy of ± 1 percent, and a 4- 20 mA or 0-10 VDC output.

3. Power Supplies and Noise Suppression Devices

- a. 24 Volt DC Power Supply:

Size Power supply a minimum of 33 percent larger than the total connected load to allow for expansion. Fuse the supply circuit at 150 percent of full load capacity of the power supply.

The output of the Power supply shall provide short-circuit protection.

- b. Noise Suppressors:

All microprocessor-based controllers shall be powered from a 120 VAC circuit protected by a noise suppression device. The device shall provide common mode noise reduction of 150 dB and normal mode noise reduction of 65 dB, minimum, at 100 kHz. Must provide overload capacity of 600 percent for 1 cycle and 300 percent 30 cycles. Total harmonic distortion must be less than 1 percent.

4. Thermostat - Line Voltage

- a. Materials: Cold Rolled Steel, Beige Thermoplastic, Sensing Element-Liquid

- b. Contact Rating:

6 Ampere Running/ 36 Amps. Locked Rotor at 120 VAC

3.5 Amps. Running/ 21 Amps Locked Rotor at 208 VAC

3.0 Amps. Running/ 8 Amps Locked Rotor at 240 VAC

- c. Fan and System Switch Rating:

12 Amps. Running/ 34.8 Amps. Locked Rotor at 120 VAC

6.9 Amps. Running/19.1 Amp. Locked Rotor at 208 VAC

6.0 Amps. Running/17.4 Amps Locked Rotor at 240 VAC

- d. Mounting: Wall

- e. Range: 40 to 90 degrees F

- f. Accuracy: ± 2 degrees F

- g. Differential: Mechanical: Approx. 0.7F degrees

5. Carbon Monoxide Sensors (CO)

- a. Materials: Metal Oxide Semiconductor

- b. Rating: 5000 sq. feet

- c. Mounting: Duct and wall mount
- d. Range: 0 to 200ppm
- e. Accuracy: +/- 3%
- f. Output: 0-10vDC, 4-20mA, BACnet optional

PART 3 - EXECUTION

3.01 INSTALLATION:

- A. The Contractor shall install all equipment, conduit and wiring parallel to building lines.
- B. GENERAL INSTALLATION REQUIREMENTS:
 - 1. Wiring shall be installed in conduit throughout; some exceptions are listed in the "Wiring" section of this specification.
 - 2. Horizontal runs of conduit, trays, wiring shall be hung from structural members using new supports. Single runs of conduit, tubing or wire shall be by clevis ring and all thread rod. Multiple runs shall be by "Trapeze" or "Unistrut" supports. "Plumber's Strap" shall not be allowed. Maximum distance between supports shall be per the NEC.
 - 3. All wire that enters or leaves a building structure shall be installed with lightning protection per NEC.
 - 4. All wire terminations shall be with compression type round hole spade lugs under a pan head screw landing; Stay-Kon or equivalent. All wire splices shall be with compression type insulated splice connectors or properly sized "wire-nut" connectors. Hand twisted, soldered and/or taped terminations or splices are not acceptable.
 - 5. Where wiring or conduit penetrates walls, sleeves with bushings shall be provided for wires. The conduit or sleeve opening shall be sealed with fire proof packing, so the smoke and fire rating of the wall or floor is maintained.
 - 6. All the material installed under this contract must be mounted on or supported from the building structure or supports furnished by this Contractor.
- C. Control Wiring:
 - 1. Run wiring in metallic conduit, tubing or raceways in all installations outdoors, within walls, within mechanical rooms and in any instance where the wiring is not readily accessible for service/ replacement or where control wiring could be exposed to a detrimental environment. Exceptions are as follows:
 - a. NEC Class 2 low voltage wiring where accessible and not exposed to view such as above suspended ceilings, may be run in appropriated rated cable (when approved by code authority).
All thermostat and wall mounted sensor installations shall be in conduit from the plenum to the back of box unless specifically approved by the EOR.
 - b. Wiring enclosed in temperature control panels.
 - 2. Where conduit is used, provide steel fittings.
 - 3. Where conduit is outdoors use compression (seal-tight) fittings, couplers and adapters to prevent water infiltration.

4. Low Voltage Conductors: 18 gauge minimum, except 19 gauge may be used for home runs to central panels and 22 gauge minimum for resistance or thermistor sensing element connections.
5. Wire control interlocks and control panels, except one 120V power circuit to each temperature control panel shown on drawings and schedules shall be provided under Division 1.
6. All wiring shall comply with the requirements of local and national electrical codes.
7. Do not interlock alarms with starter switching to bypass alarm when equipment is manually disconnected.
8. All costs of controls, wiring conduit and associated labor shall be included in the temperature control bid. The control wiring shall be installed under the supervision of this Contractor.

3.02 ENCLOSURES:

- A. The wiring within all enclosures shall be run in plastic trays. Tubing and wiring within BAS panels may be run using adhesive-backed tie wraps.
- B. Mount all enclosures, including those which house BAS Panels, Slaves and Field Device Panels, so that the top of the enclosure does not exceed six feet, six inches (6'-6"); and the center of any keypad/LCD combination does not exceed five foot, six inches (5'-6") from the floor or is less than four feet zero inches (4'-0") from the floor.
- C. Field Device Panels contain related Field Devices such as relays, control power (24V) transformers, output transducers, etc., that are outboard of the BAS Panels or Dedicated Controllers. Each Field Device Panel shall be mounted within an enclosure. The enclosures shall be provided with lockable latches that will accept a single key common to all Field Device Panels, BAS Panels and Slaves.

3.03 INSTALLATION PRACTICES:

- A. The Contractor shall install and calibrate all Field Devices, sensors and transducers as necessary for the complete operation of the I/O points described herein.
- B. Thermistor wire leads shall be permanently terminated at panels or controllers with wire clamps.

3.04 IDENTIFICATION:

- A. All control air piping, J-boxes, conduit and wiring shall be labeled.
- B. Electrical devices, wiring, conduit and J-boxes shall be labeled and identified as required by Division 26.
 1. As a minimum regardless of Division 26 requirements, all temperature control J-box covers shall be painted on both sides of cover. Coordinate paint and color selections with other trades and the owner.

- C. Identification shall be provided for all enclosures, panels, junction boxes, controllers or Field Devices. Plastic laminate nameplates shall be used. The nameplates shall be 1/16-inch thick and a minimum of 1 inch by 2 inches. The lettering shall be white on a background that matches the color selection of section 3.4.B.1 (above) with minimum 1/4-inch high engraved letters. The nameplates shall be permanently affixed.
 - 1. All new devices will be tagged.
- D. The plan code designation shown on all shop drawing identification shall be consistent with the contract documents.
- E. All I/O Field Devices that are not mounted within Field Device Panel enclosures shall be identified with engraved plastic laminated nameplates installed so that they are visible from ground level.
- F. The identification shall show the designation used on the record documents and identify the function such as "mixed air temperature sensor" and "fan status DP switch".

3.05 LOCATIONS:

- A. All sensing devices and locations shall be located by the Contractor as shown on the submittal shop drawings with final review and approval by the Engineer and Owner.
- B. Wall mount space sensors shall be mounted in accordance with ADA requirements and as illustrated on architectural plans. Coordinate all sensor locations in advance of any installation to minimize re-work.
 - 1. Where interferences require moving the temperature sensor more than two feet from locations illustrated on the plans, consult with the Architect/Engineer to approve relocation.
- C. Enclosures housing Field Devices shall be located immediately adjacent horizontally to the BAS panels or Slaves which are being interfaced to.

3.06 Control devices:

- A. The Controls Contractor shall have his control equipment on the project site when required to support the work of other divisions.
 - 1. All Input devices shall be installed per the manufacturer recommendation.
 - 2. Locate components of the BAS in accessible local control panels wherever possible.
 - 3. Outside Air Sensors
 - a. Sensors shall be mounted on the North wall to minimize solar radiant heat impact or located in a continuous intake flow adequate to monitor outdoor air conditions accurately.
 - b. Sensors shall be installed with a rain proof, perforated cover.
 - 4. Duct Temperature Sensors
 - a. Duct mount sensors shall mount in an electrical box through a hole in the duct and be positioned to be easily accessible for repair or replacement.

- b. The sensors shall be insertion type and constructed as a complete assembly including lock nut and mounting plate.
 - c. For ductwork greater in any dimension than 48 inches or where air temperature stratification exists such as a mixed air plenum, utilize an averaging sensor.
 - d. The sensor shall be mounted to suitable supports using factory approved element holders.
5. Space Sensors (Temperature, Carbon Monoxide, Nitrogen Dioxide, etc.)
- a. Shall be mounted per ADA requirements.
 - b. Provide lockable tamper-proof covers in public areas and/or where indicated on the plans.

3.07 CLEANUP:

- A. At the completion of the work, all equipment pertinent to this contract shall be checked and thoroughly cleaned and all other areas shall be cleaned around equipment provided under this contract. Clean the exposed surfaces of tubing, hangers, and other exposed metal of all grease, plaster, dust, or other foreign materials.
- B. Upon final completion of work in an area, vacuum and/or damp wipe all finished room surfaces and furnishings. Use extreme care in cleaning around telephone switching and computer equipment and under no circumstances shall water or solvents be used around this equipment.
- C. At the completion of the work and at the end of each work day, remove from the building, the premises, and surrounding streets, etc., all rubbish and debris resulting from the operations and leave all equipment spaces absolutely clean and ready for use.

3.08 SOFTWARE, DATABASE AND GRAPHICS:

- A. Software Installation: The Contractor shall provide all labor necessary to install, initialize, start-up and debug all system software as described in this section. This includes any operating system software or other third-party software necessary for successful operation of the system.
- B. Database Configuration: The Contractor will provide all labor to configure those portions of the database that are required by the points list and sequence of operation. The point naming convention utilized on this project shall be clear and repeatable. Submit point names for review as indicated in other sections of this specification. Controller drawings shall indicate general point naming convention and that convention shall persist across the project.
 - 1. A. Configuration of the automation system database in a way that allows for easy export and consumption by 3rd parties is fundamental to any smart building application
- C. Color Graphics: Unless otherwise directed by the Owner, the Contractor will provide color graphic displays for all systems which are specified with a sequence of operation, depicted in the mechanical drawings for each system and floor plan. For each system or floor plan, the display shall contain the associated points identified in the point list and allow for setpoint changes as required by the Owner.

3.09 TEMPERATURE CONTROL DRAWINGS:

- A. Upon completion of project and after record drawings of the temperature controls have been prepared and reviewed, the Contractor shall provide one (1) complete set of temperature controls drawings at each temperature control panel. Each set of drawings shall be laminated in a plastic coating. The drawings shall consist of only those control functions associated with the specific control panel and any relevant or pertinent network interface information.
- B. The laminated drawings shall have a grommet connection attached to a metal cable or chain which is mechanically fastened to the temperature control cabinet.

3.10 START UP AND TESTING:

- A. Fully commission all aspects of the BAS work.
- B. Acceptance Check Sheet
 1. Prepare a check sheet that includes all points for all functions of the BAS as indicated on the point list included in this specification.
 2. Submit the check sheet to the Engineer and owner's commission agent for approval.
 3. The Engineer and commissioning agent will use the check sheet as the basis for acceptance with the BAS Contractor.
- C. VAV box performance verification and documentation:
 1. The BAS Contractor shall test each VAV box for operation and correct flow. At each step, after a settling time, box air flows and damper positions will be sampled. Following the tests, a pass/fail report indicating results shall be produced. Possible results are Pass, no change in flow between full open and full close, Reverse operation or Maximum flow not achieved. The report shall be submitted as documentation of the installation.
 2. The BAS Contractor shall issue a report based on a sampling of the VAV calculated loop performance metrics. The report shall indicate performance criteria, include the count of conforming and non-conforming boxes, list the non-conforming boxes along with their performance data, and shall also include graphical representations of performance.
 3. Promptly rectify all listed deficiencies and submit a document summarizing completion to the Engineer.

3.11 Training

- A. Provide on-site instruction for up to 8 people.
- B. Entire system operating fundamentals 2 Hours
- C. Entire system operating and maintenance instruction 2 Hours
- D. Each unique air handling system type .5 Hour

3.12 Warranty

- A. The building control system, including all hardware and software components shall be warranted for a period of one year following owner's beneficial use of system. For phased project completion, the warranty shall also commence in phases. Any manufacturing defects arising during this period shall be corrected without cost to the owner.
- B. In addition to the hardware warranty, the Contractor shall correct any software sequences that do not meet the design intent or require modification to support building operations. The owner should contact the contractor prior to heavily modifying the system. If the contractor is unresponsive or if modification or repairs are required immediately (prior to the contractor's ability to respond) then repairs and modifications due to changes enacted by the owner's system operators during the warranty period will be corrected at no cost to the owner.
- C. Within the first 12 months of the warranty period, the contractor shall provide 8 hours of onsite customer support at the direction of the owner's representative.
- D. Contractor shall provide all necessary modems, proprietary hardware and software components for operators to monitor system functions remotely.
- E. All manufacturer software system revisions relating to manufacturer's design errors are to be provided and installed at no additional cost during the warranty period.

END OF SECTION 23 0900

SECTION 23 0993 – SEQUENCES OF OPERATION FOR MECHANICAL SYSTEMS

PART 1 - GENERAL

1.01 DESCRIPTION OF WORK:

- A. Sequence of operation is hereby defined as the manner and method by which controls function. Requirements for each type of control system operation are specified in this section.
- B. Operating equipment, devices, and system components required for control are specified in other Division 23 sections of these specifications.

PART 2 - PRODUCTS

2.01 SYSTEM REQUIREMENTS:

- A. Provide control systems consisting of thermostats, dampers, operators, indicating devices, interface equipment, and other apparatus required to operate mechanical system and to perform functions specified.
- B. Provide necessary materials and field work necessary to connect control components factory supplied as part of equipment controlled, unless specified otherwise.
- C. Provide all necessary relays to make the system a full and operable system as required by the sequence of operation.

PART 3 - EXECUTION

3.01 TERMINAL UNITS' CONTROL SEQUENCES:

- A. Gas Fired Infrared Heaters: Provide a wall-mounted controller with thermostat to cycle the infrared heater burners on and off to maintain thermostat setting.
- B. Electric Unit Heaters: Provide a wall-mounted thermostat to cycle the electric heating element and fan motor on and off to maintain thermostat setting. Coordinate requirements with unit supplied.

3.02 AIR HANDLER CONTROL SEQUENCES:

- A. Furnace F-1 with Condensing Unit CU-1
 - 1. The unit shall be started/stopped by a local DDC control panel interfaced with the Building Automation System. The unit fan, furnace and condensing unit shall cycle to maintain space setpoint and shall be controlled via factory mounted and field installed control system

3.03 EXHAUST and Destratification FANS:

- A. EF- 1: Exhaust air fan shall run upon activation with ON/OFF control as initiated by carbon monoxide (CO) at 25 parts per million (adjustable) or nitrogen dioxide detectors (NO2) at 100 parts per billion (adjustable). Fan shall continue to run until below threshold values. Open intake damper on start. Additionally, manual ON/OFF control provided from local switch.
- B. EF-2 and EF-3: Exhaust air fan shall run continuously with ON/OFF control through switch. Open intake damper on start.
- C. DF-1: Fan shall run upon activation with ON/OFF control from local switch.

3.04 split system CONTROL SEQUENCE (DS-1/DSO-1):

- A. Provide wall mounted thermostat to provide cycling of the refrigeration system for cooling.

END OF SECTION 23 0993

SECTION 23 3113 – METAL DUCTS

PART 1 - GENERAL

1.01 DESCRIPTION OF WORK:

- A. Extent of metal ductwork is indicated on drawings and in schedules, and by requirements of this section.

DUCT SERVICE	TYPE/CONSTRUCTION
Supply air from discharge of terminal box/fan to air devices (low pressure).	Galvanized sheet metal /spiral round and oval or rectangular (lined as noted on drawings.)
Return air ductwork.	Galvanized steel (lined where noted on drawings); factory or shop fabricated.
General building exhaust.	Galvanized sheet metal (lined as noted on drawings); factory or shop fabricated.).
Transfer ducts.	Internally lined galvanized sheet metal as described above for low pressure supply; factory or shop fabricated.

- B. Exterior insulation of metal ductwork is specified in other Division-23 sections, and is included as work of this section.
- C. Refer to other Division-23 sections for ductwork accessories.
- D. Refer to other Division-23 sections for fans and air handling units.
- E. Refer to other Division-23 sections for testing, adjusting, and balancing of metal ductwork systems.

1.02 DEFINITIONS:

- A. Low Pressure Duct: Duct required by the drawings, specifications, or referenced standards to be constructed to 2" or less, positive or negative pressure class.
- B. Medium or High Pressure Duct: Duct required by the drawings, specifications, or referenced standards to be constructed to greater than 2" positive or negative pressure class.

1.03 QUALITY ASSURANCE:

- A. Manufacturer's Qualifications: Firms regularly engaged in manufacture of metal ductwork products of types, materials, and sizes required, whose products have been in satisfactory use in similar service for not less than 5 years.
- B. Installer's Qualifications: Firm with at least 3 years of successful installation experience on projects with metal ductwork systems similar to that required for project.
- C. References to SMACNA, ASHRAE and NFPA are minimum requirements, the Contractor shall fabricate, construct, install, seal and leak test all ductwork as described in this specification and as shown on the drawings, in addition to these minimum standard references.
- D. Codes and Standards:
 - 1. SMACNA Standards: Comply with the current SMACNA "HVAC Duct Construction Standards, Metal and Flexible" for fabrication and installation of metal ductwork. Comply with SMACNA "HVAC Air Duct Leakage Test Manual" for testing of duct systems.
 - 2. NFPA Compliance: Comply with NFPA 90A "Standard for the Installation of Air Conditioning and Ventilating Systems" and NFPA 90B "Standard for the Installation of Warm Air Heating and Air Conditioning Systems".
- E. Field Reference Manual: Have available for reference at project field office, copy of the current SMACNA "HVAC Duct Construction Standards, Metal and Flexible", and the current SMACNA "HVAC Air Duct Leakage Test Manual".

1.04 SUBMITTALS:

- A. Product Data: Submit manufacturer's technical product data and installation instructions for ductwork materials and products. Provide product data for manufactured joining systems. Include sound attenuation by octave band for sound rated flexible duct.
- B. Record Drawings: At project closeout, submit record drawings of installed systems, in accordance with requirements of Divisions 1 and 23.
- C. Maintenance Data: Submit maintenance data and parts lists for metal ductwork materials and products. Include this data, product data, shop drawings, and record drawings in maintenance manual; in accordance with requirements of Divisions 1 and 23.

1.05 DELIVERY, STORAGE, AND HANDLING:

- A. Protection: Protect ductwork, accessories and purchased products from damage during shipping, storage and handling. Prevent end damage and prevent dirt and moisture from entering ducts and fittings.
- B. Storage: Store ductwork inside elevated from floor on pallets and protected from weather, dirt, dust and debris.

PART 2 - PRODUCTS

2.01 MANUFACTURERS:

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Acoustical Duct Liner:
 - a. CertainTeed Corp.
 - b. Johns Manville
 - c. Owens-Corning Fiberglas Corp.
 - d. Knauf Insulation
 2. Flexible Ducts:
 - a. Flexmaster
 - b. Thermaflex
 3. Duct Take Off Fittings
 - a. Hercules Industries
 - b. Flexmaster
 - c. Thermaflex
 - d. Ominair

2.02 DUCTWORK MATERIALS:

- A. Exposed Ductwork Materials: Where ductwork is exposed to view in occupied spaces, provide materials which are free from visual imperfections including pitting, seam marks, roller marks, stains, dents, discolorations, labels, and other imperfections, including those which would impair painting.
- B. Sheet Metal: Except as otherwise indicated, fabricate ductwork from galvanized sheet steel complying with ASTM A 653, lockforming quality; with G 90 zinc coating in accordance with ASTM A 525; and mill phosphatized for exposed locations. Provide flat seam construction where standing seams are a hazard to the Owner's operation personnel.

2.03 MISCELLANEOUS DUCTWORK MATERIALS:

- A. General: Provide miscellaneous materials and products of types and sizes indicated and, where not otherwise indicated, provide type and size required to comply with ductwork system requirements including proper connection of ductwork and equipment.
- B. Fittings: Provide radius type fittings fabricated of multiple sections with maximum 15 deg. change of direction per section. Unless specifically detailed otherwise, use 45 deg. laterals and 45 deg. elbows for branch takeoff connections. Where 90 deg. branches are indicated, provide conical type tees.
- C. Acoustical Duct Liner: Fibrous glass, complying with Thermal Insulation Manufacturers Association (TIMA) AHC-101; of thickness indicated.
1. Unless otherwise noted, provide 1" thick, 1-1/2 lb density, fiberglass duct liner meeting ASTM C1071 Type I, NFPA 90A and 90B and TIMA (AHC-101) with minimum NRC (noise

reduction coefficient) of 0.70 as tested per STM C 423 using an "A" mounting with minimum "K" factor of 0.25. Lining shall be U.L. approved, made from flame attenuated glass fiber bonded with a thermosetting resin with acrylic smooth surface treatment and factory applied edge coating. Materials shall conform to revised NFPA No. 90A Standards, with a maximum flame spread of 25 and maximum smoke development of 50.

- D. Duct Liner Adhesive: Comply with ASTM C 916 "Specifications for Adhesives for Duct Thermal Insulation".
- E. Duct Liner Fasteners: Comply with SMACNA HVAC Duct Construction Standards, Article S2.11.
- F. Duct Sealant: Non-hardening, non-migrating mastic or liquid elastic sealant, type applicable for fabrication/ installation detail, as compounded and recommended by manufacturer specifically for sealing joints and seams in ductwork. All PVC coated exhaust ductwork shall be sealed with an approved chemical resistant sealant (P.V.S. #8-WB or approved equal). For outdoor ductwork, sealant shall also be U.V. resistant and weather resistant. Where ductwork is exposed to view in occupied spaces, utilize a clear, paintable duct sealant.
- G. Ductwork Support Materials: Except as otherwise indicated, provide hot-dipped galvanized steel fasteners, anchors, rods, straps, trim and angles for support of ductwork.
- H. Flexible Ducts: Flexible air ducts shall be listed under UL-181 standards as Class I Air Duct Material and shall comply with NFPA Standards 90A and 90B. Minimum operating pressure rating shall be 10" W.C. positive, 1" negative for sizes up to 12" through a temperature range of -20°F to 150°F; minimum working velocity rating shall be 4000 fpm. Contractor shall assume responsibility for supplying material approved by the authority having jurisdiction.
 - 1. All flexible duct shall be rated for sound attenuation. Inner core shall be black CPE supported by a galvanized steel helix, with minimum R-5 insulation and metalized reinforced outer jacket.
 - a. Flexmaster Type 1M
 - 2. Sound attenuation shall be as scheduled below:

INSERTION LOSS dB (6-foot Section, Flexmaster 1M-R6, 500 FPM Air Velocity)							
Octave Band	125	250	500	1000	2000	4000	8000
8" Diameter	5.6	10.6	23.9	34.0	22.5	17.0	11.9
12" Diameter	6.6	27.8	22.8	29.0	18.7	10.9	8.2

- 3. Non-insulated flexible ducts shall be the same as insulated less the insulation and other jacket.
- I. Duct Take Off Fittings to Individual Air Inlets & Outlets: Provide conical spin-in fittings at flexible or round sheet metal duct takeoffs. Where specifically shown on drawings, where the duct dimension does not allow for a conical spin-in, or at Contractor's option, provide 45° inlet rectangular to round duct take off fittings, with factory applied gasket. Fittings shall include

butterfly type manual volume damper with locking quadrant handle and 2" insulation stand-off. Shafts shall be solid metal, rolled metal shafts are not acceptable.

- J. Duct take off fittings to air terminals: same as for individual air inlets and outlets, less the damper.

2.04 FABRICATION:

- A. Fabricate ductwork in 4, 8, 10 or 12-ft lengths, unless otherwise indicated or required to complete runs. Preassemble work in shop to greatest extent possible, so as to minimize field assembly of systems. Disassemble systems only to extent necessary for shipping and handling. Match (-) mark sections for reassembly and coordinated installation.
- B. Fabricate ductwork of gauges and reinforcement complying with the latest SMACNA "HVAC Duct Construction Standards". Minimum 26 GA where ducts are within corridors.
- C. Where the standard allows the choice of external reinforcing or internal tie rods, only the external reinforcing options shall be used.
- D. If manufacturer flange joining systems are used as part of the reinforcing, the EI rating and rigidity class shall be equivalent to the reinforcing requirements of the standard. Submit manufacturer's product data.
- E. Fabricate duct fittings to match adjoining ducts, and to comply with duct requirements as applicable to fittings. Except as otherwise indicated, fabricate elbows and offsets with center-line radius equal to 1.5 times the associated duct width; and fabricate to include turning vanes in elbows where shorter radius is necessary. 90° mitered elbows with turning vanes may be used where specifically shown on drawings. Mitered elbows or offsets of other than 90° shall not be used. Two 90° mitered elbows shall be separated by a minimum of 2 equivalent duct diameters. Use radiused "Ogee" for offsets less than 90°. Limit angular tapers to 30 deg. for contracting tapers and 20 deg. for expanding tapers. Divided flow fittings shall be 45° inlet branches, stationary splitters and elbows, or as shown on drawings.
- F. Back to back 90° fittings on duct system shall not be installed under any circumstances.
- G. Elbows with sharp throat and radius heel are not allowed.
- H. Fabricate ductwork with accessories installed during fabrication to the greatest extent possible. Refer to Division-23 section "Ductwork Accessories" for accessory requirements.
- I. Fabricate ductwork with duct liner in each section of duct where indicated. Laminate liner to internal surfaces of duct in accordance with instructions by manufacturers of lining and adhesive, and fasten with mechanical fasteners. Provide sheet metal nosing on all leading edges preceded by unlined duct, at duct openings, and at fan or terminal unit connections.

2.05 ROUND DUCTWORK:

- A. Material: Galvanized sheet steel complying with ASTM A 527, lockforming quality, with ASTM A 525, G90 zinc coating, mill phosphatized. Spiral lockseam construction. Individual runouts to air devices may be longitudinal seam.
- B. Gauge: In accordance with the SMACNA "HVAC Duct Construction Standards", minimum 26 gauge.
- C. Elbows: One piece construction for 90 deg. and 45 deg. elbows 14" and smaller. Provide multiple gore construction for larger diameters with standing seam circumferential joint. Radius to centerline shall be 1.5 times duct diameter. Spot welded and bonded construction. Elbows on runouts to individual air devices may be pleated or adjustable.
- D. Divided Flow Fittings: 90 deg. tees, constructed with branch spot welded and bonded to duct fitting body, with minimum 2" flange shaped to fit main duct.

PART 3 - EXECUTION

3.01 INSPECTION:

- A. General: Examine areas and conditions under which metal ductwork is to be installed. Do not proceed with work until unsatisfactory conditions have been corrected.

3.02 INSTALLATION OF METAL DUCTWORK:

- A. Duct Sealing:
 - 1. Seal all low pressure ducts to SMACNA Seal Class "B".
- B. General: Assemble and install ductwork in accordance with recognized industry practices which will achieve air-tight and noiseless (no objectionable noise) systems, capable of performing each indicated service. Install each run with minimum number of joints. Align ductwork accurately at connections, within 1/8" misalignment tolerance and with internal surfaces smooth. Support ducts rigidly with suitable ties, braces, hangers and anchors of type which will hold ducts true-to-shape and to prevent buckling, popping or compressing. Support vertical ducts at every floor.
- C. Construct ductwork to schedule of operating pressures as shown on drawings.
- D. Field Fabrication: Complete fabrication of work at project as necessary to match shop-fabricated work and accommodate installation requirements.
- E. Routing: Locate ductwork runs, except as otherwise indicated, vertically and horizontally and avoid diagonal runs wherever possible. Locate runs as indicated by diagrams, details and notations or, if not otherwise indicated, run ductwork in shortest route which does not obstruct useable space or block access for servicing building and its equipment. Hold ducts close to walls, overhead construction, columns, and other structural and permanent enclosure elements of

building. Limit clearance to 1/2" where furring is shown for enclosure or concealment of ducts, but allow for insulation thickness, if any. Where possible, locate insulated ductwork for 1" clearance outside of insulation. Wherever possible in finished and occupied spaces, conceal ductwork from view, by locating in mechanical shafts, hollow wall construction or above suspended ceilings. Do not encase horizontal runs in solid partitions, except as specifically shown. Coordinate layout with suspended ceiling and lighting layouts and similar finished work.

- F. Electrical Equipment Spaces: Do not route ductwork through transformer vaults and their electrical equipment spaces and enclosures.
- G. Penetrations: Where ducts pass through fire rated walls and do not contain fire or smoke dampers, protect with fire stop material installed in accordance with its listing. Where ducts pass through interior partitions or exterior walls, and are exposed to view, conceal space between construction opening and duct or duct insulation with sheet metal flanges of same gauge as duct. Overlap opening on all four sides by at least 1-1/2". Fasten to duct only. Where ducts penetrate non-fire rated, mechanical, electrical or acoustically sensitive walls, provide 1/2" to 3/4" annular space between duct and wall, pack annular space with mineral wool insulation, and caulk both sides with non-hardening acoustical sealant.
- H. Coordination: Coordinate duct installations with installation of accessories, dampers, equipment, controls and other associated work of ductwork system.
- I. Installation: Install metal ductwork in accordance with SMACNA HVAC Duct Construction Standards and Industrial Construction Standards.
- J. Temporary Closure: At ends of ducts which are not connected to equipment or air distribution devices at time of ductwork installation, provide temporary closure of polyethylene film or other covering which will prevent entrance of dust and debris until time connections are to be completed.

3.03 installation of duct take-off fittings:

- A. Fully seal all joints.
- B. Sheet metal screw regulator arm to duct after balance is complete. Mark and date position of regulator arm.
- C. Insulation over regulator arm is not required.

3.04 INSTALLATION OF DUCT LINER:

- A. General: Install duct liner in accordance with SMACNA HVAC Duct Construction Standards.

3.05 INSTALLATION OF FLEXIBLE DUCTS:

- A. Maximum Length: For any duct run using flexible ductwork, do not exceed 6' - 0".

- B. Installation: Install in accordance with SMACNA's, "HVAC Duct Construction Standards, Metal and Flexible".
- C. Full inside diameter of flexible duct shall be maintained. Support to prevent kinking.
- D. Flexible duct shall not be installed above an inaccessible ceiling unless the air device is set in a frame allowing access to both ends of the flexible duct.

3.06 FIELD QUALITY CONTROL:

- A. Leakage Tests: Conduct duct leakage test in accordance with SMACNA HVAC Air Duct Leakage Test Manual. Repair leaks and repeat tests until total leakage is less than the maximum permissible leakage as specified below.
- B. General:
 - 1. Ductwork pressure tests shall be observed by Architect/Engineer prior to installation of insulation.
 - 2. Ductwork systems in ± 3 " W.G. pressure class and higher, regardless of system operating pressure, shall be tested in their entirety for leaks. Arbitrary sections of ductwork in ± 2 " W.G. and lower pressure class, regardless of system operating pressure, shall be tested as required by Architect/Engineer.
 - 3. Test Failures: Duct systems shall be repaired if test pressure and leakage requirements are not met or if air noise condition is encountered. Repairs and sealing shall be done with sheet metal, tape, sealant or a combination thereof.
- C. Test Equipment:
 - 1. Portable rotary type blower or tank type vacuum cleaner with control damper. Equipment shall have sufficient capacity to properly test reasonably large duct system section. Equipment shall have been calibrated within 2 years of the testing.
 - 2. Orifice assembly consisting of straightening vanes and calibrated orifice plate mounted in a straight tube with properly located pressure taps.
 - 3. Two (2) U-tube manometers, one to measure drop across calibrated orifice and one to measure S.P. in duct being tested. Provide low differential pressure Dwyer magnehelic gauges for low leak testing in lieu of U-tube manometers.
 - 4. Provide Dwyer magnehelic gauge with 0-.25" W.C. range for testing 0% leakage ductwork.
- D. Testing Pressures and Permissible Leakage:
 - 1. Test pressure shall be equal to the construction class. Negative pressure duct shall be tested at the equivalent positive pressure.
 - 2. Allowable leakage shall be determined from the following equation (or figure 4-1 in the above referenced Standard):
$$F = C_L (P)^{.65}$$

Where: F = Allowable leakage factor CFM/100 Sq. Ft.
C_L = Leakage Class
P = Test pressure inches W.C.

3. Leakage class shall be as follows:
 - a. Seal class A, Round duct, $C_L = 3$.
 - b. Seal class A, Rectangular duct, $C_L = 6$.
 - c. Seal class B, Round duct, $C_L = 6$.
 - d. Seal class B, Rectangular duct, $C_L = 12$.
 - e. Seal class C, Round duct, $C_L = 12$.
 - f. Seal class C, Rectangular duct, $C_L = 24$.
4. Record all tests using the procedure and forms in the above referenced standard.

3.07 EQUIPMENT CONNECTIONS:

- A. General: Connect metal ductwork to equipment as indicated. Provide flexible connection for each ductwork connection to equipment mounted on vibration isolators, and/or equipment containing rotating machinery. Provide access doors where required for service, maintenance and inspection of ductwork accessories. See section 23 3300.

3.08 ADJUSTING AND CLEANING:

- A. Clean ductwork internally, unit by unit as it is installed, of dust and debris. Clean external surfaces of foreign substances. Where ductwork is to be painted clean and prepare surface for painting.
- B. Protection:
 1. Store duct a minimum of 4" above ground or floor to avoid damage from weather or spills.
 2. Cover all stored ducts to protect from moisture, dust or debris.
 3. Maintain a cover on all ends of installed ductwork at all times, except when actually connecting additional sections of duct.
- C. Ductwork contaminated or damaged above "shop" or "mill" conditions shall be cleaned, repaired or replaced to the Engineer's satisfaction.
 1. Ductliner pre-installed in stored duct which has become wet may be installed if first allowed to completely dry out.
 2. Ductliner in installed ductwork which has become wet must be completely removed and replaced.
 3. Torn ductliner may be repaired by coating with adhesive if damage is minor and isolated. Extensively damaged liner shall be replaced back to a straight cut joint.
- D. Protect lined duct from becoming wet or torn.
- E. Balancing: Refer to Division-23 section "Testing, Adjusting, and Balancing" for air distribution balancing of metal ductwork; not work of this section. Seal any leaks in ductwork that become apparent in balancing process.

END OF SECTION 23 3113

SECTION 23 3300 – AIR DUCT ACCESSORIES

PART 1 - GENERAL

1.01 QUALITY ASSURANCE:

- A. Manufacturer's Qualifications: Firms regularly engaged in manufacture of ductwork accessories, of types and sizes required, whose products have been in satisfactory use in similar service for not less than 5 years.
- B. Industry Standards: Comply with ASHRAE recommendations pertaining to construction of ductwork accessories, except as otherwise indicated.
- C. NFPA Compliance: Comply with applicable provisions of NFPA 90A "Air Conditioning and Ventilating Systems", pertaining to installation of ductwork accessories.

1.02 SUBMITTALS:

- A. Product Data: Submit manufacturer's technical product data for each type of ductwork accessory, including dimensions, capacities, and materials of construction; and installation instructions.
- B. Shop Drawings: Submit manufacturer's assembly-type shop drawings for each type of ductwork accessory showing interfacing requirements with ductwork, method of fastening or support, and methods of assembly of components. Include details of construction equipment and accessories being provided.
- C. Submittals for all damper types specified in this section shall include a schedule for each damper indicating net free area, actual face velocity and pressure drop (at sea level) based on net free area & the maximum air quantity which will be passing through the damper. Submittals without this information will be rejected.
- D. Record Drawings: At project closeout, submit record drawings of installed systems products, in accordance with requirements of Division 23.
- E. Maintenance Data: Submit manufacturer's maintenance data including parts lists for each type of duct accessory. Include this data, product data, and shop drawings in maintenance manual; in accordance with requirements of Division 23.

PART 2 - PRODUCTS

2.01 MANUFACTURERS:

- A. Manufacturer: Subject to compliance with requirements, provide products by one of the following:

1. Dampers:
 - a. Greenheck
 - b. AWV
 - c. Air Balance, Inc.
 - d. Anemostat
 - e. Arrow Louver and Damper; Div. of Arrow United Industries, Inc.
 - f. Louvers & Dampers, Inc.
 - g. Penn Ventilator Co.
 - h. Pottorff
 - i. Ruskin
 - j. Nailor
2. Turning Vanes:
 - a. Aero Dyne Co.
 - b. Airsan Corp.
 - c. Barb-Aire
 - d. Duro Dyne Corp.
 - e. Environmental Elements Corp.; Subs. Koppers Co., Inc.
 - f. Hart & Cooley Mfg. Co.
3. Duct Hardware:
 - a. Ventfabrics, Inc.
 - b. Young Regulator Co.
 - c. Duro-Dyne Corp.
4. Duct Access Doors:
 - a. Kees
 - b. Ductmate
 - c. Greenheck
 - d. Flexmaster
 - e. Cesco-Advanced Air
 - f. Duro Dyne Corp.
 - g. Flame Gard
5. Flexible Connections:
 - a. Duro Dyne Corp.
 - b. Ventfabrics, Inc.
 - c. General Rubber Corp. (Process & Exhaust Only)

2.02 MANUAL VOLUME DAMPERS:

- A. Low Pressure Rectangular Dampers (less than 2000 FPM and under 2" W.C. S.P. Differential):
 1. For 12" in height or larger, use multiple opposed blade type and close fitted to ducts. The frame and blades shall be constructed of 16 ga. galvanized steel with plated steel shaft mounted with synthetic bearings. Linkage shall be in-jamb fixed type located outside the airstream made of plated steel tie bar and crank plates, with stainless steel pivots. Damper panels shall not exceed 48" wide. Provide jack shafting when duct size required is greater than 48" wide. Provide notched shaft end indicating damper position, locking quadrant to fix damper position and handle. Provide standoff bracket for insulated ducts. For flat oval and round ductwork, provide type C housing.

2. For ducts less than 12" in height, frame shall be 18 ga. blade galvanized steel, steel axle with synthetic bearings locking quadrant handle and notched shaft end indicating damper position. Provide standoff bracket for insulated ducts.

B. Low Pressure Round Dampers (less than 1800 FPM and under 1" W.C. S.P. differential):

1. For low pressure spin-in fitting dampers serving individual returns/diffusers, see 23 31 13.
2. Dampers 4" diameter through 18" diameter shall be 20 ga. galvanized steel frame and blade, utilize multi-blade square dampers with transitions for ducts over 18" diameter.
3. Axle shaft shall be plated steel with retainers mounted on synthetic bearings with notched end shaft indicating damper position, locking quadrant and handle. Provide standoff brackets for insulated ducts.
 - a. Greenheck MBDR-50 or approved equivalent.

2.03 TURNING VANES:

- A. Fabricated Turning Vanes: Provide fabricated 22 gauge, single blade or 24 gauge double bladed 4-1/2" radius, 3-1/4" spacing turning vanes and type 2, 4-1/2" wide runners, constructed in accordance with SMACNA "HVAC Duct Construction Standards" Fig 2.3.
- B. Do not use trailing edge turning vanes.

2.04 DUCT HARDWARE:

- A. General: Provide duct hardware, manufactured by one manufacturer for all items on project, for the following:
- B. Test Holes: Provide in ductwork at fan inlet and outlet, and elsewhere as indicated, duct test holes, consisting of slot and cover, for instrument tests.
- C. Quadrant Locks: Provide for each manual volume damper, quadrant lock device on one end of shaft; and end bearing plate on other end for damper lengths over 12". Provide extended quadrant locks and end extended bearing plates for externally insulated ductwork.

2.05 DUCT ACCESS DOORS:

- A. Access Doors for Low Pressure Rectangular Duct: Construct of same or greater gauge as ductwork served, provide double wall insulated doors for insulated ductwork. Exposed insulation adhered to door is not acceptable. Provide flush frames for uninsulated ductwork, extended frames for externally insulated duct. All access doors shall have gasket and will be air tight. Provide one side hinged, other side with one handle-type latch for doors 12" high and smaller, 2 handle-type latches for larger doors. Where a hinged door cannot be fully opened a removable door may be used.
- B. Flexmaster "Inspector Series Spin Door" or equivalent.
- C. All access doors in other than standard galvanized steel duct systems shall be of the same material or with the same coating as the duct system.

2.06 FLEXIBLE CONNECTIONS:

- A. General: Provide flexible duct connections wherever ductwork connects to vibration isolated equipment. Construct flexible connections of neoprene-coated flameproof fabric crimped into duct flanges for attachment to duct and equipment. Make airtight joint. Provide adequate joint flexibility to allow for thermal, axial, transverse, and torsional movement, and also capable of absorbing vibrations of connected equipment. Shelf life shall be verified to not exceed six (6) months. Any sign of cracking on interior or exterior shall be cause for replacement immediately.
- B. Use the following product types for each application accordingly:
 - 1. Indoor Equipment Non-Corrosive Air Systems: Heavy glass fabric, double-coated with DuPont's NEOPRENE, non-combustible fabric, fire retardant coating with good resistance to abrasion and flexing. Fabric shall be 30 oz per square yard, capable of operating at -10°F to 200°F, waterproof, air tight, 6 inches wide, complies with NFPA 90 and UL Standard #214. "Ventglas" Model as manufactured by VentFabric, Inc.

PART 3 - EXECUTION

3.01 INSPECTION:

- A. Examine areas and conditions under which ductwork accessories will be installed. Do not proceed with work until unsatisfactory conditions have been corrected in manner acceptable to the Engineer.

3.02 INSTALLATION OF DUCTWORK ACCESSORIES:

- A. Install ductwork accessories in accordance with manufacturer's installation instructions, with applicable portions of details of construction as shown in SMACNA standards, and in accordance with recognized industry practices to ensure that products serve intended function.
- B. Install turning vanes in square or rectangular 90 deg. elbows in supply, return and exhaust air systems, and elsewhere as indicated.
- C. Install access doors to open against system air pressure.
- D. Coordinate with other work, including ductwork, as necessary to interface installation of ductwork accessories properly with other work.
- E. Provide duct access doors whether shown or not for inspection and cleaning upstream of all coils, fans, duct smoke detectors and elsewhere as indicated. Review locations prior to fabrication.
- F. Provide balancing dampers at points on low pressure supply, return, and exhaust systems where branches are taken from larger ducts and as required for air balancing.
- G. Provide flexible connections immediately adjacent to equipment in ducts associated with fans and equipment subject to forced vibration.

3.03 COORDINATION:

- A. Make provision for manufacturers required access space in system layout. Locate over lay-in ceilings and above corridors wherever practical.
- B. Order right/left/top/bottom arrangement as required to minimize field modifications.

3.04 FIELD QUALITY CONTROL:

- A. Operate installed ductwork accessories after installation to demonstrate compliance with requirements. Test for air leakage while system is operating. Repair or replace faulty accessories, as required to obtain proper operation and leakproof performance.

3.05 ADJUSTING AND CLEANING:

- A. Adjusting: Adjust ductwork accessories for proper settings, install fusible links in fire/smoke dampers and adjust for proper action.
- B. Label access doors in accordance with Division-23 section "Mechanical Identification".
- C. Final positioning of manual dampers is specified in Division-23 section "Testing, Adjusting, and Balancing".
- D. Cleaning: Clean factory-finished surfaces. Repair any marred or scratched surfaces with manufacturer's touch-up paint.

END OF SECTION 23 3300

SECTION 23 3400 – HVAC FANS

PART 1 - GENERAL:

1.01 DESCRIPTION OF WORK:

- A. Extent of air handling equipment work required by this section is indicated on drawings and schedules, and by requirements of this section.
- B. Refer to other Division 23 sections for vibration control; control system; sequence of operation; testing, adjusting and balancing.
- C. Refer to Division 26 section for the following work; not work of this section.
 - 1. Power supply wiring from power source to power connections at air handling units.
- D. Refer to Section 23 0505 Paragraph 2.6 for requirements of sheaves and belts for critical areas.

1.02 QUALITY ASSURANCE:

- A. Manufacturer's Qualifications: Firms regularly engaged in manufacture of HVAC fans of types and sizes required, whose products have been in satisfactory use in similar service for not less than 3 years.
- B. Codes and Standards:
 - 1. Fans Performance Ratings: Establish flow rate, pressure, power air density, speed of rotation, and efficiency by factory tests and ratings in accordance with AMCA Standard 210/ASHRAE Standard 51 - Laboratory Methods of Testing Fans for Rating.
 - 2. UL Compliance: Provide air handling equipment which are listed by UL and have UL label affixed.
 - 3. UL Compliance: Provide air handling equipment which are designed, manufactured, and tested in accordance with UL 805 "Power Ventilators".
 - 4. NEMA Compliance: Provide motors and electrical accessories complying with NEMA standards.
 - 5. Sound Power Level Ratings: Comply with AMCA Standard 301 "Method for Calculating Fan Sound Ratings from laboratory Test Data." Test fans in accordance with AMCA Standard 300 "Test Code for Sound Rating."
 - 6. Nationally Recognized Testing Laboratory and NEMA Compliance (NRTL): Fans and components shall be NRTL listed and labeled. The term "NRTL" shall be defined in OSHA Regulation 1910.7.
 - 7. Electrical Component Standards: Components and installation shall comply with NFPA 70 "National Electrical Code."

1.03 SUBMITTALS:

- A. Product Data: Submit manufacturer's technical data for air handling equipment including specifications, capacity ratings, dimensions, weights, materials, operating & service/access clearance accessories furnished, and installation instructions.
- B. Shop Drawings: Submit assembly-type shop drawings showing unit dimensions, construction details, methods of assembly of components, and field connection details.
- C. Wiring Diagrams: Submit manufacturer's electrical requirements for power supply wiring to air-handling units. Submit manufacturer's ladder-type wiring diagrams for interlock and control wiring. Clearly differentiate between portions of wiring that are manufacturer-installed and portions to be field-installed.
- D. Record Drawings: At project closeout, submit record drawings of installed systems products; in accordance with requirements of Division 23.
- E. Maintenance Data: Submit maintenance data and parts list for each type of power and gravity ventilator, accessory, and control. Include this data, product data, shop drawings, and wiring diagrams in maintenance manuals in accordance with requirements of Division 23.

1.04 DELIVERY, STORAGE, AND HANDLING:

- A. Lift and support units with the manufacturer's designated lifting or supporting points.
- B. Disassemble and reassemble units as required for movement into the final location following manufacturer's written instructions.
- C. Deliver fan units as a factory-assembled unit with protective crating and covering.

1.05 SEQUENCING AND SCHEDULING:

- A. Coordinate the installation of roof curbs, equipment supports, and roof penetrations.
- B. Coordinate the size and location of structural steel support members.

PART 2 - PRODUCTS

2.01 MANUFACTURERS:

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Centrifugal Wall Ventilators:
 - a. Acme Engineering and Manufacturing Corp.
 - b. Aerovent, Inc.
 - c. Soler & Palau USA
 - d. Carnes Company, Inc.

- e. Loren Cook Co.
 - f. JennCo
 - g. PennBarry
 - h. Greenheck
2. High Volume Low Speed (HVLS) Fans
- a. Delta T LCC, dba Big Ass Fans
 - b. Greenheck

2.02 FANS, GENERAL:

- A. General: Provide fans that are factory fabricated and assembled, factory tested, and factory finished, with indicated capacities and characteristics.
- B. Fans and Shafts: Statically and dynamically balanced and designed for continuous operation at the maximum rated fan speed and motor horsepower.
 - 1. Fan Shaft: Turned, ground, and polished steel designed to operate at no more than 70 percent of the first critical speed at the top of the speed range of the fan's class.
- C. Class II fans shall be provided.
- D. Shaft Bearings: Provide type indicated, having a median life "Rating Life" AFBMA L10 of 40,000 calculated in accordance with AFBMA Standard 9 for ball bearings and AFBMA Standard 11 for roller bearings.
- E. Factory Finish: The following finishes are required:
 - 1. Sheet Metal Parts: Prime coating prior to final assembly.
 - 2. Exterior Surfaces: Baked-enamel finish coat after assembly.
- F. Vibration: Provide vibration isolators as specified in Section 23 0548 and as indicated.

2.03 high volume, low speed fans

- A. Airfoil System
 - 1. The fan shall be equipped with high volume, low speed airfoils of extruded, anodized aluminum alloy. The airfoils shall be connected to the hub and interlocked with stainless steel retainers and two (2) sets of stainless steel bolts and lock washers per airfoil.
 - 2. The fan shall be equipped with upswept winglets designed to redirect outward airflow downward. The winglets shall be molded of high strength polymer and shall be attached at the tip of each airfoil with a stainless steel screw. The standard color of the winglets shall be silver or black. Color to be selected by Architect.
- B. Motor
 - 1. The motor shall be a permanent magnet brushless motor rated for continuous operation at maximum speed with the capability of modulating the fan speed from 0–100% without the use of a gearbox or other mechanical means of control.
 - 2. The motor shall operate from any voltage ranging from 100–120 VAC or 200–240 VAC, single phase, and 50/60Hz, without requiring adapters or customer selection. The motor

shall be a non-ventilated, heat sink design with the capability of continuous operation in -4°F to 131°F ambient condition.

3. The standard color of the motor unit shall be white with silver trim or silver with black trim. Color to be selected by Architect.

C. Mounting System

1. The fan mounting system shall be designed for quick and secure installation from a variety of structural supports. All components in the mounting system shall be of formed metal design using low-carbon steel no less than 3/16" thick and containing no critical welds. The mounting system shall be powder coated for appearance and resistance to corrosion. All mounting bolts shall be metric stainless steel or equivalent. No mounting hardware substitutions, including cast aluminum, are acceptable.
2. The fan extension tube shall be a round, extruded aluminum tube. The extension tube shall include a chrome plate with forward and reverse controls and a fan status indicator light that is visible from the floor.

D. Hub

1. The fan hub shall be constructed of zinc plated steel for high strength and durability. The hub shall be precision machined to achieve a well-balanced and solid rotating assembly.

E. Safety Cable

1. The fan shall be equipped with a safety cable that provides an additional means of securing the fan assembly to the building structure. The safety cable shall be 3/16" diameter and fabricated out of 7 x 19 stranded galvanized steel, pre-loaded and tested to 3,200 lbf.
2. Field construction of safety cables is not permitted.

F. Controls

1. The fan controller shall be incorporated into the fan assembly and housed in an enclosure independent of the motor to prevent overheating or electrical interference. The fan controller shall be factory programmed to minimize starting and braking torques and shall be equipped with a simple diagnostic program and an LED light to identify and relay faults in the system.
2. Wall Control: Wired (standard). The fan shall be equipped with a low-voltage wired remote wall control providing control of all fan functions. The wall control shall be capable of mounting to a standard electrical box or directly to a wall surface. The wall control shall include a rotary-style dial for controlling the fan's power and speed and an LED light to identify and relay faults in the system. Communication with the fan drive and controller shall be by a standard, commercially available CAT5 (or higher) Ethernet cable that is field installed and provided by the installer.

G. Guy Wires

1. Guy wires shall be included for installations with extension tubes 4 ft or longer to limit the potential for lateral movement.

H. WARRANTY:

1. The manufacturer shall replace any products or components defective in material or workmanship for the customer free of charge (including transportation charges within the USA), in accordance to the following schedule:
 - a. Mechanical components of the fan, including, the gearbox, fan hub, motor frame, mounting, airfoils, and winglets : 10 years.
 - b. Electrical and electronic components of the fan, including the motor, motor drive, variable frequency drive, and any standard controller or accessories: 5 years.
 - c. Labor: 1 year.

2.04 CENTRIFUGAL WALL VENTILATORS:

- A. General Description: Belt-driven or direct-drive as indicated, centrifugal consisting of housing, wheel, fan shaft, bearings, motor and disconnect switch, drive assembly, curb base, and accessories.
- B. Housing: Heavy-gauge, removable, spun-aluminum, dome top and outlet baffle; square, one-piece, hinged, aluminum base with venturi inlet cone.
- C. Fan Wheel: Aluminum hub and wheel with backward-inclined blades.
- D. Accessories: The following items are required as indicated:
 1. Disconnect Switch: Nonfusible type, with thermal overload protection mounted inside fan housing, factory-wired through an internal aluminum conduit.
 2. Bird Screens: Removable ½" mesh, 16-gauge, aluminum or brass wire.
 3. Dampers: Counterbalanced, parallel-blade, backdraft dampers mounted in curb base, factory set to close when fan stops.

PART 3 - EXECUTION

3.01 EXAMINATION:

- A. Examine areas and conditions, with Installer present, for compliance with requirements for installation tolerances, housekeeping pads, and other conditions affecting performance of fans.
- B. Do not proceed until unsatisfactory conditions have been corrected.

3.02 INSTALLATION, GENERAL:

- A. Install fans level and plumb, in accordance with manufacturer's written instructions. Support units using vibration control devices as indicated. Vibration control devices are specified in Division 23 Section "Vibration Controls."
- B. Arrange installation of units to provide access space around HVAC fans for service and maintenance.

3.03 INSTALLATION, high volume, low speed fans:

- A. The fan shall be installed by a factory-certified installer according to the manufacturer's Installation Guide, which includes acceptable structural dimensions and proper sizing and placement of angle irons for bar joist applications.
- B. Minimum Distances
 - 1. Installation area shall be free of obstructions such as lights, cables, sprinklers, or other building structures with the airfoils at least 2 ft. clear of all obstructions.

3.04 CONNECTIONS:

- A. Duct installations and connections are specified in other Division 23 sections. Make final duct connections on inlet and outlet duct connections with flexible connections.
- B. Electrical Wiring: Install electrical devices furnished by manufacturer but not specified to be factory-mounted. Furnish copy of manufacturer's wiring diagram submittal to Electrical Installer.
 - 1. Verify that electrical wiring installation is in accordance with manufacturer's submittal and installation requirements of Division-26 sections. Ensure that rotation is in direction indicated and intended for proper performance.
 - 2. Temperature control wiring and interlock wiring are specified in Division 23.
 - 3. Grounding: Connect unit components to ground in accordance with the National Electrical Code.

3.05 FIELD QUALITY CONTROL:

- A. Upon completion of installation of HVAC fans, and after motor has been energized with normal power source, test equipment to demonstrate compliance with requirements. Where possible, field correct malfunctioning equipment, then retest to demonstrate compliance. Replace equipment which cannot be satisfactorily corrected.
- B. Manufacturer's Field Inspection: Arrange and pay for a factory- authorized service representative to perform the following:
 - 1. Inspect the field assembly of components and installation of fans including ductwork and electrical connections.
 - 2. Prepare a written report on findings and recommended corrective actions.

3.06 ADJUSTING, CLEANING, AND PROTECTING:

- A. Startup, test and adjust HVAC fans in presence of manufacturer's authorized representative.
- B. Adjust damper linkages for proper damper operation.
- C. Clean unit housing interiors to remove foreign material and construction dirt and dust. Vacuum clean fan wheel and housing.

3.07 COMMISSIONING:

- A. Final Checks Before Start-Up: Perform the following operations and checks before start-up:
 - 1. Remove shipping blocking and bracing.
 - 2. Verify unit is secure on mountings and supporting devices and that connections for piping, ductwork, and electrical are complete. Verify proper thermal overload protection is installed in motors, starters, and disconnects.
 - 3. Perform cleaning and adjusting specified in this Section.
 - 4. Verify proper motor rotation direction, and verify fan wheel free rotation and smooth bearings operations.
 - 5. Lubricate bearings with factory-recommended lubricants.
 - 6. Verify manual and automatic volume control and that fire and smoke dampers in connected ductwork systems are in the full-open position.
 - 7. Disable automatic temperature control operators.

- B. Starting procedures for fans:
 - 1. Energize motor; verify proper operation of motor, and fan wheel. Adjust fan to indicated RPM.
 - 2. Measure and record motor electrical values for voltage and amperage.

- C. Shut unit down and reconnect automatic temperature control operators.

- D. Refer to Division 23 Section "Testing, Adjusting, and Balancing" for procedures for air-handling-system testing, adjusting, and balancing.

END OF SECTION 23 3400

SECTION 23 3713 – DIFFUSERS, REGISTERS & GRILLES

PART 1 - GENERAL

1.01 DESCRIPTION OF WORK:

- A. Extent of air outlets and inlets work is indicated by drawings and schedules, and by requirements of this section.
- B. Types of air outlets and inlets required for project include the following:
 - 1. Ceiling air diffusers.
 - 2. Wall registers and grilles.
 - 3. Louvers.
- C. Refer to other Division 23 sections for ductwork, duct accessories; testing and balancing; not work of this section.

1.02 QUALITY ASSURANCE:

- A. Manufacturer's Qualifications: Firms regularly engaged in manufacture of air outlets and inlets of types and capacities required, whose products have been in satisfactory use in similar service for not less than 5 years.
- B. Codes and Standards:
 - 1. AHRI Compliance: Test and rate air outlets and inlets in accordance with AHRI 650 "Standard for Air Outlets and Inlets".
 - 2. ASHRAE Compliance: Test and rate air outlets and inlets in accordance with ASHRAE 70 "Method of Testing for Rating the Air Flow Performance of Outlets and Inlets".
 - 3. ADC Compliance: Test and rate air outlets and inlets in certified laboratories under requirements of ADC 1062 "Certification, Rating and Test Manual".
 - 4. ADC Seal: Provide air outlets and inlets bearing ADC Certified Rating Seal.
 - 5. AMCA Compliance: Test and rate louvers in accordance with AMCA 500 "Test Method for Louvers, Dampers and Shutters".
 - 6. AMCA Seal: Provide louvers bearing AMCA Certified Rating Seal.
 - 7. NFPA Compliance: Install air outlets and inlets in accordance with NFPA 90A "Standard for the Installation of Air Conditioning and Ventilating Systems".

1.03 SUBMITTALS:

- A. Product Data: Submit manufacturer's technical product data for air outlets and inlets including the following:
 - 1. Schedule of air outlets and inlets indicating drawing designation, room location, number, furnished, model number, size, and accessories furnished.
 - 2. Data sheet for each type of air outlet and inlet, and accessory furnished; indicating construction, finish, and mounting details.

3. Performance data for each type of air outlet and inlet furnished, including aspiration ability, temperature and velocity traverses, throw and drop, and noise criteria ratings. Indicate selections on data.
 - B. Record Drawings: At project closeout, submit record drawings of installed systems products, in accordance with requirements of Division 23.
 - C. Maintenance Data: Submit maintenance data, including cleaning instructions for finishes, and spare parts lists. Include this data, product data, and shop drawings in maintenance manuals; in accordance with requirements of Division 23.
- 1.04 PRODUCT DELIVERY, STORAGE AND HANDLING:
- A. Deliver air outlets and inlets wrapped in factory- fabricated fiber-board type containers. Identify on outside of container type of outlet or inlet and location to be installed. Avoid crushing or bending and prevent dirt and debris from entering and settling in devices.
 - B. Store air outlets and inlets in original cartons and protect from weather and construction work traffic. Where possible, store indoors; when necessary to store outdoors, store above grade and enclose with waterproof wrapping.

PART 2 - PRODUCTS

2.01 MANUFACTURERS:

- A. Manufacturer: Subject to compliance with requirements, provide products by one of the following:
 1. Diffusers, Registers and Grilles:
 - a. Anemostat
 - b. Price
 - c. Carnes
 - d. Krueger
 - e. Titus
 - f. Metal-Aire
 - g. Carnes
 - h. Nailor
 2. Louvers:
 - a. Air Balance
 - b. American Warming & Ventilating, Inc.
 - c. Arrow United Industries, Inc.
 - d. Pottoroff
 - e. Louvers & Dampers, Inc.
 - f. Penn Ventilator Co., Inc.
 - g. Ruskin
 - h. Greenheck
 - i. Nailor

2.02 CEILING AIR DIFFUSERS:

- A. General: Except as otherwise indicated, provide manufacturer's standard ceiling air diffusers where shown; of size, shape, capacity and type indicated; constructed of materials and components as indicated, and as required for complete installation.
- B. Performance: Provide ceiling air diffusers that have, as minimum, temperature and velocity traverses, throw and drop, and noise criteria ratings for each size device as listed in manufacturer's current data.
- C. Ceiling Compatibility: Provide diffusers with border styles that are compatible with adjacent ceiling systems, and that are specifically manufactured to fit into ceiling module with accurate fit and adequate support. Refer to general construction drawings and specifications for types of ceiling systems, which will contain each type of ceiling air diffuser.
- D. Types: Provide ceiling diffusers of type, capacity, and with accessories and finishes as listed on air device schedule.

2.03 REGISTERS AND GRILLES:

- A. General: Except as otherwise indicated, provide manufacturer's standard registers and grilles where shown; of size, shape, capacity and type indicated; constructed of materials and components as indicated, and as required for complete installation.
- B. Performance: Provide registers and grilles that have, as minimum, temperature and velocity traverses, throw and drop, and noise criteria ratings for each size device as listed in manufacturer's current data.
- C. Wall Compatibility: Provide registers and grilles with border styles that are compatible with adjacent wall systems, and that are specifically manufactured to fit into wall construction with accurate fit and adequate support. Refer to general construction drawings and specifications for types of wall construction, which will contain each type of wall register and grille.
- D. Types: Provide registers and grilles of type, capacity, and with accessories and finishes as listed on air device schedule.

2.04 LOUVERS:

- A. General: Except as otherwise indicated, provide manufacturer's standard stationary, stormproof blade type louvers with aluminum bird screen where shown; of size indicated, and as required for complete installation. 4" nominal depth, aluminum: Air Balance A445D, drainable blade style, 45 degree fixed blades.
- B. Refer to drawings for louver performance requirements and additional options.
- C. Substrate Compatibility: Provide louvers with frame and sill styles that are compatible with adjacent substrate, and that are specifically manufactured to fit into construction openings with

accurate fit and adequate support, for weatherproof installation. Refer to general construction drawings and specifications for types of substrate, which will contain each type of louver.

- D. Materials: Construct of aluminum extrusions, ASTM B 221, Alloy 6063-T6/T52. Weld units or use stainless steel fasteners.
- E. Louver Screens: On inside face of exterior louvers inside face of exhaust air outlet and outside face of outside air intake louvers, provide ½" square mesh anodized aluminum wire bird screens mounted in removable extruded aluminum frames.

PART 3 - EXECUTION

3.01 INSPECTION:

- A. Examine areas and conditions under which air outlets and inlets are to be installed. Do not proceed with work until unsatisfactory conditions have been corrected.

3.02 INSTALLATION:

- A. General: Install air outlets and inlets in accordance with manufacturer's written instructions and in accordance with recognized industry practices to insure that products serve intended functions.
- B. Coordinate with other work, including ductwork and duct accessories, as necessary to interface installation of air outlets and inlets with other work.
- C. Locate ceiling air diffusers, registers, and grilles, as indicated on general construction "Reflected Ceiling Plans". Unless otherwise indicated, locate units in center of acoustical ceiling modules.

3.03 SPARE PARTS:

- A. Furnish to Owner, with receipt, 3 operating keys for each type of air outlet and inlet that require them.

END OF SECTION 23 3713

SECTION 23 5100 – BREECHINGS, CHIMNEYS, AND STACKS

PART 1 - GENERAL

1.01 SUMMARY

- A. This Section includes the following:
1. Listed double-wall vents

1.02 SUBMITTALS

- A. Product Data: For the following:
1. Type B and BW vents.
- B. Shop Drawings: Include plans, elevations, sections, details, and attachments to other work.
1. Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, methods of field assembly, anchoring requirements, expansion compensation, pressure relief devices, components, hangers and seismic restraints, and location and size of each field connection.
 2. For installed products indicated to comply with design loads, include calculations required for selecting seismic restraints and structural analysis data signed and sealed by the qualified professional engineer responsible for their preparation.
- C. Manufacturer Seismic Qualification Certification: Submit certification that factory-fabricated breeching, chimneys, and stacks; accessories; and components will withstand seismic forces defined in Division 23 Section "Vibration and Seismic Controls for HVAC Piping and Equipment." Include the following:
1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.
 - a. 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. Dimensioned Outline Drawings of Breeching, Chimneys, and Stacks: Identify center of gravity and locate and describe mounting and anchorage provisions.
 3. Detailed description of anchorage devices on which the certification is based and their installation requirements.
- D. Warranty: Special warranty specified in this Section.
- E. Vent System Sizing Calculations: Computer calculated sizing analysis for the boilers and/or water heaters being furnished. The computer analysis shall include the make, model number, firing rate and allowable back pressure for each vented appliance. The analysis shall also include drawings detailing the vent system layout including lengths, number of fittings and sizes. Where applicable expansion calculations and expansion joint selection shall also be included.

1.03 QUALITY ASSURANCE

- A. Source Limitations: Obtain listed system components through one source from a single manufacturer.
- B. Welding: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code--Steel," for hangers and supports and AWS D9.1/D9.1M, "Sheet Metal Welding Code," for shop and field welding of joints and seams in vents, breechings, and stacks.
- C. Certified Sizing Calculations: Manufacturer shall certify venting system sizing calculations.

1.04 COORDINATION

- A. Coordinate installation of roof penetrations. These items are specified in Division 07 Section "Roof Accessories."

1.05 WARRANTY

- A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of venting system that fail in materials or workmanship within specified warranty period. Failures include, but are not limited to, structural failures caused by expansion and contraction.
 - 1. Warranty Period: 10 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
- B. Listed Type B and BW Vents
 - 1. American Metal Products; MASCO Corporation.
 - 2. Cleaver-Brooks; Div. of Aqua-Chem Inc.
 - 3. FAMCO.
 - 4. Hart & Cooley, Inc.
 - 5. Heat-Fab, Inc.
 - 6. Industrial Chimney Company.
 - 7. LSP Products Group, Inc.
 - 8. Metal-Fab, Inc.
 - 9. Schebler Co. (The).
 - 10. Selkirk Inc.; Selkirk Metalbestos and Air Mate.
 - 11. Dura-Vent Co., Inc.; Subsidiary of Simpson Manufacturing Co.
 - 12. Tru-Flex Metal Hose Corp.
 - 13. Van-Packer Company, Inc.

2.02 LISTED TYPE B AND BW VENTS

- A. Description: Double-wall metal vents tested according to UL 441 and rated for 480 deg F continuously for Type B, or 550 deg F continuously for Type BW; with neutral or negative flue pressure complying with NFPA 211.
- B. Construction: Inner shell and outer jacket separated by at least a 1/4-inch airspace.
- C. Inner Shell: ASTM B 209 (ASTM B 209M), Type 1100 aluminum or ASTM B 209 (ASTM B 209M), Type 3003 aluminum or ASTM B 209 (ASTM B 209M), Type 3105 aluminum or ASTM A 666, Type 430 stainless steel.
- D. Outer Jacket: Aluminized steel.
- E. Accessories: Tees, elbows, increasers, draft-hood connectors, terminations, adjustable roof flashings, storm collars, support assemblies, thimbles, firestop spacers, and fasteners; fabricated from similar materials and designs as vent-pipe straight sections; all listed for same assembly.
 - 1. Termination: Manufacturer approved cap.

PART 3 - EXECUTION

3.01 EXAMINATION

- A. Examine areas and conditions for compliance with requirements for installation tolerances and other conditions affecting performance of work.
 - 1. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 APPLICATIONS

- A. Listed Type B and BW Vents: Vents for certified gas appliances.

3.03 INSTALLATION OF LISTED VENTS AND CHIMNEYS

- A. General: Install vents, chimneys, and stacks in accordance with the attached boiler or appliance manufacturers requirements
- B. Locate to comply with minimum clearances from combustibles and minimum termination heights according to product listing or NFPA 211, whichever is most stringent.
- C. Support vents at intervals recommended by manufacturer to support weight of vents and all accessories, without exceeding appliance loading.
- D. Slope breechings down in direction of appliance, with condensate drain connection at lowest point piped to nearest drain.
- E. Lap joints in direction of flow.

- F. Join sections with acid-resistant joint cement to provide continuous joint and smooth interior finish.
- G. Erect stacks plumb to finished tolerance of no more than 1 inch out of plumb from top to bottom.
- H. On all flue vent low points where water is likely to collect, install drains with a p-trap sized for the vent pressures. Route drains to the nearest floor drains through an acid neutralizer.

3.04 CLEANING

- A. After completing system installation, including outlet fittings and devices, inspect exposed finish. Remove burrs, dirt, and construction debris and repair damaged finishes.
- B. Clean breechings internally, during and after installation, to remove dust and debris. Clean external surfaces to remove welding slag and mill film. Grind welds smooth and apply touchup finish to match factory or shop finish.
- C. Provide temporary closures at ends of breechings, chimneys, and stacks that are not completed or connected to equipment.

END OF SECTION 23 5100

SECTION 23 5400 - FURNACES

PART 1 - GENERAL

1.01 WORK INCLUDED:

- A. Forced air furnaces.
- B. Refrigerant cooling coil and condenser.
- C. Controls.

1.02 QUALITY ASSURANCE:

- A. Conform to requirements of UL and applicable codes.
- B. Cooling system tested and rated to AHRI Standard 210.

1.03 SUBMITTALS:

- A. Product Data: Submit manufacturer's technical product data and installation instructions for forced air furnace systems materials and products.
- B. Submit shop drawings and product data in accordance with Section 23 0500 Water Treatment for Mechanical Systems showing dimensions, connections, arrangement, accessories, flue sizing recommendations and controls.
- C. Submit manufacturer's installation instructions.
- D. Submit manufacturer's descriptive literature, operating instructions, and maintenance and repair data.
- E. Wiring Diagrams: Submit manufacturer's electrical requirements for power supply wiring to compressed air equipment. Submit manufacturer's ladder-type wiring diagrams for interlock and control wiring. Clearly differentiate between portions of wiring that are factory-installed and portions to be field-installed.
- F. Record Drawings: At project closeout, submit record drawings of installed systems products; in accordance with requirements of Division 23.
- G. Maintenance Data: Submit maintenance data and parts lists for compressed air systems materials and products. Include this data, product data, shop drawings, record drawings, and wiring diagrams in maintenance manual; in accordance with requirements of Division 23.

1.04 WARRANTY:

- A. Provide 5 year parts warranty on heat exchangers.

- B. Provide 5 year warranty on compressors.

PART 2 - PRODUCTS

2.01 MANUFACTURERS:

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Forced Air Furnaces:
 - a. Rheem
 - b. Fedders
 - c. York
 - d. Lennox
 - e. Trane

2.02 TYPE:

- A. Provide upflow or counterflow type (as shown on the drawings) with gas burner and electric refrigeration.
- B. Provide self-contained, packaged, factory assembled, pre-wired unit consisting of cabinet, supply fan, heat exchanger, burner or heater, controls, air filter, refrigerant cooling coil and outdoor package containing compressor, condenser coil and condenser fan.

2.03 CONSTRUCTION:

- A. Cabinet: Galvanized steel with baked enamel finish, easily removed and secured access doors, glass fiber insulation and reflective liner and welded steel base.
- B. Heat Exchanger: Cold rolled steel construction.
- C. Burners shall be aluminized steel with crossover igniter of burner ports.
- D. Supply Fan: Centrifugal type, rubber mounted with direct or belt drive, with adjustable variable pitch motor pulley or rubber isolated hinge mounted multispeed motor.
- E. Air Filters: 1 inch (25 mm) thick glass fiber, disposable type arranged for easy replacement. Provide pleated type with 30 percent Eff. rating.

2.04 BURNER:

- A. Gas Burner: Induced draft type with adjustable combustion air supply, equipped with combustion gas valve and pressure regulator incorporating manual shut-off, pilot valve, automatic 100 percent shut-off, and thermocouple pilot safety device. Provide with spark pilot ignition.

- B. Gas Burner Safety Controls: Thermocouple sensor prevents opening of solenoid gas valve until pilot flame is proven and stops gas flow on ignition failure.

2.05 BURNER OPERATING CONTROLS:

- A. Provide low voltage, adjustable room heating-cooling thermostats, to control burner operation to maintain room temperature settings.
- B. Provide high limit control, with fixed stop at maximum permissible setting, to de-energize burner on excessive bonnet temperature and energize burner when temperature drops to lower safe value.
- C. Provide controls for supply fan in accordance with bonnet temperatures independent of burner controls. Include manual switch for continuous fan operation.
- D. Provide safety interlock switch located in wiring junction box which shall automatically turn power off to unit when blower access panel is removed.
- E. See drawing schedules for alternate options to be provided.

2.06 EVAPORATOR COIL:

- A. Mount in furnace supply plenum copper tube aluminum fin coil assembly, with galvanized drain pan, 3/4" drain connection, refrigerant piping connections. Provide with coil cabinet and adapter bases where required by manufacturer.
- B. Provide factory installed thermostatic expansion valve kit including expansion and check valve.

2.07 REFRIGERATION PACKAGE:

- A. Compressor: Hermetically sealed, 3600 rpm maximum, resiliently mounted integral with condenser, with positive lubrication, crankcase heater, high pressure control, motor overload protection, service valves, and drier.
- B. Air Cooled Condenser: Aluminum fin and copper tube coil, direct drive propeller fan resiliently mounted, galvanized or PVC fan guard, mounting base.
- C. Provide capacity ratings derived in accordance with ARI and DOE tests procedures. Provide certification of ARI on each unit. Provide units with UL listing.

2.08 REFRIGERATION OPERATING CONTROLS:

- A. Low voltage, adjustable thermostat controls compressor, condenser fan and supply fan to maintain room temperature setting. Provide remote return air temperature sensor behind return air grille in location shown.
- B. Include thermostat system selector switch (heat-cool-off) and fan control switch (on-auto). Locate in corresponding mechanical room.

- C. Timed off circuit shall limit number of compressor starts to 12 per hour.
- D. Provide refrigerant pressure switch to cycle condenser fan.

PART 3 - EXECUTION

3.01 INSTALLATION:

- A. Mount counterflow furnaces installed on combustible floors, on additive base.
- B. Mount air cooled condenser package on concrete mounting pad. Pad by General Contractor.

END OF SECTION 23 5400

SECTION 23 5523 – LOW INTENSITY HEATERS

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 low-intensity, gas-fired, forced-draft radiant heaters.

1.03 ACTION SUBMITTALS

- A. Product Data: For each type of product.
 - 1. Include rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories.
- B. Shop Drawings:
 - 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. Detail fabrication and assembly of high-intensity, gas-fired, radiant heaters, as well as procedures and diagrams.
 - 4. Include diagrams for power, signal, and control wiring.

1.04 INFORMATIONAL SUBMITTALS

- A. Field quality-control reports.

1.05 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For gas-fired, radiant heaters to include in emergency, operation, and maintenance manuals.

1.06 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. Igniter: One hot-surface burner igniter(s) for each style of high-intensity, gas-fired, radiant heater furnished.

1.07 WARRANTY

- A. Manufacturer's Special Warranty: Manufacturer agrees to repair or replace components of radiant heaters that fail in materials or workmanship within specified warranty period.
 - 1. Warranty Period: All warranty periods listed below are from date of Substantial Completion.
 - a. Burner Assembly: Three years.
 - b. Combustion and Emitter Tubes: Five years.
 - c. Heater Controls: One year(s).

PART 2 - PRODUCTS

2.01 PERFORMANCE REQUIREMENTS

- A. CSA certified, with CSA Seal and certification number clearly visible on units indicating compliance with ANSI Z83.20/CSA 2.34.
- B. UL listed and labeled, with UL label clearly visible on units indicating compliance with ANSI Z83.20/CSA 2.34.
- C. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

2.02 FORCED-DRAFT HEATERS

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - 1. Calcana Industries Ltd.
 - 2. Combustion Research Corp.
 - 3. Detroit Radiant Products Company
 - 4. Roberts-Gordon LLC
 - 5. Schwank Inc
 - 6. Solaronics Inc
 - 7. Space-Ray; div of Gas Fired Products Inc
 - 8. Sterling HVAC Products; a Mestek company
 - 9. Thomas & Betts Corp; a member of the ABB group
- B. Description: Factory-assembled, indoor, overhead-mounted, electrically controlled, low-intensity, infrared radiant heating units using gas combustion. Heater to have all necessary factory-installed wiring and piping required prior to field installation and startup.
- C. Fuel Type: Design burner for natural gas having characteristics same as those of gas available at Project site.
- D. Burner Assembly:
 - 1. Combustion-Air Inlet: Ducted vertical to outdoors through roof with vent caps, if shown.
 - 2. Burner Control Housing: Stainless steel or Corrosion-resistant, aluminized steel.

- a. Totally enclosed with stainless-steel or steel access cover.
 - b. Sight glass for visual inspection of burner.
 - c. Finish: Enameled finish or powder-coated finish.
 3. Burner: Stainless steel or One-piece cast iron.
 4. Ignition System: Silicon carbide hot-surface igniter or Direct spark 24/25-V ac with flame rod sensing capabilities and self-diagnostic control module.
 5. Combustion Blower Fan: Dynamically balanced, direct-driven, forward-curved fan with cast-aluminum-alloy or stainless-steel impeller and aluminized-steel housing, with a minimum temperature rating of 450 deg F.
 6. Motors:
 - a. Motor: Resilient-mounted, capacitor-start-capacitor-run type with sealed ball bearings; totally enclosed, nonventilated type with internal thermal protection.
 - b. Motor Sizes: Minimum size as indicated. If not indicated, large enough so driven load will not require motor to operate in service factor range above 1.0.
- E. Combustion Chamber: 4-inch-diameter, 12-gage, stainless or hot-rolled-steel tubing with high-emissivity, high-temperature, corrosion-resistant external finish. Chambers shall be equipped with sight glass for burner and pilot flame observation.
- F. Emitter Tube: 4-inch-diameter, 12-gage, calorized, aluminized hot-rolled or stainless-steel tubing with high-emissivity, high-temperature, corrosion-resistant external finish. Emitter tubing shall be equipped with baffles to maximize heating efficiency.
 1. Tubing Connections: Stainless-steel threaded couplings, Interlocking flare joints with stainless-steel draw bolts or Compression couplings made from aluminized or stainless steel.
 2. 90 or 180-degree-bend emitter steel tubing with high-emissivity, high-temperature, corrosion-resistant external finish.
 3. Exhaust Vent Termination: Vertical through roof as shown on drawings with vent caps.
- G. Reflector: Polished aluminum, Polished stainless steel or High-grade steel with a heat- and corrosion-resistant, hot-bonded, aluminum-silicon alloy coating, with end caps. Shape to control radiation from tubing for uniform intensity at floor level with 100 percent cutoff above centerline of tubing. Reflectors or entire heater shall accommodate rotational adjustment from horizontal to a minimum 30-degree tilt from vertical.
- H. Accessories:
 1. Reflector Extension Shields: Same material as reflectors, arranged for fixed connection to lower reflector lip and rigid support to provide 100 percent cutoff of direct radiation from tubing at angles greater than 30 degrees from vertical.
 2. Protective grilles mounted to reflectors to protect emitter tubing.
 3. Stainless-steel flexible connector with manual valve for gas supply.
 4. Hanger chain with "S" hooks.
 5. Rigid mounting kits.
 6. Clearance warning plaque.
- I. Capacities and Characteristics: As scheduled on drawings.

2.03 CONTROLS AND SAFETIES

- A. Gas Control Valve: Single-stage, regulated redundant 24-V ac gas valve that contains pilot solenoid valve, electric gas valve, pilot filter, pressure regulator, pilot shutoff, and manual shutoff all in one body.
- B. Failure Safeguards: 100 percent shutoff of gas flow in the event of flame or power failure.
- C. Prepurge of air control system prior to burner ignition.
- D. Safety lockout of burner after three consecutive ignition failures or flame is not reestablished within trial ignition period.
- E. Blocked Vent Safety: Differential pressure switch in burner safety circuit to stop burner operation with high discharge or suction pressure.
- F. Control Panel Interlock: Stops burner if panel is open.
- G. Indicator Lights: "burner-on" indicator lights.
- H. Thermostat: Programmable, single-stage, wall-mounted type with 50 to 90 deg F operating range, relays, etc., necessary to control up to six units.
 - 1. Control Transformer: Integrally mounted as required.

PART 3 - EXECUTION

3.01 EXAMINATION

- A. Examine structures, substrates, areas and conditions, with Installer present, for compliance with requirements for installation tolerances, required clearances, and other conditions affecting performance of the Work.
- B. Examine roughing-in for fuel-gas piping to verify actual locations of piping connections before equipment installation.
- C. Prepare written report, endorsed by Installer, listing conditions detrimental to performance of the Work.
- D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 INSTALLATION

- A. Equipment Installation: Install gas-fired, radiant heaters and associated gas features and systems according to NFPA 54 and International Fuel Gas Code.
- B. Suspended Units: Suspend from substrate using chain hanger kits and building attachments.
 - 1. Restrain the unit to resist seismic acceleration.

2. Comply with requirements for hangers and supports specified in Section 23 0529 "Hangers and Supports for HVAC Piping and Equipment."

C. Maintain manufacturers' recommended clearances for combustibles.

3.03 CONNECTIONS

A. Gas Piping: Comply with Section 23 1123 "Facility Natural-Gas Piping." Connect gas piping to gas train inlet; provide union with enough clearance for burner removal and service.

1. Gas Connections: Connect gas piping to radiant heaters according to NFPA 54 and International Fuel Gas Code.

B. Where installing piping adjacent to gas-fired, radiant heaters, allow space for service and maintenance.

C. Vent Connections: Comply with Section 23 5123 "Gas Vents."

D. Electrical Connections: Comply with applicable requirements in Division 26.

1. Install electrical devices furnished with heaters but not specified to be factory mounted.

E. Controls: Wire units to programmable t-stats in groups.

3.04 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. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
2. Verify bearing lubrication.
3. Verify proper motor rotation.
4. Test Reports: Prepare a written report to record the following:
 - a. Test procedures used.
 - b. Test results that comply with requirements.
 - c. Test results that do not comply with requirements and corrective action taken to achieve compliance with requirements.

C. Gas-fired, radiant heaters will be considered defective if they do not pass tests and inspections.

D. Prepare test and inspection reports.

3.05 ADJUSTING

A. Adjust initial-temperature set points.

- B. Adjust burner and other unit components for optimum heating performance and efficiency.

3.06 DEMONSTRATION

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain gas-fired, radiant heaters.

END OF SECTION 23 5523

SECTION 23 8000 - DECENTRALIZED HVAC EQUIPMENT

PART 1 - GENERAL

1.01 DESCRIPTION OF WORK:

- A. Extent of terminal unit work is indicated on drawings and schedules, and by requirements of this section.
- B. Types of terminal units required for project include the following:
 - 1. Unit heaters.
 - 2. Electric wall heaters.
- C. Refer to other Division 23 sections for piping; ductwork; testing, adjusting and balancing of terminal units; not work of this section.
- D. Refer to Division 26 section for the following work; not work of this section.
 - 1. Power supply wiring from power source to power connection on terminal units.
 - 2. Provide the following electrical work as work of this section, complying with requirements of Division-26 sections:
 - a. Control wiring between field-installed controls, indicating devices, and terminal unit control panels.
 - 1) Control wiring specified as work of Division 23 for Automatic Temperature Controls is work of that section.
- E. Refer to other Division 23 sections for automatic temperature controls not factory installed, required in conjunction with terminal units; not work of this section.

1.02 QUALITY ASSURANCE:

- A. Manufacturer's Qualifications: Firms regularly engaged in manufacture of terminal units, of types and sizes required, whose products have been in satisfactory use in similar service for not less than 5 years.
- B. Codes and Standards:
 - 1. AHRI Compliance: Provide coil ratings in accordance with AHRI Standard 410 "Forced-Circulation Air-Cooling and Air-Heating Coils".
 - 2. ASHRAE Compliance: Test coils in accordance with ASHRAE Standard 33 "Methods of Testing Forced Circulation Air Cooling and Heating Coils".
 - 3. UL Compliance: Provide electrical components for terminal units, which have been listed and labeled by UL.
 - 4. Electric Heating Equipment: Equipment not exceeding 48 amps shall also have overcurrent protection. Overcurrent protection devices shall be factory wired and installed in accordance with the National Electric Code. All equipment shall be factory assembled and wired in accordance with the National Fire Protection Association and shall be listed by Underwriters' Laboratories.

1.03 SUBMITTALS:

- A. Product Data: Submit manufacturer's technical product data, for terminal units showing dimensions, capacities, ratings, performance characteristics, gauges and finishes of materials, and installation-startup instructions.
- B. Shop Drawings: Submit manufacturer's assembly-type shop drawings indicating terminal unit dimensions, weight loading, required clearances, construction details, field connection details and methods of assembly of components.
- C. Wiring Diagrams: Submit manufacturer's electrical requirements for power supply wiring to terminal units. Submit manufacturer's ladder-type wiring diagrams for interlock and control wiring. Clearly differentiate between portions of wiring that are factory-installed and portions to be field-installed.
- D. Record Drawings: At project closeout, submit record drawings of installed systems products in accordance with requirements of Division 23.
- E. Maintenance Data: Submit maintenance instructions, including lubrication instructions, filter replacement, motor and drive replacement, control, accessories, "trouble-shooting" maintenance guide, and spare parts lists. Include this data, product data, and shop drawings in maintenance manuals; in accordance with requirements of Division 23.

1.04 DELIVERY, STORAGE, AND HANDLING:

- A. Handle terminal units and components carefully to prevent damage, breaking, denting and scoring. Do not install damaged terminal units or components; replace with new.
- B. Store terminal units and components in clean dry place. Protect from weather, dirt, fumes, water, construction debris, and physical damage.
- C. Comply with Manufacturer's rigging and installation instructions for unloading terminal units, and moving them to final location.

PART 2 - PRODUCTS

2.01 MANUFACTURERS:

- A. Manufacturer: Subject to compliance with requirements, provide products by one of the following:
 - 1. Electric Unit Heater
 - a. Q Mark
 - b. Singer
 - c. Trane
 - d. Brasch
 - e. Indeeco
 - f. Berko

- g. Markel
- h. Modine
- i. Raywall
- 2. Electric Wall Heaters
 - a. Berko
 - b. Q Mark
 - c. Singer
 - d. Brasch
 - e. Markel
 - f. Raywall

2.02 ELECTRIC UNIT HEATERS:

- A. General: Provide electric unit heaters in locations as indicated, and of capacities, style, and having accessories as scheduled. Provide factory mounted disconnect.
- B. Horizontal Unit Heaters:
 - 1. Casings: Construct of steel, phosphatized inside and out, and finished with standard color baked enamel finish. Provide motor-mounted panel, minimum of 18-ga steel. Fabricate casing to enclose coil, louvers, and fan blades. Provide louvers for 2-way air diffusion.
 - 2. Fans: Construct of aluminum, and factory-balance. Provide fan inlet orifice, smooth, and drawn into casing back panel.
- C. Elements: Unit shall include electric resistance element with manual-reset thermal overload protection, unit mounted contactors and transformer.
- D. Motors: Provide totally enclosed motors, with built-in overload protection, having electrical characteristics as scheduled.
- E. Provide transformer and relay kit for remote t-stat where shown, provide unit mounted and t-stat where indicated.

2.03 ELECTRIC WALL HEATER:

- A. Unit shall include electric resistance type heating elements concealed adjustable thermostat, concealed electrical connections, line voltage disconnect, enclosed fan motor, and wall box.
- B. Unit shall be standard color baked enamel finish.

PART 3 - EXECUTION

3.01 INSPECTION:

- A. Examine areas and conditions under which terminal units are to be installed. Do not proceed with work until unsatisfactory conditions have been corrected in manner acceptable to Installer.

3.02 INSTALLATION OF UNIT HEATERS:

- A. General: Install unit heaters as indicated, and in accordance with manufacturer's installation instructions.
- B. Uncrate units and inspect for damage. Verify that nameplate data corresponds with unit designation.
- C. Hang units from building substrate. Mount as high as possible to maintain greatest headroom possible unless otherwise indicated.
- D. Support units with rod-type hangers anchored to building substrate.
- E. Protect units with protective covers during balance of construction.

3.03 ELECTRICAL WIRING:

- A. General: Install electrical devices furnished by manufacturer but not specified to be factory-mounted. Furnish copy of manufacturer's wiring diagram submittal to Electrical Installer.
- B. Verify that electrical wiring installation is in accordance with manufacturer's submittal and installation requirements of Division-26 sections. Do not proceed with equipment start-up until wiring installation is acceptable to equipment installer.

3.04 ADJUSTING AND CLEANING:

- A. General: After construction is completed, including painting, clean unit exposed surfaces, vacuum clean terminal coils and inside of cabinets.
- B. Retouch any marred or scratched surfaces of factory- finished cabinets, using finish materials furnished by manufacturer.

3.05 START-UP:

- A. Start-up, test, and adjust terminal units in accordance with manufacturer's published start-up instructions. Adjust for proper airflow where applicable.

END OF SECTION 23 8000

SECTION 23 8126 – SPLIT SYSTEMS

PART 1 - GENERAL

1.01 DESCRIPTION OF WORK:

- A. The air conditioner system shall be a ductless split system consisting of a horizontal discharge, outdoor unit, a matched capacity indoor unit that shall be equipped with controller type as indicated on the drawings.
- B. Refer to other Division 23 Sections for automatic temperature controls not factory-installed, and required for conjunction with packaged heating and cooling units; not work of this Section.
- C. Electrical Work: Refer to Division 23 Sections requirements of electrical provisions of mechanical work.

1.02 REFRIGERANTS:

- A. All refrigerants used for each condensing unit shall be on the latest EPA list of approved refrigerants & environmentally friendly.
- B. No CFC based refrigerants shall be used.

1.03 QUALITY ASSURANCE:

- A. Manufacturer's Qualifications: Firms regularly engaged in manufacture of packaged heating and cooling units, of types and capacities required, whose products have been in satisfactory use in similar service for not less than 5 years.
- B. The units shall be tested by and bear the label of a Nationally Recognized Testing Laboratory.
- C. Performance Requirements: Energy Efficiency Rating (EER) and Coefficient of Performance (COP) not less than prescribed by ASHRAE 90.1 when used in combination with compressors and evaporator coils when tested in accordance with AHRI Standards.
- D. Codes and Standards:
 - 1. AHRI Compliance: Provide capacity ratings for packaged heating and cooling units in accordance with AHRI Standard 210/240 "Performance Rating of Unitary Air-Conditioning & Air-Source Heat Pump Equipment".
 - 2. ASHRAE Compliance: Construct refrigerating system of packaged heating and cooling units in accordance with ASHRAE Standard 15 "Safety Standard for Refrigeration Systems, most recent edition".
 - 3. The units shall be tested by a Nationally Recognized Testing Laboratory (NRTL) and shall bear the UL or ETL label.

1.04 SUBMITTALS:

- A. Product Data: Submit manufacturer's technical product data, including rated capacities of selected model clearly indicated, weights, furnished specialties and accessories; and installation and start-up instructions.
- B. Shop Drawings: Submit manufacturer's assembly-type shop drawings indicating dimensions, weight loadings, required clearances, and methods of assembly of components.
- C. Wiring Diagrams: Submit manufacturer's electrical requirements for power supply wiring to packaged heating and cooling units. Submit manufacturer's ladder-type wiring diagrams for interlock and control wiring required for final installation of packaged heating and cooling units and controls. Clearly differentiate between portions of wiring that are factory-installed and portions to be field- installed.
- D. Record Drawings: At project closeout, submit record drawings of installed systems products in accordance with requirements of Division 23.
- E. Maintenance Data: Submit maintenance data and parts list for each packaged heating and cooling unit, control, and accessory; including "trouble-shooting" maintenance guide. Include this data and product data in maintenance manual; in accordance with requirements of Division 23.

1.05 DELIVERY, STORAGE, AND HANDLING:

- A. Handle packaged heating and cooling units and components carefully to prevent damage, breaking, denting and scoring. Do not install damaged packaged heating and cooling units or components; replace with new.
- B. Store packaged heating and cooling units and components in clean dry place. Protect from weather, dirt, fumes, water, construction debris, and physical damage.
- C. Comply with manufacturer's rigging and installation instructions for unloading packaged heating and cooling units, and moving units to final location for installation.
- D. Units shall be broken down and shipped in components as field conditions require. A factory authorized representative shall inspect the final installation to certify that the unit has been reassembled per factory recommendations and specifications.

1.06 WARRANTY:

- A. Warranty on Motor/Compressor: Provide written warranty, signed by manufacturer, agreeing to replace/repair, within warranty period, motors/compressors with inadequate and defective materials and workmanship, including leakage, breakage, improper assembly, or failure to perform as required; provided manufacturer's instructions for handling, installing, protecting, and maintaining units have been adhered to during warranty period. Replacement is limited to component replacement only, and does not include labor for removal and reinstallation.
 - 1. Warranty Period: 5 years from Date of Substantial Completion.

PART 2 - PRODUCTS

2.01 MANUFACTURERS:

- A. Manufacturers: Subject to compliance with requirements, limited by style of indoor unit, system cooling capacity size range and low ambient operation, provide products by one of the following:
1. Split Systems
 - a. Mitsubishi
 - b. Daikin
 - c. Trane
 - d. Lennox

2.02 Split-systems (1.5 to 3.5 tons nominal)

- A. Indoor Units
1. General: Provide factory-assembled and tested packaged units as indicated, consisting of casing, compressor, evaporator, fans, filters, and unit controls. Provide capacities and electrical characteristics as scheduled.
 - 2.
 3. Wall-Mounted:
 - a. Cabinet: Enameled steel with removable panels on front and ends and discharge drain pans with drain connection.
 - b. Refrigerant Coil: Copper tube, with mechanically bonded aluminum fins and with thermal-expansion valve.
 - c. Fan: Direct drive, centrifugal fan.
 - d. Fan Motors: Comply with requirements in Section 23 0507 Motor, Drives, Motor Controllers and Electrical Requirements for Mechanical Equipment.
 - 1) Special Motor Features: Electronically commutated.
 - e. Filters: Permanent, cleanable.
- B. Outdoor Units:
1. General: Provide factory-assembled and tested packaged units as indicated, consisting of casing, compressors, evaporator, fans, filters, and unit controls.
 2. Provide capacities and electrical characteristics as indicated on drawings.
 3. Casing: Steel, finished with baked enamel with removable panels for access to controls, weep holes for water drainage, and mounting holes in base. Provide brass service valves, fittings, and gauge ports on exterior of casing.
 4. Compressor: Hermetically sealed with crankcase heater and mounted on vibration isolation. Compressor motor shall have thermal- and current-sensitive overload devices, start capacitor, relay, and contactor.
 - a. Compressor Type: Inverter controlled scroll.
 - b. Refrigerant Type: R-410A.
 5. Refrigerant Coil: Copper tube, with mechanically bonded aluminum fins, complying with AHRI 210/240, and with liquid subcooler. Provide with manufacturer's optional coil coating for coastal areas.
 6. Fan: Aluminum-propeller type, directly connected to motor.
 7. Motor: Permanently lubricated, with integral thermal-overload protection.

8. Mounting Base: Bigfoot or equal, equipment and stand sized to prevent over turning. Provide manufacturer's optional foot fleece (B9156).
 9. Units specified for heat pump operation shall be provided with reversing valve and related controls to switch to heating mode.
 10. Unit shall be capable of operating to the low ambient conditions indicated on the drawings.
- C. Accessories:
1. Provide wired remote wall-mounted controller for each evaporator unit to control compressor and evaporator fan and shall control on/off operation, temperature set points and other settings.
 2. Automatic-reset timer to prevent rapid cycling of compressor.
 3. Refrigerant Line Kits: Soft-annealed copper suction and liquid lines factory cleaned, dried, pressurized, and sealed; factory-insulated suction line with flared fittings at both ends.
 4. Additional refrigerant for extended line lengths as defined by the manufacturer.
 5. Integral condensate pump for indoor unit, either factory-supplied/contractor-installed or provided complete by Division 23 Contractor.

PART 3 - EXECUTION

3.01 INSPECTION:

- A. General: Examine areas and conditions under ductless split systems are to be installed. Do not proceed with work until unsatisfactory conditions have been corrected in manner acceptable to Installer.

3.02 INSTALLATION OF split systems

- A. General: Install packaged heating and cooling units in accordance with manufacturer's installation instructions. Install units plumb and level, firmly anchored in locations indicated, and maintain manufacturer's recommended clearances.
- B. Support: Install units from wall as required by manufacturer's installation instructions.
- C. Electrical Wiring: Install electrical devices furnished by manufacturer but not specified to be factory-mounted. Furnish copy of manufacturer's wiring diagram submittal to electrical installer.
1. Verify that electrical wiring installation is in accordance with manufacturer's submittal and installation requirements of Division 26 Sections. Do not proceed with equipment start-up until wiring installation is acceptable to equipment installer.
- D. Air-Cooled Condenser Piping: Refer to Division 23 Section "Basic Piping Materials and Methods". Connect liquid and hot gas piping to unit as indicated by manufacturer's installation instructions included required piping accessories.
- E. Drain Piping: Connect indoor unit drain to nearest indirect waste connection.

3.03 FIELD QUALITY CONTROL:

- A. General: Start-up ductless split system units, in accordance with manufacturer's start-up instructions. Test controls and demonstrate compliance with requirements. Replace damaged or malfunctioning controls and equipment.

3.04 SPARE PARTS:

- A. General: Furnish to Owner, with receipt, the following spare parts for each packaged heating and cooling unit:
 - 1. One set filters for each unit.

END OF SECTION 23 8126

SECTION 26 0500 - COMMON WORK RESULTS FOR ELECTRICAL

PART 1 - GENERAL:

1.01 RELATED DOCUMENTS:

- A. All drawings associated with the entire project, including general provisions of the Contract, including The General Conditions of the Contract for Construction, General and Supplementary Conditions and Division-1 Conditions specification sections shall apply to the Division 26 specifications and drawings. The Contractor shall be responsible for reviewing and becoming familiar with the aforementioned and all other Contract Documents associated with the project.
- B. Where contradictions occur between this section and Division 1, the more stringent requirement shall apply.
- C. Contractor shall be defined as any and all entities involved with the construction of the project.

1.02 SUMMARY:

- A. This Section specifies the basic requirements for electrical installations and includes requirements common to more than one section of Division 26 and Division 28. It expands and supplements the requirements specified in sections of Division 1 through 50.

1.03 ELECTRICAL INSTALLATIONS:

- A. Drawings are diagrammatic in character and do not necessarily indicate every required conduit, box, fitting, etc.
- B. Drawings and specifications are complementary. Whatever is called for in either is binding as though called for in both. Report any discrepancies to the Engineer and obtain written instructions before proceeding. Where any contradictions occur between the specifications and the drawings the more stringent requirement shall apply. The contractor shall include pricing for the more stringent and expensive requirements.
- C. Drawings shall not be scaled for rough-in measurements or used as shop drawings. Where drawings are required for these purposes or have to be made from field measurement, take the necessary measurements and prepare the drawings.
- D. The exact location for some items in this specification may not be shown on the drawings. The location of such items may be established by the Engineer during the progress of the work.
- E. The contractor shall make the installation in such a manner as to conform to the structure, avoid obstructions, preserve headroom and keep openings and passageways clear, without further instructions or costs to the Owner. All equipment shall be installed so access is maintained for serviceability.

- F. Before any work is begun, determine that equipment will properly fit the space and that conduit can be run as contemplated without interferences between systems, with structural elements or with the work of other trades.
 - G. Verify all dimensions by field measurements.
 - H. Arrange for chases, slots, and openings in other building components to accommodate electrical installations.
 - I. Sequence, coordinate, and integrate installations of electrical materials and equipment for efficient flow of the work. Give particular attention to large equipment requiring an access path for positioning prior to closing-in the building or space.
 - J. Where mounting heights are not detailed or dimensioned, install electrical conduits, boxes, and overhead equipment to provide the maximum headroom possible. In general, keep installations tight to structure.
 - K. Install electrical equipment to facilitate maintenance and repair or replacement of equipment components as much as practical, and connect equipment for ease of disconnecting and removal with minimum of interference with other installations.
 - L. Make allowance for expansion and contraction for all building electrical components and conduit systems that are subject to such.
 - M. The ceiling space shall not be "layered". It is the contractor's responsibility to offset and coordinate any systems as required to allow installation within the identified ceiling cavity. The contractor shall include labor and material in the base bid to accommodate such offsets.
 - N. In general, all conduit systems shall be routed as high as possible. Keep all equipment in accessible areas such as corridors and coordinate with systems and equipment from other sections.
 - O. 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.
 - P. Coordinate the installation of electrical materials and equipment above and below ceilings with suspension system, luminaires and other building components. Ductwork and piping shall not be installed above electrical panelboards, switchboards, motor control centers, and transformers.
- 1.04 COORDINATION:
- A. Work out all installation conditions in advance of installation. The Contractor shall be responsible for preparing coordination drawings, showing all work, in all areas. The Contractor shall be responsible for providing all labor and material, including but not limited to all fittings, hangers, control devices, lighting, low voltage equipment, cable tray, conduit, transformers, disconnects, etc., necessary to overcome congested conditions at no increase in contact sum. The Contractors base bid shall include any and all time and manpower necessary to develop

such coordination efforts and drawings. Increases to contract sum or schedule shall not be considered for such effort.

- B. Provide proper documentation of equipment, product data and shop drawings to all entities involved in the project. Coordination shall include, but not be limited to the following:
1. Fire Alarm Contractor shall provide shop drawings to other Contractors as required.
 2. Automatic Temperature Controls, Building Management and Testing, Adjusting and Balancing Contractors shall be provided with equipment product data and shop drawings from other Division 23 and Division 26 Contractors and shall furnish the same information involving control devices to the appropriate Contractor.
 3. Automatic Doors and controls, Elevators and other building access equipment shall have cut sheets reviewed and shall furnish the same information to the appropriate Contractor.
- C. Coordination Drawings:
1. Coordination drawings shall be prepared by the Contractor for his utilization and are his responsibility to assure systems will be installed in a manner to allow all systems to function properly.
 2. Prepare and submit a set of coordination drawings showing major elements, components, and systems of electrical equipment and materials in relationship with other building components. Prepare 24"x36" or 30"x42" drawings to an accurate scale of 1/4"=1'-0" or larger. Indicate the locations of all equipment and materials, including clearances for servicing and maintaining equipment. Indicate movement and positioning of large equipment into the building during construction.
 3. Coordination drawings are informational submittals. Submit coordination drawings to Engineer for information only to document proper coordination of all portions of work and that coordination issues have been identified and resolved prior to submitting to the Engineer and prior to commencing construction in each affected area. The review of the coordination drawings by the Engineer does not constitute a relief of responsibility of the Contractor or a change to the contract documents. The Contractor shall have sole responsibility in developing a fully coordinated and integrated ceiling cavity.
 4. Prepare floor plans, reflected ceiling plans, elevations, sections, and details to conclusively coordinate and integrate all installations. Indicate locations where space is limited, 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:
 - a. Electrical equipment room layouts
 - b. Mechanical equipment room layouts
 5. Clearly indicate solutions to space problems. Identification of space problems without solutions is not acceptable. Only areas clearly identified will be reviewed.
 6. All coordination drawings shall be 3D, with provision for collision check. The contractor is responsible for obtaining the architectural and structural files in 3D, if not available, the contractor shall develop them from the 2D architectural and structural drawings. All 3D drawing development, collision check, coordination, etc. shall be included as part of the Contractors base bid.
 7. Prepare coordination drawings and other Shop Drawings at a suitable scale, showing the required dimension. In addition to the mentioned areas and systems above, also submit specific equipment installations, including, but not limited to the following:
 - a. Utility Connections

- b. Pad mounted transformers
 - c. Switchboards and panelboards
 - d. Equipment connections
 - e. Control panels
 - f. Circuit and motor disconnects
 - g. Feeder conduits
8. CADD Drawings: Electronic AutoCAD drawings are available for purchase by the Contractor from the Engineer. Contact Engineer for further information in acquiring CADD drawings. The Engineers Construction documents cannot be used directly for coordination drawings. They are for information and initial coordination only.
9. Wiring Diagrams: Provide wiring diagrams indicating: field installed electrical power; control wiring; cabling layouts; overcurrent protective devices; equipment, and equipment connections.

1.05 coordination with other divisions:

A. General:

1. Coordinate all work to conform to the progress of the work of other trades.
2. Complete the entire installation as soon as the condition of the building will permit. No extras will be allowed for corrections of ill-timed work, when such corrections are required for proper installation of other work.

B. Coordinate ceiling cavity space carefully with all trades. In the event of conflict, install mechanical and electrical systems within the cavity space allocation in the following order of priority:

1. Equipment and required clearances
2. Plumbing waste, cooling coil drain piping and roof drain mains and leaders.
3. Ductwork mains.
4. Plumbing vent piping.
5. Low pressure ductwork and air devices.
6. Electrical and communication conduits, raceways and cable tray.
7. Domestic hot and cold water.
8. Hydronic piping.
9. Fire sprinkler mains, branch piping and drops (locate as tight to structure as possible).
10. DDC control wiring and other low voltage systems.
11. Fire alarm systems.

C. Chases, Inserts and Openings:

1. Provide measurements, drawings and layouts so that openings, inserts and chases in new construction can be built in as construction progresses.
2. Check sizes and locations of openings provided, including the access panels for equipment in hard lid ceilings and wall cavities.
3. Any cutting and patching made necessary by failure to provide measurements, drawings and layouts at the proper time shall be done at no additional cost in contract sum.

- D. Support Dimensions: Provide dimensions and drawings so that concrete bases and other equipment supports to be provided under other sections of the specifications can be built at the proper time.
- E. 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.
- F. Coordinate the cutting and patching of building components to accommodate the installation of electrical equipment and materials.
- G. Modifications required as result of failure to resolve interferences, provide correct coordination drawings or call attentions to changes required in other work as result of modifications shall be paid for by responsible Contractor/Subcontractor.

1.06 design work required by contractor:

- A. The construction of this project requires the Contractor to include the detailing and design of several systems and/or subsystems. All such design work associated with the development of the coordination drawings shall be the complete responsibility of the Contractor.
- B. The Contractor shall take the full responsibility to develop and complete routing strategies which will allow fully coordinated system to be installed in a fully functional manner. The Engineers contract drawings shall be for system design intent and general configurations.
- C. Systems or subsystems which require design responsibility by the contractor include but are not limited to:
 - 1. Temporary Facilities.
 - 2. Utility Company Coordination details.
 - 3. Final coordinated distribution systems within the ceiling cavity.
 - 4. Any system not fully detailed.
 - 5. Fire alarm shop drawings.
 - 6. Equipment supports, hangers, anchors and seismic systems not fully detailed nor specified in these documents, or catalogued by the manufacturer.
 - 7. Seismic restraint systems.

1.07 PROJECT CONDITIONS:

- A. The contractor shall be required to attend a pre-bid walk-thru if required and shall make themselves familiar with the existing conditions. No additional costs to the Owner shall be accepted for additional work for existing conditions.
- B. Field verify all conditions prior to submitting bids.
- C. Report any damaged equipment or systems to the Owner prior to any work.
- D. Protect all work against theft, injury or damage from all causes until it has been tested and accepted.

- E. Be responsible for all damage to the property of the Owner or to the work of other contractors during the construction and guarantee period. Repair or replace any part of the work which may show defect during one year from the final acceptance of all work, provided such defect is, in the opinion of the Architect, due to imperfect material or workmanship and not due to the Owner's carelessness or improper use.
- F. The Contractor shall coordinate and co-operate with Owner at all times for all new to existing connections.
- G. Provide temporary electrical connections where required to maintain existing areas operable.
- H. Coordinate all services shut-down with the Owner; provide temporary services. Coordinate any required disruptions with Owner, at a minimum one week in advance.
- I. Minimize disruptions to operation of electrical systems in occupied areas.

1.08 SAFETY:

- A. Refer to Division 1.

1.09 EQUAL EMPLOYMENT OPPORTUNITY REQUIREMENTS:

- A. Refer to Division 1 and conform with the Owners requirements.

1.10 REQUIREMENTS OF REGULATORY AGENCIES:

- A. Refer to Division 1.
- B. Execute and inspect all work in accordance with Underwriters Laboratories (UL), and all local and state codes, rules and regulations applicable to the trade affected as a minimum, but if the plans and/or specifications call for requirements that exceed these rules and regulations, the more stringent requirement shall be followed. Follow application sections and requirements and testing procedures of NFPA, IEEE, NEMA, CBM, ANSI, NECA, ICEA, NETA, and IETA.
- C. Comply with standards in effect at the date of these Contract Documents, except where a standard or specific date or edition is indicated.
- D. Energy Codes: All equipment and installations shall conform to Federal, State, and local Energy Conservation Standards.
- E. The handling, removal and disposal of regulated liquids or other materials shall be in accordance with U.S. EPA, state and local regulations.
- F. The handling, removal and disposal of lead based paint and other lead containing materials shall comply with EPA, OSHA, and any other Federal, State, or local regulations.
- G. After entering into contract, Contractor will be held to complete all work necessary to meet these requirements without additional expense to the Owner.

- H. All material used on this project shall be UL listed and labeled and be acceptable to the authority having jurisdiction as suitable for the use intended.

1.11 REQUIREMENTS OF LOCAL UTILITY COMPANIES:

- A. Comply with rules and regulations of local utility companies. Include in bid the cost of all meter boxes, meters and such accessory equipment which will be required but not provided by Local Utility Company for the project.

- B. Utility Connections:

1. Coordinate connection of electrical systems with exterior underground and overhead utilities and services. Comply with requirements of governing regulations, franchised service companies and controlling agencies. Provide required connection for each service.
2. The contract documents indicate the available information on existing utilities and services and on new services (if any) to be provided to the project by utility companies and agencies. Notify Engineer immediately if discrepancies are found.
3. Coordinate electrical utility interruptions at least one week in advance as approved in writing with the Owner and the Utility Company. Plan work so that duration of the interruption is kept to a minimum.
4. Nominal System Voltages have been identified on the contract documents. Coordinate and install relay settings, circuit breaker settings, generator output settings, transformer taps, etc. with measured utility voltage obtained from the Utility. Identify Phase rotation and other parameters with Shop Drawings for Service Entrance Equipment Submittals.
5. Provide Utility Company approved equipment and install all CT enclosures/bus, conduit and wiring, meter sockets, connection cabinets, etc. as required by Serving Utility. Locate final Meter location in conjunction with Utility representative and coordinate with Architect/Engineer.
6. Make all applications for service including Temporary services for construction and coordinate service requirements. Arrange and pay for all Utility fees and costs of electricity until final services are transferred to owner.
7. Document final phase rotation, voltages on each phase, neutral and ground currents and voltages once serving Utility services are connected at service entrance location. Adjust tap, relay, and other settings as necessary for delivered Utility electric services. Submit final configurations and values with Testing and Equipment Settings Report.

1.12 PERMITS AND FEES:

- A. Refer to Division 1.
- B. Contractor shall pay all fees required for connection to municipal and public utility facilities.
- C. Contractor shall arrange for and pay for all inspections, licenses and certificates required in connection with the work.

1.13 PROJECT SEISMIC REQUIREMENTS:

- A. Installation shall comply with the local seismic requirements for the area of installation. Provide restraints, bracing, anchors, vibration isolation, seismic snubbers, and all other components required for the installation.
- B. All electrical and fire alarm systems shall be installed to meet NFPA and IBC Seismic requirements.
 - 1. Where any conflicts arise the more stringent requirements shall be applicable.
 - 2. The design of the seismic requirements shall be the responsibility of the contractor.

1.14 TEMPORARY FACILITIES:

- A. Light, Heat, Power, Etc. Responsibility for providing temporary electricity, heat and other facilities shall be as identified in these specifications, as shown on the drawings and as specified in Division 1.
- B. Building distribution equipment and devices (existing or new) shall not be used without written permission of the Owner. If used for temporary power, the equipment shall be properly maintained and any damage resulting from use shall be repaired by the Contractor. The guarantee period for new equipment shall not begin until the equipment is turned over to the Owner.
- C. If AC power systems or their backup systems serving telecommunications, computer equipment, or their associated HVAC equipment and controls are taken out of service, for any reason, the Contractor shall be responsible for providing temporary systems during the period when the AC power systems or their backup systems are out of service. The Contractor shall be responsible for providing temporary power to all loads being interrupted.

1.15 PRODUCT OPTIONS AND SUBSTITUTIONS:

- A. Refer to the Instructions to Bidders and Division 1.
- B. The burden of proof that proposed equipment is equal in size, capacity, performance, and other pertinent criteria for this specific installation, or superior to that specified is up to the Contractor. Substituted equipment will only be allowed where specifically listed in a written addendum. If substitutions are not granted, the specified materials and equipment must be installed. Where substituted equipment is allowed, it shall be the Contractor's responsibility to notify all related trades of the accepted substitution and to assume full responsibility for all costs caused as a result of the substitution.
- C. Materials and equipment of equivalent quality may be submitted for substituted prior to bidding. This may be done by submitting to the Architect/Engineer at least ten (10) working days prior to the bid date requesting prior review. This submittal shall include all data necessary for complete evaluation of the product.
 - 1. Substitutions shall be allowed only upon the written approval of the Architect/Engineer
NO EXCEPTIONS.

2. The Contractor shall be responsible for removal, replacement and remedy of any system or equipment which has been installed which does not meet the specifications or which does not have prior approval.

1.16 SUBMITTALS:

A. General

1. Refer to the Conditions of the Contract (General and Supplementary), Division 1.
2. Contractor shall provide a submittal schedule appropriate for the size and schedule of the project. Limit the number of large submittals being reviewed at one time and coordinate timing of sections that are dependent on each other i.e. submit coordination and short circuit study prior to or together with gear, overcurrent protection devices, ATS, etc.
3. The Contractor shall identify any "long lead time" items which may impact the overall project schedule. If these submittal requirements affect the schedule, the Contractor shall identify the impacts and confer with the Engineer within two weeks of entering into the contract.
4. The front of each submittal package shall be identified with the specification section number, job name, Owner's project number, date, Prime Contractor and Subcontractor's names, addresses, and contact information, etc. Each Specification Section shall be submitted individually and submittal shall be tabbed for the equipment/materials/etc. within the section. Submittals that are not complete with the required information will not be reviewed and will be sent back to be corrected.
5. Submittals shall be provided electronically. All electronic submittals need to be complete with all design information and stamped for conformity by the contractor. Submittals will be reviewed, marked appropriately and returned by the same means received.
6. An index shall be provided which includes:
 - a. Product
 - b. Plan Code (if applicable)
 - c. Specification Section
 - d. Manufacturer and Model Number
- 7.
8. Submittal schedule shall be provided for review within four (4) working weeks from award of contract to successful bidder.

B. Basis of Design: The manufacturer's material or equipment listed first in the specifications or on the drawings are the basis of design and are provided for the establishment of size, capacity, grade and quality. If alternates are used in lieu of the first names, the cost of any changes in construction required by their use shall be borne by this Contractor.

C. All equipment shall conform to the State and/or local Energy Conservation Standards

D. Contractor Review: Submittal of shop drawings, product data, and samples will be accepted only when submitted by the Contractor. Each submittal shall be reviewed by the contractor for general conformance with contract requirements and stamped by the respective contractor prior to submittal to the Architect/Engineer. Any submittal not stamped or complete will be sent back. Data submitted from subcontractors and material suppliers directly to the

Architect/Engineer will not be processed unless written prior approval is obtained by the Contractor.

- E. Submittal Review Process: Before starting work, prepare and submit to the Architect/Engineer shop drawings and descriptive product data required for the project. Continue to submit in the stated format after each Architect/Engineer's action until a "No Exception Taken" or "Make Correction Noted" action is received. When a "Make Corrections Noted" is received, make the required corrections for inclusion in the operation and maintenance manual (O&M). Submittals marked "Make Corrections Noted" shall not be resubmitted during the submittal process. Unless each item is identified with specification section and sufficient data to identify its compliance with the specifications and drawings, the item will be returned "Revise and Resubmit". Where an entire submittal package is returned for action by the Contractor, the Engineer may summarize comments in letter format and return the entire set. Submittals shall be prepared per the ELECTRICAL SUBMITTAL CHECKLIST, at the end of this section; supplemental requirements are listed in each Division 26 Section.
- F. The Design Professional's review and appropriate action on all submittals and shop drawings is only for the limited purpose of checking for conformance with the design concept and the information expressed in the contract documents. This review shall not include:
 - 1. Accuracy or completeness of details, such as quantities, dimensions, weights or gauges, fabrication processes
 - 2. Construction means or methods
 - 3. Coordination of the work with other trades
 - 4. Construction safety precautions
- G. The Design Professional's review shall be conducted with reasonable promptness while allowing sufficient time in the Design Professional's judgment to permit adequate review. Review of a specific item shall not indicate that the Design Professional has reviewed the entire assembly of which the item is a component.
- H. The Design Professional shall not be responsible for any deviations from the contract documents not brought specifically to the attention of the Design Professional in writing by the Contractor. This shall clearly identify the design and the specific element which vary from the Design. The Contractor shall be responsible for all remedy for lack of strict conformance associated with this criteria.
- I. The Design Professional shall not be required to review partial submissions or those for which submissions of correlated items have not been received.
- J. If more than two submittals (either for product data, shop drawings, record drawings, test reports, or O&M's are made by the Contractor, the Owner reserves the right to charge the Contractor for subsequent reviews by their consultants. Such extra fees shall be deducted from payments by the Owner to the Contractor.
- K. The contractor shall cloud all changes made on submittals that are marked "Revise and Resubmit."

- L. Required Submittals: Provide submittals for each item of equipment specified or scheduled in the contract documents. See table at the end of this section.
- M. Submit letters certifying compliance with ANSI standards for medium or high voltage gear. These letters shall be signed by a corporate officer and shall list applicable standards. Letters signed by local representatives will not be acceptable.
- N. Submit proposed changes to electrical room or other equipment room layouts when revised from contract documents prior to installation.
- O. Mark submittals with designations as shown on the drawings and identify as required by Specification Sections. Identification shall contain the information as required in details and each label shall be submitted in list form with disconnects, panelboards, switchboards, overcurrent protection devices and utilization equipment.

1.17 SPECIFIC CATEGORY SUBMITTAL REQUIREMENTS:

- A. Product Listing:
 - 1. Prepare listing of major electrical equipment and materials for the project, within (2) two weeks of signing the Contract Documents and transmit to the Architect
 - a. Provide all information requested.
 - b. Submit this listing as a part of the submittal requirement; see Paragraph 1.15 "PRODUCT OPTIONS AND SUBSTITUTIONS."
 - 2. Unless otherwise specified, all materials and equipment shall be of domestic (USA) manufacture and shall be of the best quality used for the purpose in commercial practice.
 - 3. When two or more items of same material or equipment are required (lighting, wiring devices, switchgear, panelboards, protective devices, etc.) they shall be of the same manufacturer. Product manufacturer uniformity does not apply to raw materials, bulk materials steel bar stock, welding rods, solder, fasteners, except as otherwise indicated.
 - a. Provide products which are compatible within systems and other connected items.
 - 4. For conduit, wire and fittings, the Contractor shall select a prime and alternate manufacturer from the list of acceptable manufacturers provided in the appropriate sections of this Division. The prime and alternate manufacturers shall be identified in the product listing. The contractor shall make every effort to use the prime manufacturer for the entire project. If products from this manufacturer are unavailable, the Contractor shall use the listed alternate with the following provisions.
 - a. Wire: All wire placed in a single conduit or installed in multiple conduits making up parallel feeders shall be of the same manufacturer.
 - b. Conduit and Fittings: All conduits and fittings installed exposed within the same room or immediate area shall be of the same manufacturer.
- B. Schedule of Values
 - 1. Provide Preliminary Schedule of Values to Engineer with product data submittal within four (4) weeks from award of contract to successful bidder. Provide according to the following descriptions:
 - a. General Construction (total)
 - b. Service/Distribution

- c. Lighting - Interior
 - d. Lighting – Exterior
 - e. Lighting Controls
 - f. Basic Materials/Devices/Equipment Connections (Mechanical)
 - g. Fire Alarm (Material/Installation)
 - h. Security
2. Provide a final Schedule of Values at close-out of project including updated values based on actual installation.
- C. Product Data:
1. Where pre-printed data covers more than one distinct product, size, type, material, trim, accessory group or other variation, mark submitted copy with black pen to indicate which of the variations is to be provided.
 2. Delete or mark-out portions of pre-printed data which are not applicable.
 3. Where operating ranges are shown, mark data to show portion of range required for project application.
 4. For each product, include the following:
 - a. Sizes.
 - b. Weights.
 - c. Speeds.
 - d. Capacities.
 - e. Conduit and electrical connection sizes and locations.
 - f. Statements of compliance with the required standards and regulations.
 - g. Performance data.
 - h. Manufacturer's specifications.
 - i. Housing and proposed Finishes.
 - j. NEMA or other ratings that apply.
 5. Checklist: Where identified in ELECTRICAL SUBMITTAL CHECKLIST or within individual Division 26 Sections or necessary for confirmation of products, submit a detailed checklist which acknowledges compliance or a reason for non-compliance to each of the specification requirements. Arrange the checklist according to the headings of each item identified in each specification (i.e. Shop Drawings, Wiring Diagrams, Product requirements, individual line items, etc.) Mark items as "N/A" where the item is not applicable.
- D. Shop Drawings:
1. Shop Drawings are defined as electrical system layout drawings prepared specifically for this project, or fabrication and assembly type drawings of system components to show more detail than typical pre-printed materials.
 2. Prepare Electrical Shop Drawings, except diagrams, to accurate scale, min 1/8"-1'-0", Electrical rooms shall be 1/4"-1'-0" unless otherwise noted.
 3. Shop drawings shall include:
 - a. Proposed equipment installations.
 - b. Electrical characteristics and connection requirements.
 - c. Clearance dimensions at critical locations.
 - d. Dimensions of spaces required for operation and maintenance.
 - e. Interfaces with other work, including structural support.

- f. Elevations when necessary in areas with multiple pieces of equipment on common walls or to clarify incoming/exiting methods/clearances, etc.
 - g. Wall and floor penetrations.
 - h. Wiring diagrams shall showing all components, internal connecting wiring, and contractor connection requirements including terminal blocks/lugs, wire sizes, etc.
 - E. Coordination Drawings: See separate paragraph of this specification section.
 - F. Test Reports:
 - 1. Submit test reports which have been signed and dated by the accredited firm or testing agency performing the test.
 - 2. Prepare test reports in the manner specified in the standard or regulation governing the test procedure (if any) as indicated.
 - 3. Submit test reports as required for O & M manuals.
 - G. Operation and Maintenance Data: See separate paragraph of this specification section.
 - H. Equipment Settings Report: Where identified in the ELECTRICAL SUBMITTAL CHECKLIST or within individual Division 26 Sections or necessary for confirmation of products, submit Equipment Settings Report for each device indicating final configurations and settings.
 - 1. Provide report of settings, parameters, programing inputs and parameters, etc., installed at each piece of electrical equipment that allows adjustments to be made in the field and those set at the factory. The report shall be arranged by specification section and each piece of equipment broken out individually or by listing of equipment if the same settings are installed in multiple pieces of equipment.
 - 2. In addition to the requirements above, include within this report any settings of monitoring equipment including trip levels and alarm levels; relay settings; transformer tap settings; phase rotation documentation; lighting control settings with associated timer settings; posted operational signage; and any other pertinent information.
 - 3. Report shall be submitted and received by the Engineer at least fifteen calendar days prior to the contractor's request for final observation. Include in the O & M Manual after review and "No Exceptions Taken" has been accomplished.
 - I. Software Licenses: Provide documentation of ownership under the owner's corporate name (coordinate with owner's representative for exact ownership wording) for Software Licenses provided as part of the work. Include information for updates, subscription requirements if applicable, backup, support, login, passwords, date when purchased, expiration date if applicable, version, etc. Include in the O & M Manual after review and "No Exceptions Taken" has been accomplished.
 - J. Record Drawings: See separate paragraph of this specification section.
- 1.18 DELIVERY, STORAGE AND HANDLING:
- A. Refer to the Division 1, Sections on Transportation and Handling and Storage and Protection.

- B. Deliver products to project properly identified with names, model numbers, types, grades, compliance labels, and similar information needed for distinct identifications; adequately packaged and protected to prevent damage during shipment, storage, and handling.
- C. Check delivered equipment against contract documents and submittals.
- D. Store equipment and materials at the site, unless off-site storage is authorized in writing. Protect stored equipment and materials from damage and weather.
- E. Coordinate deliveries of electrical materials and equipment to minimize construction site congestion. Limit each shipment of materials and equipment to the items and quantities needed for the smooth and efficient flow of installations.

1.19 CUTTING AND PATCHING:

- A. Cutting and patching of electrical equipment, components, and materials may be required for removal and legal disposal of selected materials, components, and equipment. Coordinate the cutting and patching of building components to accommodate the installation of electrical equipment and materials.
- B. Refer to the Division 1 Section covering cutting and patching for general requirements.
- C. Do not endanger or damage installed Work through procedures and processes of cutting and patching.
- D. Arrange for repairs required to restore other work, because of damage caused as a result of electrical installations.
- E. No additional compensation will be authorized for cutting and patching Work that is necessitated by ill-timed, defective, or non-conforming installations.
- F. Perform cutting, fitting, and patching of electrical equipment and materials required to:
 - 1. Uncover Work to provide for installation of ill-timed Work;
 - 2. Remove and replace defective Work;
 - 3. Remove and replace Work not conforming to requirements of the Contract Documents;
 - 4. Remove samples of installed Work as specified for testing;
 - 5. Install equipment and materials in existing structures;
 - 6. Upon written instructions from the Architect/Engineer, uncover and restore Work to provide for Architect/Engineer observation of concealed Work.
- G. Cut, remove and legally dispose of selected electrical equipment, components, and materials as indicated, including, but not limited to removal of conductors, conduit, luminaires, boxes, devices and other electrical items made obsolete by the new Work.
- H. Protect the structure, furnishings, finishes, and adjacent materials not indicated or scheduled to be removed.

- I. Provide and maintain temporary partitions or dust barriers adequate to prevent the spread of dust and dirt to adjacent areas.
- J. Locate, identify, and protect electrical services passing through remodel or demolition area and serving other areas required to be maintained operational.
- K. When coring is required or identified, an x-ray of the area is to be taken prior to the performance of the work operation. X-ray work requires an MOP and protection.

1.20 ROUGH-IN:

- A. Verify final locations for rough-ins with field measurements and with the requirements of the actual equipment to be connected.
- B. Refer to equipment shop drawings and manufacturer's requirements for actual provided equipment for rough in requirements.
- C. Work through all coordination before rough-in begins.

1.21 ACCESSIBILITY:

- A. Install equipment and materials to provide required code clearances and access for servicing and maintenance. Coordinate the final location with piping, ducts, and equipment of other trades to insure proper access for all trades. Coordinate locations of concealed equipment, disconnects, and boxes with access panels and doors. Allow ample space for removal of parts, fuses, lamps, etc. that require replacement or servicing.
- B. Extend all conduits so that junction and pull boxes are in accessible locations.
- C. Provide access panel or doors where equipment or boxes are concealed behind finished surfaces.
- D. Furnish hinged steel access doors with concealed latch, whether shown on drawings or not, in all walls and ceilings for access to all concealed valves, shock absorbers, air vents, motors, fans, balancing cocks, and other operating devices requiring adjustment or servicing. Refer to Division 1 for access door specification and requirements.
- E. The minimum size of any access door shall not be less than the size of the equipment to be removed or 12 inches x 12 inches if used for service only.
- F. Furnish doors to trades performing work in which they are to be built, in ample time for building in as the work progresses. Whenever possible, group valves, cocks, etc., to permit use of minimum number of access doors within a given room or space.
- G. Factory manufactured doors shall be of a type compatible with the finish in which they are to be installed. In lieu of these doors, approved shop fabricated access doors with DuroDyne hinges may be used.

- H. Access doors in fire rated walls and ceilings shall have equivalent U.L. label and fire rating.

1.22 TESTING:

- A. Submit test reports as outlined in Division 1 Sections on Quality Control Services and each Division 26 Section.
- B. Testing as required by these specifications shall pertain to all equipment, wiring, devices, etc. installed under this contract and being reused.
- C. General Scope:
 - 1. Perform all tests and operational checks to assure that all electrical equipment, both Contractor and Owner-supplied, is operational within industry and manufacturer's tolerances and is installed in accordance with design specifications.
 - 2. The tests and operational checks shall determine the suitability for energization.
 - 3. Schedule tests and give a minimum of two weeks advance notice to the Architect/Engineer. Reschedule testing for Owner convenience if required.
- D. Test Report: Submit the completed report to the Architect/Engineer no later than fifteen (15) days after completion of test unless directed otherwise. The test report shall be bound and its contents certified. A final compilation of all Test Reports shall be submitted with the Testing and Equipment Settings Report (Refer to Operation and Maintenance Data paragraphs).
- E. Each test report shall include the following:
 - 1. Project information including: Building, name, address, date, and other pertinent information.
 - 2. List of equipment tested.
 - 3. Description of test.
 - 4. List of test equipment used and calibration date.
 - 5. Baseline, acceptable, or published target value for test with code or standard reference indicating where value was derived.
 - 6. Test results that summarize all measured values with baseline values.
 - 7. Conclusions and recommendations.
 - 8. Appendix, including appropriate test forms that show all measured values.
- F. Failure to Meet Test:
 - 1. Any system material or workmanship which is found defective on the basis of performance tests shall be reported directly to the Architect/Engineer.
 - 2. All failed tests shall be sent immediately by email to Architect/Engineer with proposed corrective action and proposed re-test date and time.
 - 3. Contractor shall replace the defective material or equipment as necessary, and have test repeated until test proves satisfactory without additional cost to the Owner.
- G. The testing agency shall have a calibration program which maintains all applicable test instrumentation within rated accuracy. The accuracy shall be traceable to the National Institute of Standards and Technology (NIST) in an unbroken chain. Instruments shall be calibrated in accordance with the following frequency schedule:

1. Field Instruments: 6 months
2. Laboratory Instruments: 12 months
3. Leased specialty equipment: 12 months. (Where accuracy is guaranteed by lessor
4. Dated calibration labels shall be visible on all test equipment.

1.23 EXCAVATING AND BACKFILLING:

A. General:

1. Provide all necessary excavation and backfill for installation of electrical work in accordance with Division 2.
2. In general, follow all regulations of OSHA as specified in Part 1926, Subpart P, "Excavations, Trenching and Shoring." Follow specifications of Division 26 as they refer specifically to the electrical work.

B. Contact Owners of all underground utilities to have them located and marked, at least 2 business days before excavation is to begin. Prior to starting excavation, brief employees on marking and color codes and train employees on excavation and safety procedures for Utilities including electrical lines and natural gas lines. When excavation approaches electrical or gas lines, expose lines by carefully probing and hand digging.

C. Trenching:

1. Provide all necessary pumping, cribbing and shoring.
2. Walls of all trenches shall be a minimum of 6 inches clearance from the side of the nearest electrical work. Install conduits with a minimum of 6 inches (or as identified on the drawings) clearance between them when located in same trench.
3. Dig trenches to depth, width, configuration, and grade appropriate to the materials being installed. Dig trenches to 6 inches below the level of the bottom of the material to be installed. Install 6 inches bed of sand, pea gravel, or squeegee, mechanically tamp to provide a firm bed, true to line and grade without irregularity. Provide depressions only at hubs, couplings, flanges, or other normal protrusions.

D. Backfilling shall not be started until all work has been inspected, tested and accepted. All backfill material shall be accepted by the soils engineer. In no case shall lumber, metal or other debris be buried in with backfill.

1. Provide warning tape for marking and locating underground utilities. Tape shall be specifically manufactured for this purpose and shall be polyethylene film, 6 inches wide, 0.004 inches thick and have a minimum strength of 1750 psi. Tape shall carry continuous inscription naming the specific utility.
 - a. Tape shall have magnetic strip and be used for exterior underground system only.

E. Trench Backfill

1. Backfill to 4 inches above top of conduits with sand, the same as used for conduit bed, compact properly.
2. Continue backfill to finish grade, using friable material free of rock and other debris. Install in 6 inch layers, each properly moistened and mechanically compacted prior to installation of ensuing layer. Compaction by hydraulic jetting is not permissible.

- F. After backfilling and compacting, any settling shall be refilled, tamped, and refinished at contractor's expense.
- G. This contractor shall repair and pay for any damage to finished surfaces.
- H. Backfill near manholes or hand holes using sand, installing it in 6 inch layers to 4 inches above the shallowest conduit. Use suitable excavated material to complete the backfill, installed in 6 inch layers and mechanically compacted to seal against water infiltration. Compact to 95% below paving and slabs and 90% elsewhere.
- I. Use suitable excavated material to complete the backfill, installed in 6 inch lifts and mechanically compacted to seal against water infiltration. Compact to 95 percent for the upper, 30 inches below paving and slabs and 90 percent elsewhere.

1.24 NAMEPLATE DATA:

- A. Provide equipment with permanent operational data nameplate on each item of power operated equipment, indicating manufacturer, product name, model number, serial number, capacity, operating and power characteristics, labels of tested compliances, and similar essential data. Install equipment so that nameplate is readily visible.
- B. Phase Rotation
 - 1. New Building: Provide clockwise phase rotation on this project. Provide a label at service entrance main disconnect and the generator tap box indicating phase rotation for the building.

1.25 CLEANING:

- A. Refer to the Division 1 Section on project closeout or final cleaning for general requirements for final cleaning.
- B. Clean all luminaires, lamps and lenses per manufacturer's recommendations prior to final acceptance. Replace all inoperative lamps.

1.26 RECORD DOCUMENTS:

- A. Refer to the Division 1 Section on Project Closeout or Project Record Documents for requirements. The following paragraphs supplement the requirements of Division 1.
- B. Keep a complete set of record document prints in custody during entire period of construction at the construction site. Documents shall be updated on a weekly basis.
- C. Mark Drawings to indicate revisions to conduit size and location both exterior and interior; actual equipment locations, dimensioned from column lines; concealed equipment, dimensioned to column lines; distribution and branch electrical circuitry; fuse and circuit breaker size and arrangements; support and hanger details; concealed control system devices, and any other relevant deviations from the Contract Documents.

- D. Mark shop drawings to indicate approved substitutions; Addenda; Change Orders; actual equipment and materials used.
 - E. Schedules:
 - 1. Mark luminaire schedule on drawings to indicate manufacturer and complete catalog numbers of installed equipment.
 - 2. Mark schedules including panelboard, switchboard, motor control center, mechanical, kitchen and similar equipment schedules on drawings to indicate installed equipment and materials used, and any deviations or revisions to electrical load data and calculations.
 - F. Revisions to the Contract Documents shall be legible and shall be prepared using the following color scheme.
 - 1. Red shall indicate new items, deviations and routing.
 - 2. Green shall indicate items removed or deleted.
 - 3. Blue shall be used for relevant notes and descriptions.
 - G. At the completion of the project, obtain from the Architect a complete set of the Contract Documents in a read-only electronic format (.pdf unless otherwise noted). This set will include all revisions officially documented through the Architect/Engineer. Using the above color scheme, transfer any undocumented revisions from the construction site record drawings to this complete set. Submit marked up and completed documents to the Architect/Engineer. This contract will not be considered completed until these record documents have been received and reviewed by the Architect/Engineer.
 - H. Contractor may propose methods of maintaining record documents on electronic media. Obtain approval of Engineer and Owner prior to proceeding. Marked-up .pdf format readable by Bluebeam is preferred.
 - I. One full size set of record drawing one line diagrams shall be posted in the electrical room and one half size set of the remaining electrical record drawings shall be bound with 3 Hole inserts and plastic cover and stored in the electrical room.
- 1.27 OPERATION AND MAINTENANCE DATA:
- A. Refer to the Division 1 Section on project closeout or operation and maintenance data for procedures and requirements for preparation and submittal of maintenance manuals.
 - B. No later than four (4) weeks prior to the completion of the project provide complete set of operating and maintenance manuals, or as specified in Sections of Division 1 (whichever is more stringent). Operation and Maintenance Data shall be submitted in electronic format.
 - C. Operation and Maintenance Data: Submit operation and maintenance data in maintenance manual in accordance with requirements of applicable Division 26 Sections and Division 1. Provide Operating and Maintenance Instructions in electronic format covering all equipment furnished. Manuals shall include all information required below, as indicated in each Division 26 Section, and the following for each piece of equipment:

1. The job name and address, contractor's name, address, and phone number, and each subcontractor's name, address, and phone number shall be identified at the front of the electronic submittal.
 2. Name, address and telephone number to be contacted of the local authorized service organization/company and individual to be contacted for service and maintenance for each item of equipment.
 3. Submit operation and maintenance data, schedule of recommended service and parts lists for all materials and products specified and intended for installation. Include description of function, normal operating characteristics and limitations, fuse curves, engineering data and tests, and complete nomenclature and commercial numbers of all replaceable parts.
 4. Manufacturer's printed operating procedures to include start-up, break-in, routine and normal operating instructions; regulation, control, stopping, shut-down, and emergency instructions; and summer and winter operating instructions.
 5. Maintenance procedures for routine preventative maintenance and troubleshooting; disassembly, repair, and reassembly; aligning and adjusting instructions.
 6. Servicing instructions and lubrication charts and schedules.
 7. Manufacturer's service manuals for all electrical equipment provided under this contract.
 8. Complete equipment and protection wiring diagrams. All wiring diagrams shall show color coding of all connections and mounting dimensions of equipment.
 9. Equipment identification numbers and adjustment clearly indicated for each piece of equipment.
 10. Electrical System and Equipment Warranties.
 11. Provide manuals tabbed and divided into major sections and special equipment. Mark the individual equipment when more than one model or make is listed on a page. Provide detailed table of contents.
 12. Record Set of Shop Drawings: Shop drawings corrected to show as-built conditions. Transfer modifications from field set.
 13. Equipment Testing Report including all test reports and Equipment Settings Report indicating final configurations and settings.
- D. This contract will not be considered completed nor will final payment be made until all specified material, including test reports, settings reports, and final Schedule of Values with all Electrical and Information Technology change order costs included and identified is provided and the manual is reviewed by the Architect/Engineer.
- 1.28 PROJECT CLOSEOUT LIST:
- A. In addition to the requirements specified in Division 1, complete the requirements listed below.
1. The contractor shall be responsible for providing the items listed on the Electrical Submittal Checklist prior to applying for certification of substantial completion. Refer to individual specification sections for additional requirements (Checklist is located at the end of this section.)
 2. Final payment will not be authorized until all items on the final punch list have been complete.

1.29 WARRANTIES:

- A. Refer to the Division 1 Section on Warranties and Bonds for procedures and submittal requirements for warranties. Refer to individual equipment specifications for warranty requirements. In no case shall the warranty for the total electrical system be less than one year from date of acceptance by the Owner.
- B. Compile and assemble the warranties specified in Division 26, into a separated set of vinyl covered, three ring binders, tabulated and indexed for easy reference.
- C. Provide complete warranty information for each item. Information to include product or equipment description, date of beginning of warranty or bond; duration of warranty or bond; and names, addresses, and telephone numbers and procedures for filing a claim and obtaining warranty services.

1.30 CONSTRUCTION REQUIREMENTS:

- A. The contractor shall maintain and have available at the jobsite current information on the following at all times:
 - 1. Up to date record drawings.
 - 2. Addenda
 - 3. Change Orders
 - 4. Submittals
 - 5. Site observation reports with current status of all action items.
 - 6. Test results; including recorded values, procedures, and other findings.
 - 7. Outage information.

1.31 EQUIPMENT HOUSEKEEPING PADS:

- A. Provide 4" concrete housekeeping pad for all floor mounted equipment including, but not limited to: switchgear, switchboards, motor control centers, floor mounted distribution panelboards, floor mounted branch panelboards, floor mounted VFD's and starter cabinets. Fabricate pads as follows:
 - 1. Coordinate size of equipment bases with actual unit sizes provided. Fabricate base 4" larger in both directions than the overall dimensions of the supported unit.
 - 2. Form concrete pads with framing lumber with form release compounds. Chamfer top edge and corners of pad.
 - 3. Place concrete and allow curing before installation of units. Use Portland cement that conforms to ASTM C 150, 54000-psi compressive strength, and normal weight aggregate.
 - 4. Anchor housekeeping pads to slab using #3 rebar bent in "L" or "Z" shape 12 inch on center on each side of slab.

1.32 Electrical SUBMITTAL Checklist:

- A. Provide submittals including shop drawings, product data, product checklists, tests and reports, training, extra material, coordination drawings, record drawings, O&M manuals, device setting reports, and software licenses per the following schedule:

Division 26

C – Product Checklist; Q – Qualifications, CD – Coordination Drawings, RD - Record Drawings, D – Device Setting Report; S – Software License, W – Special Project Warranty

SPEC Section	TITLE	Requirements									
		Report Data		Test	Factory Test	Report	Factory Rep Supervision at Site	Training Req'd at Site	Extra Material	O&M	Other
		Shop Drawings	Product Data								
26 05 00	Common Work Results For Electrical										
	Electrical Coordination Drawings	X									
	Utility Company Final Parameters, Measurements, Equipment, and Contacts	X	X	X		X				X	D
	Seismic Design Parameters per Local Authority	X	X			X				X	
	Temporary Facilities	X	X			X					
	Product Listing		X							X	C
	Preliminary Schedule Of Values					X					
	Final Schedule Of Values					X				X	
	Electrical On-Site Metering Reports			X		X				X	
	Tests/Independent Testing	X	X	X	X	X	X	X		X	D
	Completed/Signed MOP's					X				X	
	Record Drawings including changes to existing Equip.	X								X	
	O&M Manuals	X	X	X	X	X			X	X	C,D,S
	Project Closeout List					X				X	
	Contractor/Equipment Warranties					X				X	
26 05 19	Low Voltage Electrical Power Conductors And Cables		X	X		X				X	
26 05 26	Grounding And Bonding For Electrical Systems	X	X	X		X				X	
26 05 29	Hangers And Supports For Electrical Systems	X	X							X	
26 05 33	Raceway And Boxes For Electrical Systems	X	X								CD, RD
	Electrical Metallic Tubing		X								CD, RD
	Flexible Metal Conduit		X								CD, RD
	Intermediate Metal Conduit		X								CD, RD

C – Product Checklist; Q – Qualifications, CD – Coordination Drawings, RD - Record Drawings, D – Device Setting Report; S – Software License, W – Special Project Warranty

SPEC Section	TITLE	Requirements									
		Report Data		Test	Factory Test	Report	Factory Rep Supervision at Site	Training Req'd at Site	Extra Material	O&M	Other
		Shop Drawings	Product Data								
	Liquid-Tight Flexible Conduit		X								CD, RD
	Non-Metallic Conduit PVC		X								CD, RD
	Rigid Metal Conduit		X								CD, RD
	Surface Metal Raceway	X	X							X	CD, RD
	Wireways	X	X							X	CD, RD
	Rigid Aluminum Conduit		X								CD, RD
26 05 34	Cabinets, Boxes & Fittings	X	X								CD, RD
26 05 53	Identification For Electrical Systems	X	X							X	
26 05 83	Wiring Connections	X	X	X							D
26 09 23	Lighting Control Devices	X	X	X		X	X	X	X	X	C CD, RD,,D,S
26 24 13	Switchboards	X	X	X	X	X	X	X	X	X	C, CD, RD, D, S
26 24 16	Panelboards	X	X	X		X			X	X	CD, RD, D
26 27 26	Wiring Devices		X	X		X				X	
26 28 00	Low Voltage Circuit Protective Devices	X	X	X		X		X	X	X	C, D,S
26 43 13	Surge Protection Device	X	X	X	X	X		X		X	Q
26 50 00	Lighting	X	X	X		X			X	X	
	Ballasts, LED's, Drivers	X	X	X		X				X	W
28 31 00	Fire Alarm Systems	X	X	X		X	X	X		X	C, Q, S

END SECTION 26 0500

SECTION 26 0519 - LOW VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES

PART 1 - GENERAL

1.01 SUMMARY:

- A. This section includes wires, cables, and connectors for power, lighting, signal, control, and related systems rated 600 volts and less.

1.02 QUALITY ASSURANCE:

- A. Manufacturers: Firms regularly engaged in manufacture of electrical wire and cable products of types, sizes, and ratings required, whose products have been in satisfactory use in similar service for not less than 5 years.
- B. Installer's Qualifications: Firm with at least 3 years of successful installation experience with projects utilizing electrical wiring and cabling work similar to that required for this project.
- C. Conform to applicable code regulations regarding toxicity of combustion products of insulating materials.

1.03 SUBMITTALS:

- A. See Section 26 0500 Common Work Results for Electrical for Submittal requirements. Supplemental information is listed within this section.
- B. Product Data: Submit manufacturer's data on electrical wires, cables and connectors.

1.04 DELIVERY, STORAGE, AND HANDLING:

- A. Deliver wire and cable properly packaged in factory- fabricated type containers, or wound on NEMA-specified type wire and cable reels.
- B. Store wire and cable in clean dry space in original containers. Protect products from weather, damaging fumes, construction debris and traffic.
- C. Handle wire and cable carefully to avoid abrading, puncturing and tearing wire and cable insulation and sheathing. Ensure that dielectric resistance integrity of wires/cables is maintained.

PART 2 - PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS:

- A. Manufacturers: Subject to compliance with requirements, provide products by the following (for each type of wire, cable, and connector):
 - 1. Wire and Cable:

- a. American Insulated Wire
 - b. Belden
 - c. Cerrowire
 - d. Encore Wire
 - e. General Cable Corporation.
 - f. Southwire Company
 - g. Okonite
 - h. Superior Essex:
 - 1) Triangle
 - 2) Excel
 - 3) Royal
2. Connectors:
- a. O-Z/Gedney Co.
 - b. AMP, Inc.
 - c. Burndy Corporation.
 - d. Ideal Industries, Inc.
 - e. 3M Company
 - f. Thomas and Betts Corp.

2.02 WIRES AND CABLES:

- A. General: Provide wire and cable suitable for the temperature, conditions, and location where installed.
- B. Conductors: Provide solid conductors and approved connectors for power, control, and lighting circuits 10 AWG and smaller. Provide stranded conductors for 8 AWG and larger.
- C. Conductor Material: Use the following material for sizes indicated.
 1. No. 1 AWG and Smaller and all grounding system conductors not sharing a common raceway: copper
 2. No 1/0 AWG and Larger: 8000 Series electrical grade aluminum alloy 600v, except where another specific material is indicated.
 3. Conductor sizes indicated on One line or schedules may be based on copper, see individual drawings for details. Sizes are based on Copper if no designation is shown, Sizes are based on Aluminum if Al is included in nomenclature. Modify conductor sizes as required to provide equivalent ampacity to indicated copper conductors. (A minus tolerance of 2 percent is permissible if ampacities remain above those shown in NEC Ampacity Tables.) Fully adapt and adjust the electrical system to size aluminum in lieu of copper. This includes, but is not limited to, the following actions:
 - a. Where connecting to equipment whose manufacturer requires copper conductors connection, provide copper conductors from source, i.e. circuit breaker, disconnect, etc., and provide all necessary splices, splice boxes and other devices required to satisfy manufacturer requirements. Do not otherwise intermix copper and aluminum conductors.
 - b. Increase conduit size and increase sizes of pull boxes, and junction boxes, and gutter space as required to accommodate larger aluminum conductors. Make

- structural, mechanical and other construction adjustments necessitated by these changes.
- c. Assure the pulling tension rating and support requirements of the aluminum conductors is adequate for wiring runs indicated.
 - d. Assure that equipment at which aluminum conductors terminate is UL listed and manufacturer approved for use with aluminum and so labeled.
 - e. Submit to the Architect/Engineer a record of actions taken in accordance with the above including marked-up project drawings, copies of manufacturer literature and communications and written conductor re-sizing calculations.
 - f. Do not reduce raceway or enclosure sizes as part of the above adjustments.
4. Metal Clad Cable - Type MC: Sizes 12 AWG and 10 AWG, copper conductors with 600 volt thermoplastic insulation rated 90 degrees C, galvanized steel interlocked metal type covering. Fitting shall be steel with double grip saddle and locking nut.
 5. Portable Cord:
 - a. Type SO: Sizes 12 AWG through 2 AWG, copper conductors with 600 volt thermoset insulation 0.1 resistant insulation.
 - b. Type G-GC: Sizes 1 AWG through 500 KCMIL, copper conductors with 600/2000 volt, 90 degrees C, ethylene-propylene insulation.
 6. Cables: Provide the following types of cables in NEC approved locations and applications where permitted by the contract documents. Cables shall be U.L. listed and approved by the local building authority. All cables shall contain a green insulated equipment ground conductor of the same size as the neutral conductor.

2.03 CONNECTORS:

- A. Description: Provide UL-type factory-fabricated, solderless metal connectors of sizes, ampacity ratings, materials, types and classes for applications and for services indicated. Use connectors with temperatures equal to or greater than those of the wires upon which used.
- B. Provide 2-hole compression lugs for all power feeder, neutral, and grounding connections when installed on bus bars. (Including phase, neutral and grounding conductors).
- C. Provide connectors that are designed to accept stranded conductors where stranded conductors are used.

PART 3 - EXECUTION

2.04 WIRE AND CABLE INSTALLATION SCHEDULE:

- A. Building Wire: Install all building wire in raceway regardless of location.
- B. Metal Clad Cable:
 1. Maximum of 6 feet unsupported length for connecting luminaires in accessible ceilings to the local junction box.
 2. Maximum of 6 feet unsupported length for connecting luminaires in non-accessible ceilings to the local junction box.
 3. In stud walls and casework for horizontal branch circuit runs between devices.

4. For vertical branch circuit drops from a local junction box in each room above an accessible ceiling to the direct or single device in a stud wall, casework, under counter lighting.
 5. May not be used for branch circuit home runs, feeders, motor feeder circuits or in the following locations:
 - a. Hazardous locations
 - b. Emergency Systems
 6. Branch circuit conductors shall match color coding schedule within this specification section.
- C. Portable Cord: Use for flexible pendant leads to luminaires, outlets, and equipment where indicated and in compliance with codes.

2.05 INSTALLATION OF WIRES AND CABLES:

- A. General: Install electrical cables, wires and connectors in compliance with applicable requirements of NEC, NEMA, UL, and NECA's "Standard of Installation", and in accordance with recognized industry practices.
- B. Coordinate wire/cable installation work, including electrical raceway and equipment connection work, with other work.
- C. Pull conductors simultaneously where more than one is being installed in same raceway. Use pulling compound or lubricant, where necessary; compound used must not deteriorate conductor or insulation.
- D. Use pulling means including, fish tape, cable, rope and basket weave wire/cable grips which will not damage cables or raceway. Do not use rope hitches for pulling attachment to wire or cable.
- E. Keep conductor splices to minimum. Splice only in accessible junction boxes. No splices are allowed in feeder, control or fire alarm wiring. Connect unspliced wire to numbered terminal strips at each end.
- F. Install splices and taps which possess equivalent or better mechanical strength and insulation ratings than conductors being spliced.
- G. Use splice and tap connectors which are compatible with conductor material.
- H. Tighten electrical connectors and terminals, including screws and bolts, in accordance with manufacturer's published torque tightening values. Where manufacturer's torqueing requirements are not indicated, tighten connectors and terminals to comply with tightening torques specified in UL Std. 486A for copper and 486B for aluminum.
- I. Support cables above accessible ceilings. Independent from the ceiling suspension system to support cables from structure, do not rest on ceiling tiles.
- J. Provide adequate length of conductors within electrical enclosures and train the conductors to terminal points with no excess. Bundle multiple conductors, with conductors larger than No. 10

- AWG cabled to individual circuits. Make terminations so there is no bare conductor at the terminal.
- K. Use solderless pressure connectors with insulating covers for copper wire splices and taps, 8 AWG and larger. For 10 AWG and smaller, use insulated screw on type spring wire connectors with plastic caps, push on type are not acceptable.
 - L. Use copper compression connectors for copper wire splices and taps, 1/0 AWG and larger. Tape uninsulated conductors and connectors with electrical tape to 150 percent of the insulation value of the conductor.
 - M. Make splices, taps and terminations to carry full ampacity of conductors without perceptible temperature rise.
 - N. Thoroughly tape the ends of spare conductors in boxes and cabinets.
 - O. Install exposed cable, parallel and perpendicular to surfaces, or exposed structural members, and follow surface contours, where possible.
 - P. Make all ground, neutral and line connections to receptacle and wiring device terminals as recommended by manufacturer. Provide ground jumper from outlet box to individual ground terminal of devices.
 - Q. Branch circuits whose length from panel to first outlet exceeds 100 feet for 120 volt circuits shall be #10 or larger, as required to comply with the National Electrical Code.
 - R. Parallel conductors shall be cut to the same length.
 - S. All splices in control panels, terminal junction boxes, low voltage control circuits, fire alarm, etc., conductors shall be on numbered terminal strip.
 - T. Where conduit is not required, plenum rated cable shall be provided in ceiling, floor or other air plenum spaces.
 - U. Provide wire training, lacing, labeling, and terminal blocks as required in panelboards and all control cabinets including, but not limited to, lighting, transfer switch, fire alarm, and security cabinets. All wiring shall be installed neat and be labeled to match wiring diagrams, control devices, etc.
 - 1. Make temporary connections to panelboard devices with sufficient slack conductor to facilitate reconnections required for balancing loads between phases.
 - V. Color coding of switch legs, travelers, etc. shall be different and distinct from phase and neutral conductors. Where systems utilize two (2) different voltages, the color coding of switch legs, travelers, etc. shall be different and distinct for each voltage system.

2.06 FIELD QUALITY CONTROL:

- A. Test installed wires and cables with 1000 VDC megohm meter to determine insulation resistance levels to ensure requirements are fulfilled. Test shall be made on all feeders regardless of size and on all branch circuits with No. 4 AWG and larger conductors. The megger values obtained shall be compared to the minimum values listed in NETA. All phase conductors and cables shall be meggered after installation, and prior to termination. Submit test report.
- B. Prior to energization, test wires and cables for electrical continuity and for short-circuits.
- C. Subsequent to wire and cable hook-ups, energize circuitry and demonstrate functioning in accordance with requirements. Where necessary, correct malfunctioning units, and then retest to demonstrate compliance.

2.07 COLOR CODING SCHEDULE:

- A. Color code secondary service, feeder, and branch circuit conductors as follows:

<u>120/208 Volts</u>	<u>Phase</u>
Black	A
Red	B
Blue	C
White	Neutral
Green	Ground

- B. Conductors shall be solid color for entire length.
- C. If solid color conductor insulation is not available and specific acceptance is given by the engineer for use of black conductor insulation, provide the following:
 - 1. Conductors 6 AWG and smaller shall be solid color for the entire length.
 - 2. Conductors 4 AWG and larger shall have either solid color insulation as specified above for the entire length or be black with color coding at each termination and in each box or enclosure. For a distance of 6 inches use half-lapped $\frac{3}{4}$ inch plastic tape in the above specified color. Do not cover cable identification markings. Adjust tape locations to prevent covering of markings.

2.08 METAL CLAD WIRING INSTALLATION:

- A. The location of system components, including cable routing shown on the plans, are approximate. Use good judgment in their placement to eliminate all interference with ducts, piping, etc.
- B. All cable routing shall be done in a neat and workmanlike manner, consistent with recognized good practice and in accordance with the manufacturer's instructions.
- C. Route the cables along the grid system. Do not route cables diagonally or in any way which restricts removal of lay-in ceiling material.

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- D. Support cable on ceiling wires adjacent to each luminaire and at four foot intervals using clamp supports manufactured specifically for that purpose.

END OF SECTION 26 0519

SECTION 26 0526 - GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.01 SUMMARY:

- A. This Section includes solid grounding of electrical systems and equipment. It includes basic requirements for grounding for protection of life, equipment, circuits, and systems. Grounding requirements specified in this Section may be supplemented in other sections of these Specifications.

1.02 SUBMITTALS:

- A. See Section 26 0500 Common Work Results for Electrical for Submittal requirements. Supplemental information is listed within this section.
- B. Product data for ground rods, connectors and connection materials, and grounding fittings.
- C. Wiring Diagrams: Submit wiring diagrams for electrical grounding and bonding work which indicates layout of ground rings, location of system grounding electrode connection, routing of grounding electrode conductors, also include diagrams for circuits and equipment grounding connections.

1.03 QUALITY ASSURANCE:

- A. Listing and Labeling: Provide products specified in this Section that are listed and labeled. The terms "listed" and "labeled" shall be defined as they are in the National Electrical Code, Article 100.
- B. Manufacturer's Qualifications: Firms regularly engaged in manufacture of grounding and bonding products, of types, and ratings required, and ancillary grounding materials, including stranded cable, copper braid and bus, grounding electrodes and plate electrodes, and bonding jumpers whose products have been in satisfactory use in similar service for not less than 5 years.
- C. Installer's Qualifications: Firm with at least 3 years of successful installation experience on projects with electrical grounding work similar to that required for project.

PART 2 - PRODUCTS

2.01 MANUFACTURERS:

- A. Manufacturers: Subject to compliance with requirements, provide products by the following:
 - 1. Burndy Corporation
 - 2. Cadweld Div.; Erico Products Inc.
 - 3. Ideal Industries
 - 4. OZ Gedney Div.

5. Thermoweld
6. Thomas and Betts Corp.

2.02 GROUNDING AND BONDING PRODUCTS:

- A. Products: Of types indicated and of sizes and ratings to comply with NEC. Where types, sizes, ratings, and quantities indicated are in excess of NEC requirements, the more stringent requirements and the greater size, rating, and quantity indications govern.
- B. Conductor Materials: Copper.

2.03 WIRE AND CABLE CONDUCTORS:

- A. General: Comply with Division 26 Section on Wires and Cables. Conform to NEC, except as otherwise indicated, for conductor properties, including stranding.
- B. Equipment Grounding Conductor: Green insulated.
- C. Grounding Electrode Conductor: Stranded cable.
- D. Bare Copper Conductors: Conform to the following:
 1. Solid Conductors: ASTM B-3
 2. Assembly of Stranded Conductors: ASTM B-8
 3. Tinned Conductors: ASTM B-33

2.04 MISCELLANEOUS CONDUCTORS:

- A. Ground Bus: Bare annealed copper bars of rectangular cross section.
- B. Braided Bonding Jumpers: Copper tape, braided No. 30 gage bare copper wire, terminated with copper ferrules.
- C. Bonding Strap Conductor/Connectors: Soft copper, 0.05 inch thick and 2 inches wide, except as indicated.

2.05 CONNECTOR PRODUCTS:

- A. General: Listed and labeled as grounding connectors for the materials used.
- B. Pressure Connectors: High-conductivity-plated units.
- C. Bolted Clamps: Heavy-duty units listed for the application.
- D. Exothermic Welded Connections: Provided in kit form and selected for the specific types, sizes, and combinations of conductors and other items to be connected.

2.06 GROUNDING ELECTRODES:

- A. Ground Rods: Copper-clad steel with high-strength steel core and electrolytic-grade copper outer sheath, molten welded to core.
 - 1. Size: $\frac{3}{4}$ " by 10 feet.

PART 3 - EXECUTION

3.01 APPLICATION:

- A. Equipment Grounding Conductor Application: Comply with NEC for sizes and quantities of equipment grounding conductors, except where larger sizes or more conductors are indicated.
 - 1. Install separate insulated equipment grounding conductors with circuit conductors for the following in addition to those locations where required by Code:
 - a. Feeders and branch circuits.
 - b. Provide individual grounding and neutral conductors for each isolated ground receptacle. When individual or groups of isolated ground receptacles are on dedicated circuits, individual ground and neutral conductors for each circuit is acceptable.
 - 2. Nonmetallic Raceways: Install an insulated equipment ground conductor in nonmetallic raceways unless they are designated for telephone or data cables.
 - 3. Air Duct Equipment Circuits: Install an insulated equipment grounding conductor to duct-mounted electrical devices operating at 120-V and above including air cleaners and heaters. Bond the conductor to each such unit.
 - 4. Water Heater, Heat Tracing, and Anti-Frost Heater Circuits: Install separate insulated equipment ground conductor to each electric water heater, heat tracing, and surface anti-frost heating cable. Bond this conductor to heater units, piping, and connected equipment and components.
- B. Underground Conductors: Bare, tinned, stranded copper except as otherwise indicated.
- C. Signal and Communications: For telephone, alarm, and communication systems, provide a #6 AWG minimum green insulated copper conductor in raceway from the grounding electrode system to each terminal cabinet or central equipment location.
- D. All systems shall be grounded in accordance with the NEC.

3.02 INSTALLATION:

- A. General: Ground electrical systems and equipment in accordance with NEC requirements except where the Drawings or Specifications exceed NEC requirements. Connect together system neutral, service equipment enclosures, exposed noncurrent carrying metal parts of electrical equipment, metal raceway systems, grounding conductor in raceways and cables, receptacle ground connectors, and plumbing systems.
- B. Electrical Room Ground Bus: Size, location, and arrangement as indicated. Space 1 inch from wall and support from wall 6 inches above finished floor, except as otherwise indicated.

- C. Ground Rods: Locate a minimum of two-rod lengths from each other and at least the same distance from any other grounding electrode. Interconnect ground rods with bare conductors buried at least 24 inches below grade. Connect bare-cable ground conductors to ground rods by means of exothermic welds except as otherwise indicated. Make these connections without damaging the copper coating or exposing the steel. Drive rods until tops are 6 inches below finished floor or final grade except as otherwise indicated.
 - D. Metallic Water Service Pipe:
 - 1. Provide insulated copper ground conductors, sized as indicated, in conduit from the building main service equipment, or the ground bus, to main metallic water service entrances to the building. Connect ground conductors to the main metallic water service pipes by means of ground clamps. Where a dielectric main water fitting is installed, connect the ground conductor to the street side of the fitting. Do not install a grounding jumper around dielectric fittings. Provide grounded bushing at conduit ends and bond the ground conductor conduit to the ground bars at each end.
 - 2. Where more than one metallic water service exists, provide insulated copper ground conductors sized to match the water service bonding jumper, in conduit, to the main service equipment main ground bus or to the other water service entrance. Provide grounded bushing at conduit ends and bond to ground bars at grounding conductor termination.
 - E. Braided-Type Bonding Jumpers: Install to connect ground clamps on water meter piping to bypass water meters electrically. Use elsewhere for flexible bonding and grounding connections.
 - F. Route grounding conductors along the shortest and straightest paths possible without obstructing access or placing conductors where they may be subjected to strain, impact, or damage, except as indicated.
 - G. UFER Ground: Fabricate grounding electrode conductor by installing lengthwise in form for foundation or footings. Install so conductor is within 2 inches of the bottom of the concrete. Extend conductor below grade and connect to building grounding grid, grounding electrode, or ground bar as required and as shown on plan drawings and details.
 - H. Labeling: Provide a phenolic tag for all grounding electrode conductors as described in section on Electrical Identification.
 - I. Where grounding conductors, grounding electrode conductors, or bonding conductors are non-exposed, identify each with a 6-inch band of green tape at each end and at 10 foot intervals. When run in conduits, provide color banding on conduit per section on Electrical Identification.
- 3.03 CONNECTIONS:
- A. General: Make connections in such a manner as to minimize possibility of galvanic action or electrolysis. 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 assure high conductivity and make contact points closer in order of galvanic series.
 2. Make connections with clean bare metal at points of contact.
 3. Coat and seal connections involving dissimilar metals with inert material such as red lead paint to prevent future penetration of moisture to contact surfaces.
- B. Exothermic Welded Connections: Use for connections to structural steel and for underground connections except those at test wells. Install at connections to ground rods and plate electrodes. Comply with manufacturer's written recommendations. Welds that are puffed up or that show convex surfaces indicating improper cleaning are not acceptable.
- C. Terminate insulated equipment grounding conductors for feeders and branch circuits with pressure-type grounding lugs. Where metallic raceways terminate at metallic housings without mechanical and electrical connection to the housing, terminate each conduit with a grounding bushing. Connect grounding bushings with a bare grounding conductor to the ground bus in the housing. Bond electrically non-continuous conduits at both entrances and exits with grounding bushings and bare grounding conductors. Terminate each conductor on an individual ground lug terminal.
- D. Tighten grounding and bonding connectors and terminals, including screws and bolts, in accordance with manufacturer's published torque tightening values for connectors and bolts. Where manufacturer's torqueing requirements are not indicated, tighten connections to comply with torque tightening values specified in UL 486A.
- E. Compression-Type Connections: Use hydraulic compression tools to provide the correct circumferential pressure for compression connectors. Use tools and dies recommended by the manufacturer of the connectors. Provide embossing die code or other standard method to make a visible indication that a connector has been adequately compressed on the ground conductor.
- F. Moisture Protection: Where insulated ground conductors are connected to ground rods or ground buses, insulate the entire area of the connection and seal against moisture penetration of the insulation and cable.
- 3.04 UNDERGROUND DISTRIBUTION SYSTEM GROUNDING:
- A. Pad Mounted Gear: Install a $\frac{3}{4}$ inch by 10 feet. Driven ground rod inside the cable access block-out of the pad and set the rod depth such that 4 inches will extend above the finished pad. Where necessary, install ground rod before the equipment is placed. Protect ground rods passing through concrete with a double wrapping of pressure-sensitive tape or heat-shrunk insulating sleeve from 2 inches above to 6 inches below the concrete.
- B. Grounding System: Ground non-current-carrying metallic items associated with pad-mounted equipment by connecting them to grounding electrodes arranged as indicated.

3.05 FIELD QUALITY CONTROL:

- A. Upon completion of installation of electrical grounding and bonding systems, test ground resistance with ground resistance tester. Where tests show resistance-to-ground is over 5 ohms, take appropriate action to reduce resistance to 5 ohms, or less, by driving additional ground rods; then retest to demonstrate compliance.
- B. Ground Resistance Test:
 - 1. Grounding electrode resistance testing shall be accomplished with a ground resistance direct-reading single test meter utilizing the fall-of-potential method and two reference electrodes. Perform test prior to interconnection to other grounding systems. Orient the ground electrode to be tested and the two reference electrodes in a straight line spaced fifty (50) feet apart. Drive the two reference electrodes five (5) feet deep.
- C. Correct Deficiencies, Retest and Report:
 - 1. Correct unsatisfactory conditions and retest to demonstrate compliance; replace conductors, units and rods as required to bring system into compliance.
 - 2. Prepare a written report and show temperature, humidity and condition of soil at time of tests. Report shall be certified by testing agency that identifies components checked and describes results. Include notation of deficiencies detected, remedial action taken, and observations and test results after remedial action.

3.06 CLEANING AND ADJUSTING:

- A. Restore surface features at areas disturbed by excavation and reestablish original grades except as otherwise indicated. Where sod has been removed, replace it as soon as possible after backfilling is completed. Restore areas disturbed by trenching, storing of dirt, cable laying, and other Work to their original condition. Include necessary top-soiling, fertilizing, liming, seeding, sodding, sprigging, or mulching. Restore vegetation and disturbed paving to original condition.

END OF SECTION 26 0526

SECTION 26 0529 - HANGERS AND SUPPORTS FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.01 SUMMARY:

- A. This Section includes secure support from the building structure for electrical items by means of hangers, supports, anchors, sleeves, inserts, seals, and associated fastenings.

1.02 SUBMITTALS:

- A. See Section 26 0500 Common Work Results for Electrical for Submittal requirements. Supplemental information is listed within this section.
- B. Product data for each type of product specified.
 - 1. Hanger and support schedule showing manufacturer's figure number, size, spacing, features, and application for each required type of hanger, support, sleeve, seal, and fastener to be used.
- C. Shop drawings indicating details of fabricated products and materials.
- D. Engineered Design consisting of details and engineering analysis for supports for the following items:
 - 1. Cable trays
 - 2. Trapeze hangers for multiple conduit runs.

PART 2 - PRODUCTS

2.01 MANUFACTURERS:

- A. Manufacturers: Subject to compliance with requirements, provide products by the following:
 - 1. Slotted Metal Angle and U-Channel Systems:
 - a. Allied Tube & Conduit
 - b. B-Line Systems, Inc.
 - c. Unistrut Diversified Products
 - 2. Conduit Sealing Bushings:
 - a. O-Z/Gedney
 - b. Cooper Industries, Inc.
 - c. Killark Electric Mfg. Co.
 - d. Madison Equipment Co.
 - e. Raco, Inc.
 - f. Spring City Electrical Mfg. Co.
 - g. Thomas & Betts Corp.

2.02 COATINGS:

- A. Coating: Supports, support hardware, and fasteners shall be protected with zinc coating or with treatment of equivalent corrosion resistance using approved alternative treatment, finish, or inherent material characteristic. Products for use outdoors shall be hot-dip galvanized.

2.03 MANUFACTURED SUPPORTING DEVICES:

- A. Raceway Supports: Clevis hangers, riser clamps, conduit straps, threaded C-clamps with retainers, ceiling trapeze hangers, wall brackets, and spring steel clamps.
- B. Fasteners: Types, materials, and construction features as follows:
 - 1. Expansion Anchors: Carbon steel wedge or sleeve type.
 - 2. Toggle Bolts: All steel springhead type.
 - 3. Powder-Driven Threaded Studs: Heat-treated steel, designed specifically for the intended service.
- C. Conduit Sealing Bushings: Factory-fabricated watertight conduit sealing bushing assemblies suitable for sealing around conduit, or tubing passing through concrete floors and walls. Construct seals with steel sleeve, malleable iron body, neoprene sealing grommets or rings, metal pressure rings, pressure clamps, and cap screws.
- D. U-Channel Systems: 12-gage steel channels, with 9/16 inch-diameter holes, at a minimum of 8 inches on center, in top surface. Provide fittings and accessories that mate and match with U-channel and are of the same manufacture.
- E. Supports: Provide supporting devices of types, sizes and materials indicated; and having the following construction features:
 - 1. One-Hole Conduit Straps: For supporting 1 inch and smaller rigid metal conduit; galvanized steel.
 - 2. Two-Hole Conduit Straps: For supporting 1 inch and larger rigid metal conduit, galvanized steel; ¾ inch strap width; and 2-1/8 inch between center of screw holes.

2.04 FABRICATED SUPPORTING DEVICES:

- A. General: Shop- or field-fabricated supports or manufactured supports assembled from U-channel components.
- B. Steel Brackets: Fabricated of angles, channels, and other standard structural shapes. Connect with welds and machine bolts to form rigid supports.
- C. Pipe Sleeves: Provide pipe sleeves of one of the following:
 - 1. Steel Pipe: Fabricate from Schedule 40 galvanized steel pipe.
 - 2. EMT, IMC, or Rigid Conduit.

2.05 FIRE SEALS:

- A. Material: Fire stopping material shall be asbestos free, 100 percent intumescent, have code approval under BOCA, ICBO, SSBC, NFPA 101, NFPA 70, and be capable of maintaining an effective barrier against flame and gases in compliance with the following requirements.
- B. Flame Spread: 25 or less, ASTM E84
- C. Fire Resistance and Hose Stream Tests: Fire stopping materials shall be rated "F" and "T" in accordance with ASTM E 814 or UL 1479. Rating periods shall conform to the following:
 - (F) 3 (T) 3 Time-rated floor or wall assemblies.
 - (F) 3 (T) 3 Openings between floor slabs and curtain wall.
- D. Manufacturers: Subject to compliance with requirements, provide fire seals of the following:
 - 1. 3M Company
 - 2. STI
 - 3. Tremco
 - 4. Hilti

PART 3 - EXECUTION

3.01 INSTALLATION:

- A. Install supporting devices to fasten electrical components securely and permanently in accordance with NEC requirements.
- B. Coordinate with the building structural system and with other electrical installation.
- C. Junction Box Supports: Comply with the NEC and the following requirement:
 - 1. Use ¼" all-thread rod from structure to support junction boxes.
- D. Raceway Supports: Comply with the NEC and the following requirements:
 - 1. Conform to manufacturer's recommendations for selection and installation of supports.
 - 2. Strength of each support shall be adequate to carry present and future load multiplied by a safety factor of at least four. Where this determination results in a safety allowance of less than 200 lbs., provide additional strength until there is a minimum of 200 lbs. safety allowance in the strength of each support.
 - 3. Install individual and multiple (trapeze) raceway hangers and riser clamps as necessary to support raceways. Provide U-bolts, clamps, attachments, and other hardware necessary for hanger assembly and for securing hanger rods and conduits.
 - 4. Use #9 ceiling wire to support individual conduits up to 3/4inch with spring steel fasteners. Use of ceiling support wires is unacceptable.
 - 5. Support parallel runs of horizontal raceways together on trapeze-type hangers. Use 3/8 inch diameter or larger threaded steel rods for support.
 - 6. Support individual horizontal raceways by separate pipe hangers. Spring steel fasteners may be used in lieu of hangers only for 1-1/2 inch and smaller raceways serving lighting

- and receptacle branch circuits above suspended ceilings only. For hanger rods with spring steel fasteners, use ¼ inch-diameter or larger threaded steel. Use spring steel fasteners that are specifically designed for supporting single conduits or tubing. For hanger rods supporting 1-1/2 inch or larger conduits provide 3/8 inch minimum threaded steel rods with pipe hangers.
7. Space supports for raceways in accordance with NEC. When there are 4 or more 2 inch conduits in a trapeze, supports shall be spaced 5 feet O.C.
 8. In all runs, arrange support so the load produced by the weight of the raceway and the enclosed conductors is carried entirely by the conduit supports with no weight load on raceway terminals.
 9. Threaded rod supports to have bottoms cut off at a maximum length equal to rod diameter below bottom nut.
 10. Attachment of electrical supports to piping, ductwork, mechanical equipment or conduit is not allowed.
- E. Conductor or Cable Supports: Comply with the NEC and the following requirements:
1. Support individual conductors or cables by separate clamps with rubber or plastic grommet, fasten using a non-metallic bolt and nut, and secure clamps to unistrut supports anchored to structure (multiple clamps may be secured to a single unistrut support). Individual conductors or cables may be served utilizing a vinyl or fiberglass clamp which shall be anchored to the structure.
 2. Space supports as follows:
 - a. Horizontal conductors not more than 3 feet o.c.
 - b. Vertical conductors not more than 5 feet o.c.
 3. Install simultaneously with installation of conductors.
 4. MC Cable shall be supported by UL listed clip or clamp. Cable tie support is not acceptable.
- F. Miscellaneous Supports: Support miscellaneous electrical components separately and as required to produce the same structural safety factors as specified for raceway supports. Install metal channel racks for mounting cabinets, panelboards, disconnects, control enclosures, pull boxes, junction boxes, transformers, and other devices.
- G. In overhead spaces, support metal boxes directly from the building structure via 1/4" minimum all-thread or by bar hangers. Where bar hangers are used, attach the bar to raceways on opposite sides of the box and support the raceway with an approved type of fastener not more than 24 inches from the box. Supporting metal boxes utilizing ceiling type wire is not acceptable.
- H. Sleeves: Install in concrete slabs and walls and all other fire-rated floors and walls for cable installations as required. Where sleeves through floors are installed, extend above finish floor. For sleeves through fire rated-wall or floor construction, apply UL-listed fire stopping sealant in gaps between sleeves and cables in accordance with "Fire Resistant Joint Sealers" requirement of Division 7 Section "Joint Sealers." See Architectural plans for location and extent of fire rated assemblies.
- I. Conduit Seals: Install seals for conduit penetrations of exterior walls below grade. Tighten sleeve seal screws until sealing grommets have expanded to form watertight seal.

- J. Fastening: Unless otherwise indicated, fasten electrical items and their supporting hardware securely to the building structure, including but not limited to conduits, raceways, cables, cable trays, busways, cabinets, panelboards, transformers, boxes, disconnect switches, and control components in accordance with the following:
1. Fasten by means of wood screws on wood, toggle bolts on hollow masonry units, concrete inserts or expansion bolts or self-drilling masonry anchors on concrete or solid masonry, cast in inserts on precast structures, spring-tension clamps on steel. Drilling of structural steel members is prohibited. Threaded studs driven by a powder charge and provided with lock washers and nuts may be used instead of expansion bolts and machine or wood screws, where authorized by the Owner and structural engineer. Do not weld conduit, pipe straps, or items other than threaded studs to steel structures. In partitions of light steel construction, use sheet metal screws.
 2. Coordinate with the owner and structural engineer and obtain written prior approval of all work on concrete beams. Holes cut to depth of more than 1-1/2 inches in reinforced concrete beams or to depth of more than 3/4 inch in concrete shall not cut the main reinforcing bars. Fill holes that are not used.
 3. Ensure that the load applied to any fastener does not exceed 25 percent of the proof test load. Use vibration- and shock-resistant fasteners for attachments to concrete slabs.
- K. Communication and Telephone Cable Supports: Use No. 9 ceiling wire to support individual or small bundles of cables run above accessible ceilings.

3.02 PERSONNEL PROTECTION:

- A. Where U-channel systems, angles, brackets or other standard structural metal shapes are readily accessible and exposed to personnel, provide plastic or rubber end caps.
- B. Where threaded rod supports are readily accessible and exposed to personnel, provide plastic or rubber end caps.

3.03 FIRE STOPPING LOCATIONS:

- A. Preparation:
1. Coordination: Coordinate the work with other trades. Fire stopping materials at penetrations of insulated pipes and ducts can be applied after insulation is in place. If insulation is composed of combustible material, the thickness of fire stopping materials must be equivalent to that of the insulation. If the insulation is composed of non-combustible material, it may be considered as part of the penetrating item.
 2. Surface Preparation: Surface Preparation to be in contact with fire stopping materials shall be free of dirt, grease, oil, loose material or other substances that may affect proper fitting or the required fire resistance.
- B. Installation: Install fire stopping materials in accordance with the manufacturer's instructions.
- C. Cleaning: After completion of fire stopping work in any area, equipment shall be reviewed and walls, ceilings and all other surfaces shall be cleaned of deposits of firestop materials.

- D. Inspection: The architect may select and the Owner will pay an independent testing laboratory to examine fire stopped areas to ensure proper installation prior to concealing or enclosing the fire stopped areas.

END OF SECTION 26 0529

SECTION 26 0533 - RACEWAY AND WIREWAY FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.01 SUMMARY:

- A. Extent of raceway work is indicated by drawings and schedules. Provide complete conduit systems for all conductors unless otherwise specified.
- B. Types of raceways specified in this section include the following:
 - 1. Electrical metallic tubing (EMT).
 - 2. Flexible metal conduit.
 - 3. Intermediate metal conduit (IMC).
 - 4. Liquid-tight flexible metal conduit.
 - 5. Non-metallic Conduit and Ducts.
 - 6. Rigid metal conduit (RGC).
 - 7. Wireways.
 - 8. Rigid Aluminum Conduit.

1.02 QUALITY ASSURANCE:

- A. Manufacturers: Firms regularly engaged in manufacture of raceway systems of types and sizes required, whose products have been in satisfactory use in similar service for not less than 5 years.
- B. Installer's Qualifications: Firm with at least 3 years of successful installation experience on projects with electrical raceway work similar to that required for this project.

1.03 SUBMITTALS:

- A. See Section 26 0500 Common Work Results for Electrical for Submittal requirements. Supplemental information is listed within this section.
- B. Product Data: Submit manufacturer's technical product data, including specifications and installation instructions, for each type of raceway system required. Include data substantiating that materials comply with requirements.
- C. Shop Drawings: Submit dimensioned drawings of surface metal raceway systems showing layout of raceways and fittings, spatial relationships to associated equipment, and adjoining raceways, if any. Show connections to electrical power panels and feeders.

PART 2 - PRODUCTS

2.01 MANUFACTURERS:

- A. Subject to compliance with requirements, provide products by the following:

1. Rigid Metal Conduit:
 - a. Allied
 - b. Wheatland
 - c. Triangle
 - d. Western Tube & Conduit
2. Intermediate Metal Conduit (IMC):
 - a. Allied
 - b. Triangle
 - c. Western Tube & Conduit
3. PVC Coated:
 - a. Rob Roy
 - b. Perma Cote
 - c. OCAL
 - d. Calbond
4. EMT Conduit:
 - a. Allied
 - b. Republic
 - c. Triangle
 - d. LTV
 - e. Western Tube & Conduit
5. Non-Metallic Conduit:
 - a. Carlon
 - b. MPF
 - c. Can-Tex
 - d. PW
6. Steel Fittings:
 - a. O/Z Gedney
 - b. Raco
 - c. Appleton
 - d. EPT
 - e. Midwest
 - f. Picoma
 - g. Steel City
7. Conduit Bodies:
 - a. O/Z Gedney
 - b. Killark
 - c. Regal
 - d. Appleton
 - e. Crouse Hinds
8. Wireway:
 - a. Square D. Co.
 - b. Circle AW Products
 - c. Erickson Electric Equipment Co.
 - d. G.S. Metals Corp.
 - e. Hoffman Engineering Co.
 - f. Wadsworth Electric Mfg. Co., Inc.

2.02 METAL CONDUIT AND TUBING:

- A. Rigid Galvanized Steel Conduit (RGC):
 - 1. Conduit: Rigid steel, zinc-coated inside and outside, threaded ends.
 - 2. Fittings: Threaded galvanized steel, bushings shall have nylon insulated throat.

- B. Intermediate Metal Conduit (IMC):
 - 1. Conduit: Rigid intermediate grade galvanized inside and outside, threaded ends.
 - 2. Fittings: Threaded galvanized steel, bushings shall have nylon insulated throat.

- C. PVC Externally Coated Rigid Steel Conduit:
 - 1. Conduit: Rigid steel zinc-coated with external coating of PVC.
 - 2. Fittings: Threaded galvanized steel with external PVC coating, bushings shall have nylon insulated throat.

- D. Electrical Metallic Tubing (EMT):
 - 1. Conduit: Galvanized steel tubing.
 - 2. Fittings: Steel compression fittings for rain-tight and concrete-tight applications. Steel set-screw for all other connections. Set-screw quick fit type for 2-1/2 inches and larger may be used. Bushings shall be threaded and have nylon insulated throat or nylon bushing.

- E. Rigid Aluminum Conduit:
 - 1. Not allowed unless otherwise noted.

- F. Flexible Metal Conduit:
 - 1. Conduit: Continuous spiral wound, interlocked, zinc-coated steel, approved for grounding.
 - 2. Fittings: Zinc coated, malleable iron. Straight connector shall be one-piece body, female end with clamp and deep slotted machine screw for securing conduit, and threaded male end provided with a locknut. Angle connectors shall be two piece body with removable upper section, female end with clamp and deep slotted machine screw for securing conduit, and threaded male end provided with a locknut. All fittings shall be terminated with threaded bushings having nylon insulated throats.

- G. Liquid-Tight Flexible Metal Conduit:
 - 1. Conduit: Continuous spiral wound, interlocked zinc-coated steel with polyvinyl chloride (PVC) jacket, approved for grounding.
 - 2. Fittings: Zinc coated malleable iron. Straight and angle connectors shall be the same as used with flexible metal conduit but shall be provided with a compression type steel ferrule and neoprene gasket sealing rings.

2.03 NON-METALLIC CONDUIT AND DUCTS:

- A. Rigid Non-Metallic Conduit (RNC):
 - 1. Conduit: Schedule 40 or 80 polyvinyl chloride (PVC), 90°C for direct burial or concrete encasement.

2. Fittings: Mate and match conduit type and material. Cement as recommended by manufacturer.

B. PVC and ABS Plastic Utilities Duct:

1. Conduit: Type 2 (EB) for encased burial in concrete; Type II (DB) for direct burial.
2. Fittings: Mate and match conduit type and material. Cement as recommended by manufacturer.

2.04 CONDUIT BODIES:

- A. General: Types, shapes and sizes, as required to suit individual applications and NEC requirements. Provide matching gasketed covers secured with corrosion-resistant screws.
- B. Metallic Conduit and Tubing: Use malleable iron conduit bodies. Use bodies with threaded hubs for threaded raceways and in hazardous locations.
- C. Nonmetallic Conduit: Use nonmetallic conduit bodies.

2.05 WIREWAYS:

- A. General: Provide electrical wireways of types, grades, sizes, and number of channels for each type of service as indicated. Provide complete assembly of raceway including, but not limited to, couplings, offsets, elbows, expansion joints, adapters, hold-down straps, end caps, and other components and accessories as required for complete system.
- B. Lay-In Wireways: Construct lay-in wireways with hinged covers in accordance with UL 870 with components UL listed. Construct units to be capable of sealing cover in closed position with sealing wire.
 1. Connectors: Provide wireway connectors suitable for "lay-in" conductors, with connector covers permanently attached so that removal is not necessary to utilize the lay-in feature.
 2. Finish: Protect sheet metal parts with rust inhibiting coating and baked enamel finish. Plate finish hardware to prevent corrosion. Protect screws installed toward inside of wireway with spring nuts to prevent wire insulation damage.
- C. Rain-tight Troughs: Construct in accordance with UL 870, with components UL listed.
 1. Construction: 16-gauge galvanized sheet metal parts for 4" x 4" to 6" x 6" sections, and 14 gauge parts for 8" x 8" and larger sections. Provide knockouts only in bottom of troughs, with suitable adapters to facilitate attaching to other NEMA 3R enclosures. Do not use Gasketing that can rip or tear during installation, or would compromise rain-tight capability of the trough. Do not use cover screws that will protrude into the trough area and damage wire insulation.
 2. Finish: Provide 14-gauge and 16-gauge galvanized sheet metal parts with corrosion-resistant phosphate primer and baked enamel finish. Plate hardware to prevent corrosion.

2.06 CONDUIT SIZES:

- A. Conduit sizes shall be as shown on the drawings. If the conduit size is not given on the drawings, the conduit shall be sized in accordance with NEC based on the number of conductors enclosed plus a parity sized equipment ground conductor and be subject to the following minimum sizes:
1. Rigid, Intermediate, and EMT Conduit: $\frac{3}{4}$ " for all runs except lighting switch legs, 277 volt lighting branch circuits, temperature control and fire alarm which may be $\frac{1}{2}$ inch.
 2. Flexible and Liquid-Tight Flexible Conduit: $\frac{1}{2}$ " for all runs.
 3. MC Cable: $\frac{3}{8}$ " to under-counter luminaires, $\frac{1}{2}$ " for all other runs.
 4. Underground or Concrete Encased Nonmetallic Conduit: $\frac{3}{4}$ " for all runs.
 5. Conduits used for home runs shall contain only the conductors for the circuits indicated on the drawings. Combining multiple home runs into a single conduit will not be permitted.

2.07 RACEWAY SEALING COMPOUND:

- A. Non-hardening, safe for human skin contact, not deleterious to cable insulation, workable at temperatures as low as 35 deg. F (1 deg. C), withstands temperature of 300 deg. F (149 deg. C) without slump, and adheres to clean surfaces of plastic ducts, metallic conduits, conduit coatings, concrete, masonry, lead, cable sheaths, cable jackets, insulation materials and the common metals.

PART 3 - EXECUTION

3.01 INSPECTION:

- A. Examine areas and conditions under which raceways are to be installed, and substrate which will support raceways. Provide notification in writing of conditions detrimental to proper completion of the work. Do not proceed with work until unsatisfactory conditions have been corrected in manner acceptable to Installer.

3.02 CONDUIT SCHEDULE:

- A. Buried Raceways: rigid PVC plastic conduit.
- B. Raceways embedded in concrete slabs or walls in contact with earth: coated rigid steel galvanized conduit.
- C. Raceways embedded in concrete slabs above grade level: Schedule 40 plastic conduit in slab.
- D. Raceways Through Foundation Walls Below Grade: One 10 foot section of PVC coated rigid steel galvanized, extending from 1 foot inside the foundation wall.
- E. Hazardous areas: Rigid steel galvanized conduit.

- F. Raceways in locations subject to mechanical injury: Rigid steel galvanized conduit or intermediate metal conduit. Locations subject to mechanical injury include, but are not limited to, the following:
 - 1. Exposed conduits outdoors up to 8' A.F.G.
 - 2. Exposed conduits in dock areas and high/medium bay locations up to 25 feet above finished floor.
 - 3. Exposed conduits in apparatus bays.
 - 4. Exposed service entrance feeders.
- G. Motor and equipment connections: PVC jacketed liquid-tight flexible metallic conduit with liquid tight connectors.
- H. Raceways in all other areas shall be electrical metallic tubing unless otherwise noted.
- I. Use flexible metal conduit inside movable partition wireways, from junction boxes to devices and between devices in casework, from outlet boxes to recessed luminaires, and for "fishing" of existing walls.

3.03 INSTALLATION OF CONDUITS:

- A. General: Install electrical raceways in accordance with manufacturer's written installation instruction, applicable requirements of NEC, and as follows:
 - 1. Conceal all conduits unless indicated otherwise, within finished walls, ceilings, and floors. Keep raceways at least 6 inches away from parallel runs of flues and steam or hot water pipes. Install raceways level and square and at proper elevations.
 - 2. Elevation of Raceway:
 - a. Where horizontal raceway is installed near water and steam piping, route raceway above piping and as close to structure as possible and practical.
 - b. Route raceway as close to structure as possible.
 - 3. Complete installation of electrical raceways before starting installation of conductors within raceways.
 - 4. Provide supports for raceways as specified elsewhere in Division 26.
 - 5. Prevent foreign matter from entering raceways by using temporary closure protection.
 - 6. Protect stub-ups from damage where conduits rise from floor slabs. Arrange so curved portion of bend is not visible above the finished slab.
 - 7. Make bends and offsets so the inside diameter is not effectively reduced. Unless otherwise indicated, keep the legs of a bend in the same plane and the straight legs of offsets parallel.
 - 8. Use raceway fittings that are types compatible with the associated raceway and suitable for the use and location. Install expansion fittings across all structural construction joints and expansion/deflection couplings across all structural expansion joints.
 - 9. Run raceways parallel and perpendicular to building elements and other equipment with a minimum of bends in the shortest practical distance considering the type of building construction and obstructions except as otherwise indicated.
 - 10. Raceways embedded in slabs: (Allowed only by written authorization of Structural Engineer/Architect): Install with a minimum of bends, in the shortest practical distance, in middle third of the slab thickness where practical, and leave at least 1 inch concrete

cover. Tie raceways to reinforcing rods or otherwise secure them to prevent sagging or shifting during concrete placement. Space raceways laterally to prevent voids in the concrete. Run conduit larger than 1inch trade size, parallel with or at right angles to the main reinforcement; where at right angles to the reinforcement, the conduit shall be close to one of the supports of the slab. Where nonmetallic conduit is used, raceways must be converted to PVC coated rigid steel conduit before rising above floor.

11. Install exposed raceways parallel and perpendicular to nearby surfaces or structural members and follow the surface contours as much as practical.
12. Install vertical feeder conduits in exterior walls, core walls, or chase spaces. Do not install in interior wall partition areas.
13. Run exposed and parallel raceways together. Make bends in parallel runs from the same center line so that the bends are parallel. Factory elbows may be used only where they can be installed parallel. In other cases provide field bends for parallel raceways.
14. Make raceway joints tight. Where joints cannot be made tight, use bonding jumpers to provide electrical continuity of the raceway system. Make raceway terminations tight. Where terminations are subject to vibration, use bonding bushings or wedges to assure electrical continuity. Where subject to vibration or dampness, use insulating bushings to protect conductors. Joints in non-metallic conduits shall be made with solvent cement in strict accordance with manufacturer's recommendations.
15. Tighten set screws of thread less fittings with suitable tool.
16. Terminations: Where raceways are terminated with locknuts and bushings, align the raceway to enter squarely and install the locknuts with dished part against the box. RGC and IMC shall be secured with double locknuts and an insulated metallic bushing. EMT shall be secured with one locknut and shall have nylon insulated throats or threaded nylon bushings from 1/2" to 1". 1-1/4" and above shall be metal with nylon insulated throats. Use grounding type bushings for feeder conduits at switchboards, panelboards, pull boxes, transformers, motor control centers, VFD's, etc.
17. Where terminating in threaded hubs, screw the raceway or fitting tight into the hub so the end bears against the wire protection shoulder. Where chase nipples are used, align the raceway so the coupling is square to the box, and tighten the chase nipple so no threads are exposed.
18. Provide nylon pull string with printed footage indicators having not less than 200 pounds tensile strength. Leave not less than 12 inches of slack at each end of the pull string. Identify with tags at each end the origin and destination of each empty conduit and indicate same on all empty or spare conduits on the as-built drawings.
19. Telephone and Signal System Raceways: Install raceways with maximum lengths at 100 feet and with a maximum of two, 90 degrees radiused bends or equivalent. Install 2' x 2' pull boxes where necessary to comply with these requirements. Install long sweep bends for all data and voice raceways.
20. Install raceway sealing fittings in accordance with the manufacturer's written instructions. Locate fittings at suitable, approved, accessible locations and fill them with UL-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 at the following points and elsewhere as indicated:
 - a. Where conduits enter or leave hazardous locations.

- b. Where conduits pass from warm locations to cold locations, such as the boundaries of refrigerated spaces and air-conditioned spaces.
 - c. Where conduits enter through a foundation wall or stub-up through a slab on grade floor.
 - d. Where required by the NEC.
21. Stub-up Connections: Extend conduits through concrete floor for connection to freestanding equipment with an adjustable top or coupling threaded inside for plugs and set flush with the finished floor. Extend conductors to equipment with rigid steel conduit; flexible metal conduit may be used 6 inches above the floor. Where equipment connections are not made under this contract, install screwdriver-operated threaded plugs flush with floor.
 22. Flexible Connections: Use short length (maximum of 6 feet) of flexible conduit for recessed and semi-recessed luminaires, for equipment subject to vibration, noise transmission, or movement; and for all motors. Use liquid-tight flexible conduit in wet locations. Install separate ground conductor across flexible connections. Where PVC conduit/couplings have been approved for exterior use and are exposed to sunlight, provide UV rated PVC coatings or protect with 2 coats of water based latex paint that is chemically compatible with the PVC products. Color selection shall be by Architect.
 23. PVC externally coated rigid steel conduit: Patch all nicks and scrapes in PVC coating after installing conduit.
 24. Where conduits are to be installed through structural framing members, the Contractor shall provide sleeves. The Architect/Engineer's written approval must be obtained prior to cutting, notching or drilling of structural framing members.
 25. Ream the ends of all cut and/or threaded conduit. Ends shall be cut square.
 26. Use of running threads for rigid or intermediate metallic conduit are not permitted. When threaded couplings cannot be used, provide 3 piece union or solid coupling.
 27. Route conduit through roof openings for piping and ductwork where possible; otherwise, rout through jack with pitch pocket.
 28. Conduit stub-ups from below grade or thru the slab shall be PVC coated or PVC taped rigid steel galvanized conduit and shall extend 6 inches above grade.
 29. Wherever conduits enter a structure through a foundation or basement wall below grade, grout around the conduit with water-proof grout or install entrance seals. Seals shall be OZ Type WS or approved equivalent for new construction and OZ type CSM Series for existing structures.
 30. Conduits shall not cross pipe shafts or ventilation duct openings. Where conduits must penetrate air-tight spaces or plenums, seal around the conduit with a mastic acceptable to the Architect/Engineer.
 31. Install an insulated ground conductor in all conduits.
 32. Where individual conduits penetrate existing fire-rated walls and floors, pack void around conduit with fire rated insulation and seal opening around conduit with UL listed foamed silicone elastomer compound. Where conduits penetrate exterior walls, new floors, or roof, provide pipe sleeve one size larger than conduit, pack void around conduit with fire rated insulation, and seal opening around conduit with UL listed foam silicone elastomer compound.
 33. Where conduit sleeves penetrate fire rated floors or walls for installation of system cables, AC or MC cables, or modular wiring cables pack void around cables or empty

- sleeve with fire rated insulation and fill ends with fire-resistive compound. Seal opening around sleeve with UL listed foam silicone elastomer compound.
34. Use PVC-coated rigid steel or Fiberglass factory elbows for bends in plastic conduit runs longer than 100 feet, or in plastic conduit runs which have more than two bends regardless of length. Use long sweep bends for wiring larger than 350 mcm.
 35. Wipe plastic conduit clean and dry before joining. Apply full even coat of cement to entire area that will be inserted into fitting. Let joint cure for 20 minutes minimum.
 36. No PVC conduit shall be run exposed or inside stud or masonry walls unless specifically called for on the drawings. Transition from PVC to metal conduit shall be made below grade.
 37. Provide separate raceway systems for each of the following:
 - a. Lighting
 - b. Power Distribution
 - c. Communications and Data
 - d. Fire Alarm
 - e. Temperature Control
 38. Paint new exposed conduits to match existing exposed conduits where installed in areas with existing painted conduits or where otherwise indicated.
 39. Provide rebar and tie downs for all conduits and conduit racks to be installed with concrete or slurry to prevent conduit "float".
- B. Install buried electrical line warnings per Division 26 section - "Electrical identification".
- C. Install labeling as required in Division 26 section - "Electrical Identification".
- 3.04 INSTALLATION OF WIREWAYS:
- A. Wireways: Mechanically assemble metal enclosures and raceways to form continuous electrical conductor and connect to electrical boxes, fittings and cabinets as to provide effective electrical continuity and rigid mechanical assembly.
1. Where practicable, avoid use of dissimilar metals throughout system to eliminate possibility of electrolysis. Where dissimilar metals are in contact, coat all surfaces with corrosion inhibiting compound before assembling.
 2. Install expansion fittings in all raceways wherever structural expansion joints are crossed.
 3. Make changes in direction of raceway run with proper fittings, supplied by raceway manufacturer. Field bends of raceway sections are not permitted.
 4. Properly support and anchor raceways for their entire length by structural materials. Raceways are not to span any space unsupported.
 5. Use boxes as supplied by raceway manufacturer wherever junction, pull or device boxes are required. Standard electrical "handy" boxes, etc., are not permitted for use with surface raceway installations.
 6. Install an insulated grounding conductor in all wireways and surface raceways. Bond grounding conductor to all wireways and surface raceways.
 7. Paint new exposed surface metal raceway to match adjacent surfaces where raceway is installed in finished areas such as lobbies, corridors, and normally occupied spaces.

8. Surface raceways and wireways are acceptable only where specifically indicated on the drawings. The proposed use of surface raceways and wireways shall be submitted for review by the Engineer prior to installation.
9. Common wireways are not acceptable for convergence of multiple circuits unless specifically indicated on the drawings. The proposed use of a common wireway shall be submitted for review by the Engineer prior to installation.
10. The proposed use of wireways above or below panelboards, switchboards, motor control centers, and other electrical equipment shall be submitted along with a layout drawing for review by the Engineer prior to installation.

3.05 ADJUSTING AND CLEANING:

- A. Upon completion of installation of raceways, inspect interiors of raceways; clear all blockages and remove burrs, dirt and construction debris.

END OF SECTION 26 0533

SECTION 26 0534 - CABINETS, BOXES AND FITTINGS

PART 1 - GENERAL

1.01 SUMMARY:

- A. This section includes cabinets, boxes, and fittings for electrical installations and certain types of electrical fittings not covered in other sections. Types of products specified in this section include:
 - 1. Outlet and device boxes
 - 2. Pull and junction boxes
 - 3. Floor boxes and service fittings
 - 4. Cabinets
 - 5. Hinged door enclosures
 - 6. Boxes and fittings for hazardous locations
- B. Conduit-body-type electrical enclosures and wiring fittings are specified in the Division 26 Section on Raceways.

1.02 DEFINITIONS:

- A. Cabinets: An enclosure designed either for surface or for flush mounting and having a frame, or trim in which a door or doors may be mounted.
- B. Device Box: An outlet box designed to house a receptacle device or a wiring box designed to house a switch.
- C. Enclosure: A box, case, cabinet, or housing for electrical wiring or components.
- D. Hinged Door Enclosure: An enclosure designed for surface mounting and having swinging doors or covers secured directly to and telescoping with the walls of the box.
- E. Outlet Box: A wiring enclosure where current is taken from a wiring system to supply utilization equipment.
- F. Wiring Box: An enclosure designed to provide access to wiring systems or for the mounting of indicating devices or switches for controlling electrical circuits.

1.03 SUBMITTALS:

- A. See Section 26 0500 Common Work Results for Electrical for Submittal requirements. Supplemental information is listed within this section.
- B. Submit product data for cabinets and enclosures with classification higher than NEMA 1.

- C. Shop drawings for boxes, enclosures, and cabinets that are to be shop fabricated (non-stock items). For shop fabricated junction and pull boxes, show accurately scaled views and spatial relationships to adjacent equipment. Show box types, dimensions, and finishes.

PART 2 - PRODUCTS

2.01 MANUFACTURERS:

- A. Manufacturers: Subject to compliance with requirements, provide products by the following:
 - 1. Cabinets:
 - a. Hoffman Engineering Co.
 - b. Erickson Electrical Equipment Co.
 - c. Electric Panelboard, Inc.
 - d. Parker Electrical Mfg. Co.
 - e. Spring City Electrical Mfg. Co.
 - f. Square D Co.
 - g. Circle AW
 - 2. Boxes and Fittings for Hazardous Locations:
 - a. OZ/Gedney.
 - b. Cooper Industries, Inc.
 - c. Killark Electric Mfg. Co.
 - d. Adalet-PLM.
 - e. Robroy Industries, Inc.
 - f. Spring City Electrical Mfg. Co.
 - g. Appleton

2.02 CABINETS, BOXES, AND FITTINGS, GENERAL:

- A. Electrical Cabinets, Boxes, and Fittings: Of indicated types, sizes, and NEMA enclosure classes. Where not indicated, provide units of types, sizes, and classes appropriate for the use and location. Provide all items complete with covers including blank covers for unused boxes, knockout closures for unused openings and other accessories required for the intended use. Provide gaskets for units in damp or wet locations. Provide protective pocket inside front cover with schematic diagram, connection diagram, and layout drawing of control wiring and components within enclosure.

2.03 MATERIALS AND FINISHES:

- A. Sheet Steel: Flat-rolled, code-gage, galvanized steel.
- B. Fasteners for General Use: Corrosion resistant screws and hardware including cadmium and zinc plated items.
- C. Fasteners for Damp or Wet Locations: Stainless steel screws and hardware.
- D. Cast Metal for Boxes, Enclosures, and Covers; Copper-free aluminum except as otherwise specified.

- E. Exterior Finish: Gray baked enamel for items exposed in finished locations except as otherwise indicated.
- F. Painted Interior Finish: Where indicated, white baked enamel. Emergency system cabinets and boxes shall be red.
- G. Fittings for Boxes, Cabinets, and Enclosures: Conform to UL 514B. Malleable iron or zinc plated steel for conduit hubs, bushings and box connectors.

2.04 METAL OUTLET, DEVICE, AND SMALL WIRING BOXES:

- A. General: Conform to UL 514A, "Metallic Outlet Boxes, Electrical," and UL 514B, "Fittings for Conduit and Outlet Boxes." Boxes shall be of type, shape, size, and depth to suit each location and application. For multiple device installations, use multi-gang boxes. Sectional boxes are not permitted. Provide barrier for different voltage conductors in the same box.
- B. Steel Boxes: Conform to NEMA OS 1, "Sheet Steel Outlet Boxes, Device Boxes, Covers, and Box Supports." Boxes shall be 4" square minimum with 2" depth minimum sheet steel with stamped knockouts, threaded screw holes and accessories suitable for each location including mounting brackets and straps, cable clamps, exterior/plaster rings and fixture studs.
- C. Cast-Aluminum Boxes: Copper free aluminum deep type, with threaded raceway entries/hubs, and features and accessories suitable for each location including mounting ears, threaded screw holes for devices and closure plugs.
- D. Malleable or Cast-Iron Boxes: Iron alloy, waterproof, with threaded raceway entries and features and accessories suitable for each location, including mounting ears, threaded screw holes for devices and closure plugs.
- E. Malleable or Cast-Iron Floor Boxes: Fully adjustable, waterproof, with threaded raceway entrances, adjusting rings, gaskets, and brass floor plates. Where indicated, provide multi-section boxes with individual hinged section covers. Provide for power, data, and communication outlets as indicated on the drawings.

2.05 NONMETALLIC OUTLET, DEVICE, AND SMALL WIRING BOXES:

- A. General: Conform to NEMA OS 2, "Nonmetallic Outlet Boxes, Device Boxes, Covers, and Box Supports" and UL 514C, "Nonmetallic Outlet Boxes, Flush Device Boxes and Covers." Boxes shall be molded PVC units of type, shape, size, and depth to suit location and application.
- B. Boxes for Concealed Work: Mounting provisions and wiring entrances to suit installation conditions and wiring method used.
- C. Boxes for Exposed Work: Ultra-violet stabilized, nonconductive, high impact-resistant boxes with integrally molded raceway entrance hubs and removable mounting flanges. Boxes shall be equipped with threaded screw holes for device and cover plate mounting. Each box shall have a molded cover of matching PVC material suitable for the application.

2.06 PULL AND JUNCTION BOXES:

- A. General: Comply with UL 50, "Electrical Cabinets and Boxes", for boxes over 100 cubic inches volume. Boxes shall have screwed or bolted on covers of material same as box and shall be of size and shape to suit application.
- B. Steel Boxes: Sheet steel with welded seams. Where necessary to provide a rigid assembly, construct with internal structural steel bracing.
- C. Hot-Dipped Galvanized Steel Boxes: Sheet steel with welded seams. Where necessary to provide a rigid assembly, construct with internal structural steel bracing. Hot-dip galvanized after fabrication. Cover shall be gasketed.
- D. Stainless-Steel Boxes: Fabricate of stainless steel conforming to Type 302 of ASTM A 167, "Specification for Stainless and Heat Resisting Chromium-Nickel Steel Plate, Sheet, and Strip." Where necessary to provide a rigid assembly, construct with internal structural stainless steel bracing. Cover shall be gasketed.
- E. Cast-Aluminum Boxes: Molded of copper free aluminum, with gasketed cover and integral threaded conduit entrances and Neoprene gaskets.
- F. Malleable or Cast-Iron Boxes: Molded of iron alloy with gasketed cover and integral threaded conduit entrances.
- G. Boxes Approved for Classified Locations: Cast metal boxes conforming to UL 886, "Outlet Boxes and Fittings for Use in Hazardous (Classified) Locations," listed and labeled for use in the specific location classification, and with the specific hazardous material encountered. Conduit entrances shall be integral threaded type.

2.07 CABINETS:

- A. Comply with UL 50, "Electrical Cabinets and Boxes."
- B. Construction: Sheet steel, NEMA 1 class except as otherwise indicated. Cabinet shall consist of a box and a front consisting of a one piece frame and a hinged door. Arrange door to close against a rabbet placed all around the inside edge of the frame, with a uniformly close fit between door and frame. Provide concealed fasteners, not over 24 inches apart, to hold fronts to cabinet boxes and provide for adjustment. Provide flush or concealed door hinges not over 24 inches apart and not over 6 inches from top and bottom of door. For flush cabinets, make the front approximately $\frac{3}{4}$ " larger than the box all around. For surface mounted cabinets make front same height and width as box.
- C. Doors: Double doors for cabinets wider than 24 inches.
- D. Locks: Combination spring catch and key lock, with all locks for cabinets of the same system keyed alike. Locks may be omitted on signal, power, and lighting cabinets located within wire closets and mechanical-electrical rooms. Locks shall be of a type to permit doors to latch closed without locking.

2.08 STEEL ENCLOSURES WITH HINGED DOORS:

- A. Comply with UL 50, "Cabinets and Enclosures" and NEMA ICS 6, "Enclosures for Industrial Controls and Systems."
- B. Construction: Sheet steel, 16 gage, minimum, with continuous welded seams. NEMA class as indicated; arranged for surface mounting.
- C. Doors: Hinged directly to cabinet and removable, with approximately $\frac{3}{4}$ inch flange around all edges, shaped to cover edge of box. Provide handle operated, key locking latch. Individual door width shall be no greater than 24 inches. Provide multiple doors where required.
- D. Mounting Panel: Provide painted removable internal mounting panel for component installation.
- E. Enclosure: NEMA 1 except as indicated. Where door gasketing is required, provide neoprene gasket attached with oil-resistant adhesive, and held in place with steel retaining strips. For all enclosures of class higher than NEMA 1, use hubbed raceway entrances.

2.09 CAST METAL ENCLOSURES WITH HINGED DOORS:

- A. Copper free aluminum with bolted, hinged doors. Where used at hazardous (classified) locations, enclosures shall conform to UL and shall be listed and labeled for the classification of hazard involved.

2.10 MOLDED NONMETALLIC ENCLOSURES WITH HINGED DOOR:

- A. General: Molded, glass fiber reinforced high impact strength polyester with bolt or screw secured doors and solid neoprene gaskets.

PART 3 - EXECUTION

3.01 INSTALLATION, GENERAL:

- A. Locations: Install items where indicated and where required to suit code requirements and installation conditions. Coordinate box locations with Architectural elements including casework, backsplash, door swings, etc.
- B. Cap with Knock out closures all unused knockout holes where blanks have been removed and plug unused conduit hubs.
- C. Support and fasten items securely in accordance with Division 26 Section on Supporting Devices.
- D. Sizes shall be adequate to meet NEC volume requirements, but in no case smaller than sizes indicated. Size boxes to accommodate wire pulling, splices, taps, equipment connections and code compliance.

- E. Remove sharp edges where they may come in contact with wiring or personnel.

3.02 APPLICATIONS:

- A. Cabinets: Flush mounted, NEMA enclosure type 1 except as otherwise indicated.
- B. Hinged Door Enclosures Indoor: NEMA type 1 enclosure except as indicated.
- C. Hinged Door Enclosures Outdoors: NEMA Type 4. Install drip hood, factory tailored to individual units.
- D. Hinged Door Enclosures in Corrosive Locations: NEMA type 4X nonmetallic enclosure.
- E. Outlet Boxes and Fittings: Install outlet and device boxes and associated covers and fittings of materials and NEMA types suitable for each location and in conformance with the following requirements:
 - 1. Interior Dry Locations: Sheet steel, NEMA Type 1.
 - 2. Locations Exposed to Weather or Dampness: Cast metal, NEMA type 3R.
 - 3. Wet Locations: NEMA Type 4 enclosures.
 - 4. Corrosive Locations: NEMA Type 4X enclosures.
 - 5. Hazardous (Classified) Locations: NEMA type listed and labeled for the location and class of hazard indicated.
- F. Pull and Junction Boxes: Install pull and junction boxes of materials and NEMA types suitable for each location except as otherwise indicated.

3.03 INSTALLATION OF OUTLET BOXES:

- A. Outlets at Windows and Doors: Locate close to window trim. For outlets indicated above doors center outlets above the door opening except as otherwise indicated.
- B. Column and Pilaster Locations: Locate outlet boxes for switches and receptacles on columns or pilasters so the centers of the columns are clear for future installation of partitions.
- C. Locations in Special Finish Materials: For outlet boxes for receptacles and switches mounted in desks or furniture cabinets or in glazed tile, concrete block, marble, brick, stone or wood walls, use rectangular shaped boxes with square corners and straight sides. Install such boxes without plaster rings. Saw cut all recesses for outlet boxes in exposed masonry walls.
- D. Gasketed Boxes: At the following locations use malleable or cast metal, threaded hub type boxes with gasketed weatherproof covers:
 - 1. Exterior locations.
 - 2. Where surface mounted on unfinished walls, columns or pilasters. (Cover gaskets may be omitted in dry locations).
 - 3. Where exposed to moisture laden atmosphere.
 - 4. At food preparation equipment within four ft. of steam connections.
 - 5. High traffic areas (surface installations).
 - 6. Where indicated.

- E. Mounting: Mount outlet boxes for switches with the long axis vertical or as indicated. Mount boxes for receptacles vertically, except above counter receptacles to be mounted horizontally. Three or more gang boxes shall be mounted with the long axis horizontal. Locate box covers or device plates so they will not span different types of building finishes either vertically or horizontally. Locate boxes for switches near doors on the side opposite the hinges and close to door trim, even though electrical floor plans may show them on hinge side. Provide far side box supports, for electrical switch boxes installed on metal studs and provide stud to stud support for electrical receptacle boxes installed on metal studs.
- F. Ceiling Outlets: For fixtures, where wiring is concealed, use outlet boxes 4 inches square by 1-1/2 inches deep, minimum.
- G. Cover Plates for Surface Boxes: Use plates sized to box front without overlap.
- H. Protect outlet boxes to prevent entrance of plaster, and debris. Thoroughly clean foreign material from boxes before conductors are installed.
- I. Concrete Boxes: Use extra deep boxes to permit side conduit entrance without interfering with reinforcing, but do not use such boxes with over 6 inch depth.
- J. Back to back outlet boxes are not permitted. Separate boxes a minimum of 6 inches in standard walls and 24 inches in acoustical walls.

3.04 INSTALLATION OF PULL AND JUNCTION BOXES:

- A. Box Selection: For boxes in main feeder conduit runs, use sizes not smaller than 8 inches square by 4 inches deep. Do not exceed 6 entering and 6 leaving raceways in a single box. Quantities of conductors (including equipment grounding conductors) in pull or junction box shall not exceed the following:

Size of Largest Conductors in <u>Box</u>	Maximum no. of Conductors in <u>Box</u>
No. 4/0 AWG	30
250 MCM	20
500 MCM	15
Over 500 MCM	10

- B. Cable Supports: Install clamps, grids, or devices to which cables may be secured. Arrange cables so they may be readily identified. Support cable at least every 30 inches inside boxes.
- C. Mount pull boxes in inaccessible ceilings with the covers flush with the finished ceiling. Where possible, locate pull and junction boxes above accessible ceilings in finished areas.
- D. Flush in grade outdoor boxes shall be adequately supported against settling or tipping. Where heavy traffic or poor soil compaction exists, cast box in concrete base which provides 6" of cover around and under the box.
- E. Size: Provide pull and junction boxes for telephone, signal, and other systems at least 50 percent larger than would be required by Article 370 of NEC, or as indicated. Locate boxes strategically and provide shapes to permit easy pulling of future wires or cables of types normal for such systems.

3.05 INSTALLATION OF CABINETS AND HINGED DOOR ENCLOSURES:

- A. Mount with fronts straight and plumb.
- B. Install with tops 78 inches above floor.
- C. Set cabinets in finished spaces flush with walls.

3.06 GROUNDING:

- A. Electrically ground metallic cabinets, boxes, and enclosures. Where wiring to item includes a grounding conductor, provide a grounding terminal in the interior of the cabinet, box or enclosure.

3.07 CLEANING AND FINISH REPAIR:

- A. Upon completion of installation, inspect components. Remove burrs, dirt, and construction debris and repair damaged finish including chips, scratches, abrasions and weld marks.
- B. Galvanized Finish: Repair damage using a zinc-rich paint recommended by the tray manufacturer.
- C. Painted Finish: Repair damage using matching corrosion inhibiting touch-up coating.

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SECTION 26 0534
CABINETS, BOXES AND FITTINGS

END OF SECTION 26 0534

SECTION 26 0533 - IDENTIFICATION FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.01 SUMMARY:

- A. This Section includes identification of electrical materials, equipment, and installations. It includes requirements for electrical identification components including but not limited to the following:
 - 1. Buried electrical line warnings.
 - 2. Identification labeling for raceways, cables, and conductors.
 - 3. Operational instruction signs.
 - 4. Warning and caution signs.
 - 5. Equipment labels and signs.
- B. Identification required in this section shall apply to equipment furnished in Division 26 and any other applicable Divisions including Division 23.

1.02 SUBMITTALS:

- A. See Section 26 0500 Common Work Results for Electrical for Submittal requirements. Supplemental information is listed within this section.
- B. Product Data for each type of product specified.
- C. Submit schedule of identification nomenclature to be used for identification signs and labels for each piece of equipment including, but not be limited to, the following equipment types as specified in Division 26.
 - 1. Cabinets and enclosures
 - 2. Switchboards
 - 3. Panelboards
 - 4. Disconnect switches
 - 5. Circuit breakers and switches
 - 6. Motor control centers
 - 7. Starters
 - 8. Variable frequency drives
 - 9. Fire alarm system panels and all ancillary cabinets and equipment
 - 10. Paging, intercom and background music system cabinets.
 - 11. Lighting control cabinets.
- D. Submit samples of each color, lettering style and other graphic representation required for identification materials including samples of labels and signs.

1.03 QUALITY ASSURANCE:

- A. ANSI Compliance: Comply with requirements of ANSI Standard A13.1, "Scheme for the Identification of Piping Systems," with regard to type and size of lettering for raceway and cable labels.

PART 2 - PRODUCTS

2.01 MANUFACTURERS:

- A. Manufacturers: Subject to compliance with requirements, provide products by the following:
1. Ideal Industries, Inc.
 2. LEM Products, Inc.
 3. Markal Corp.
 4. Panduit Corp.
 5. W.H.Brady, Co.
 6. 3M Company

2.02 ELECTRICAL IDENTIFICATION PRODUCTS:

- A. Adhesive Marking Labels for Exposed Raceway and Busway: Pre-printed, flexible, self-adhesive labels with legend indicating voltage and service (Emergency, Lighting, Power, Power D.C., HVAC, Communications, Control, Fire).
1. Label Size for Raceways and Busway: Kroy or Brother Labels 1 inch high by 12 inches long (minimum) with 5/8 inch minimum height letters.
 2. Normal: White letters on black background indicating source equipment designation, circuit number(s), and voltage.
 3. Fire Alarm: White letters on red background indicating "FIRE ALARM".
 4. Temperature Control: White or black letters on blue background indicating "TEMP. CONTROL."
 5. Ground: White or black letters on green background indicating "GROUND" and equipment and designation.
 6. Building Alarms: Orange letters on white background indicating "BUILDING ALARMS."
 7. Network Fiber: Black letters on white background indicating "NETWORK FIBER."
 8. Where conduits enter or exit a panelboard, pull or junction box, switchboard, or other distribution equipment, conduit labels shall include circuit number in addition to feeder identification and voltage.
- B. Provide colored Adhesive Marking Tape for banding Wires and Cables: Self-adhesive vinyl tape not less than 3 mils thick by 1 inch to 2 inches in width. Make each color band completely encircling cables, at penetrations of walls and floors, at each junction box and at 20-foot maximum intervals in straight runs.
- C. Underground Line Marking Tape: Metal-detector detectable, permanent, bright-colored, continuous-printed, plastic tape compounded for direct-burial service not less than 6 inches wide by 4 mils thick. Printed legend indicative of general type of underground line below.

- D. Wire/Cable Designation Tape Markers: Vinyl or vinyl-cloth, self-adhesive, wraparound, cable/conductor markers with preprinted numbers and letter.
- E. Engraved, Plastic-Laminated Labels, Signs and Instruction Plates: Engraving stock melamine plastic laminate, 1/16 inch minimum thick for signs up to 20 square inches, or 8 inches in length; 1/8 inch thick for larger sizes. Engraved legend in white letters on black face for normal and white letters on red face for emergency, black letters on yellow face for UPS and punched for mechanical fasteners. Where required for ground connections, provide engraved legend in white letters on green face.
- F. Fasteners for Plastic-Laminated and Metal Signs: Self-tapping stainless steel screws when screw ends do not protrude into working areas of equipment otherwise use number 10/32 stainless steel machine screws with nuts and flat and lock washers or rivets.
- G. Cable Ties: Fungus-inert, self-extinguishing, one-piece, self-locking nylon cable ties, 0.18-inch minimum width, 50 lb minimum tensile strength, and suitable for a temperature range from minus 50 degrees F to 350 degrees F. Provide ties in specified colors when used for color coding.
- H. Adhesive Marking Tape for Device Cover Plates: 3/8 inch Kroy tape or Brother labels with 3/16 inch minimum height letters. Tape shall have black letters on clear background for normal and red letters on clear background for emergency. Embossed Dymo-Tape labels are not acceptable.

PART 3 - EXECUTION

3.01 INSTALLATION:

- A. Lettering and Graphics: Coordinate names, abbreviations, colors, and other designations used in electrical identification work with corresponding designations specified or indicated. Install numbers, lettering, and colors as approved in submittals and as required by code. Clean surfaces to receive nameplates and labels and install nameplates and labels on front of equipment parallel with equipment/raceway/cable/wire/etc. lines.
- B. Install identification devices in accordance with manufacturer's written instructions and requirements of NEC.
- C. Sequence of Work: Where identification is to be applied to surfaces that require finish, install identification after completion of finish work.
- D. Conduit Identification:
 - 1. Adhesive Marking Labels: Provide adhesive marking labels for exposed raceway and busway and Raceway or Busway located above accessible ceilings. Install labels at **//30** foot intervals. Conduits located above non-accessible ceiling or in floors and walls shall be labeled within 3 feet of becoming accessible. Labels for multiple conduits shall be aligned and read the same direction.
- E. Identify Junction, Pull and Connection Boxes: Identification of systems and circuits shall indicate system voltage and identity of contained circuits on outside of box cover. Color code shall be

same as raceway systems. Use self-adhesive marking tape labels at exposed locations and indelible black marker at concealed boxes.

- F. Underground Electrical Line Identification: During trench backfilling, for exterior underground power, signal and communications lines, install continuous underground plastic line marker, located directly above line at 6 to 8 inches below finished grade. Where multiple lines installed in a common trench or concrete envelope, do not exceed an overall width of 16 inches; install a single line marker. Tape shall be 6 inches wide, 0.004 inches thick and 1750 psi minimum strength, trace wire run continuous length manhole to manhole and to equipment. Provide 3 feet slack rolled at each end.
1. Install line marker for underground wiring, both direct-buried and in raceway. Red for electrical, orange for phone and cable.
- G. Circuit Identification: 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, control wiring or communications/signal conductors are terminated or spliced in a box or enclosure, label each conductor or cable with circuit number. For control and communications/signal wiring, use wire/cable marking tape at terminations in wiring boxes, troughs and control cabinets. Use consistent letter/number conductor designations throughout on wire/cable marking tapes.
 3. Match identification markings with designations used in panelboards shop drawings, Contract Documents, and similar previously established identification schemes for the facility's electrical installations.
- H. Apply warning, caution and instruction signs and stencils as follows:
1. Install warning, caution or instruction signs where required by NEC, where indicated, or where reasonably required to assure safe operation and maintenance of electrical systems and of the items to which they connect. Install engraved plastic-laminated instruction signs with approved legend where instructions or explanations are needed for system or equipment operation. Install butyrate signs with metal backing for outdoor items.
 2. Emergency Operating Signs: Install, where required by NEC, where indicated, or where reasonably required to assure safe operation and maintenance of electrical systems and of the items to which they connect, engraved laminate signs with white legend on red background with minimum 3/8 inch high lettering for emergency instructions on power transfer, load shedding, or other emergency operations.
 - a. Provide sign at main service entrance switch, indicating type and location of on-site stand-by generator as required by NEC. Sign shall read "Secondary Source Provided by Engine Generator Located In Room NAME and NUMBER".
- I. Install equipment/system circuit/device identification as follows:
1. Apply equipment identification labels of engraved plastic-laminate on each major unit of electrical equipment in building, including central or master unit of each electrical system. This includes communication/signal/alarm systems, unless unit is specified with its own self-explanatory identification. Text shall match terminology and numbering of the

Contract Documents and shop drawings. Apply labels for each unit of the following categories of electrical equipment.

- a. Panelboards, electrical cabinets and enclosures.
 - b. Access doors and panels for concealed electrical items.
 - c. Electrical switchboards.
 - d. Motor starters.
 - e. Pushbutton stations.
 - f. Contactors.
 - g. Remote-controlled switches.
 - h. Dimmers.
 - i. Control devices.
 - j. Telephone switching equipment.
 - k. TV/audio monitoring master station.
 - l. Fire alarm master station or control panel.
 - m. Security monitoring master station or control panel.
- J. Apply circuit/control/item designation labels of engraved plastic laminate for disconnect switches, breakers, pushbuttons, pilot lights, motor control centers, and similar items for power distribution and control components above, except panelboards and alarm/signal components, where labeling is specified elsewhere.
- K. For panelboards, provide framed, typed circuit schedules (label all spares and spaces in pencil) with explicit description and identification of items controlled by each individual breaker.
- L. Tag all grounding electrode conductors, associated bonding conductors, and grounding conductors at their point of attachment to any ground bus and grounding electrode (where possible) with a 2 inch diameter round green phenolic nameplate. Lettering shall be 1/4 inch high with 1/5 inch between lines centered on the tag stating "DO NOT DISCONNECT," "MAIN GROUND." Nameplate shall attach to conductor with a short length of small chain.
- M. Install labels at locations as required and at locations for best convenience of viewing without interference with operation and maintenance of equipment.
- N. Provide adhesive marking tape labels for identification of individual receptacles including receptacles in furniture systems and light switch wall-plates. Locate tape on front of plate and identify panel and branch circuit serving the receptacle. Provide tape labels for identification of individual switches or thermal overload switches which serve as equipment disconnects. Locate the tape on the front of the cover-plate and identify panel and branch circuit serving the equipment.

END OF SECTION 26 0553

SECTION 26 0583 - WIRING CONNECTIONS

PART 1 - GENERAL

1.01 SUMMARY:

- A. Extent of electrical connections for equipment is indicated by drawings and schedules. Electrical connections are hereby defined to include connections used for providing electrical power to equipment.
- B. Applications of electrical power connections specified in this section include the following:
 - 1. To resistive heaters.
 - 2. From electrical source to motor starters.
 - 3. From motor starters/motor controllers/VFD's/etc. to motors.
 - 4. To lighting equipment.
 - 5. To converters, rectifiers, transformers, inverters, rheostats, and similar current adjustment features of equipment.
 - 6. To grounds including earthing connections.
 - 7. To master units of communication, signal, alarm, clock, public address, sound, and video systems.
 - 8. From push buttons to equipment requiring electrical connection.
 - 9. Other connections as shown.

1.02 QUALITY ASSURANCE:

- A. Manufacturers: Firms regularly engaged in manufacture of electrical connectors and terminals, of types and ratings required, and ancillary connection materials, including electrical insulating tape, soldering fluxes, and cable ties, whose products have been in satisfactory use in similar service for not less than 5 years.
- B. Installer's Qualifications: Firms with at least 2 years of successful installation experience with projects utilizing electrical connections for equipment similar to that required for this project.

1.03 SUBMITTALS:

- A. See Section 26 0500 Common Work Results for Electrical for Submittal requirements. Supplemental information is listed within this section.
- B. Product Data: Submit manufacturer's data on electrical connections for equipment products and materials. All mechanical and plumbing equipment shall be coordinated with unit nameplate information per the actual nameplate to be included on the equipment. As a minimum, information shall include: Operating Voltage; MCA (Min. circuit amperes); FLA (Full load amperes); MFS (Max. fuse size) or MOP (Max. overcurrent protection); and SCCR (Short Circuit Current Rating) and shall match electrical equipment and protection/distribution sizes and be rated for available short circuit currents as shown on the drawings. Bracing for equipment shall be provided at incoming terminals and as an option throughout the equipment

for the available fault current or downstream equipment and devices shall be protected by current limiting fuses.

1.04 DEFINITIONS:

A. Load voltage wiring shall be defined as:

1. Conduit and wiring required to carry power to motors and other equipment or devices. Wiring from control devices to equipment that carry power to drive that equipment such as line voltage thermostats, etc., shall be included as load voltage wiring. Wiring that provides power to control panels, control transformers, control relays, time clocks, etc., shall also be included as load voltage wiring.

1.05 DELIVERY, STORAGE, AND HANDLING:

- A. Deliver electrical connection products wrapped in proper factory fabricated type containers.
- B. Store electrical connection products in original cartons and protect from weather, construction traffic and debris.
- C. Handle electrical connection products carefully to prevent breakage, denting, and scoring finish.

PART 2 - PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS:

- A. Manufacturer: Subject to compliance with requirements, provide circuit and motor disconnects by one of the following:
 1. General Electric Co.
 2. Eaton
 3. Square D Company
 4. Siemens Energy & Automation, Inc.
 5. Westinghouse Electric Corp.

2.02 GENERAL:

- A. Overcurrent Protective Devices (OCPDs): Provide type, rating, and features as indicated. Comply with Division 26 Section on Low Voltage Circuit Protective Devices, with OCPDs adapted to equipment connection installation. Tandem circuit breakers shall not be used. Multiple breakers shall have common trip.
- B. Provide motor controllers that are horsepower rated to suit the motor controlled.
- C. Contacts shall open each ungrounded connection to the motor. Contacts shall be NEMA rated, 75 degrees C.
- D. Overload relays shall be ambient-compensated type with inverse-time-current characteristic. Provide with heaters or sensors in each phase matched to nameplate full load current of the

specific motor to which connected with appropriate adjustment for duty cycle and power factor correction supplied with the motor.

2.03 MATERIALS AND COMPONENTS:

- A. General: For each electrical connection indicated, provide complete assembly of materials, including but not necessarily limited to, pressure connectors, terminals (lugs), electrical insulating tape, electrical solder, electrical soldering flux, heat-shrinkable insulating tubing, cable ties, solderless wire-nuts, disconnect, starter, contactor, relays, etc., and other items and accessories as needed to complete splices and terminations of types indicated.
- B. Metal Conduit, Tubing and Fittings:
 - 1. General: Provide metal conduit, tubing and fittings of types, grades, sizes and weights (wall thicknesses) indicated for each type service. Provide products complying with Division-26 section on Raceways.
- C. Wires, Cables, and Connectors:
 - 1. General: Provide wires, cables, and connectors complying with Division-26 section on Wires and Cables.
 - 2. Wires/Cables: Unless otherwise indicated, provide wires/cables (conductors) for electrical connections which match, including sizes, ratings, and material of wires/cables which are supplying electrical power.
 - 3. Connectors and Terminals: Provide electrical connectors and terminals which mate and match, including sizes and ratings, with equipment terminals and are recommended by equipment manufacturer for intended applications.
 - 4. Electrical Connection Accessories: Provide electrical insulating tape, heat-shrinkable insulating tubing and boots, electrical solder, electrical soldering flux, wire-nuts and cable ties as recommended for use by accessories manufacturers for type services indicated.
 - 5. Cord and Plug Connected Equipment: Where indicated, contractors shall provide a length of SO cord complete with a straight blade or twist-lock receptacle for connection of equipment. Cord and plug rating shall be suitable for the connected equipment load and rating of the branch circuit overcurrent protective device. Plug shall match receptacle configuration included on the plans and cord length shall be as required. Contractor shall connect cord to equipment.

2.04 MANUAL MOTOR STARTERS:

- A. Manual starters shall be flush-mounting type except where conduits are run exposed or as otherwise noted. Manual starters shall be complete with properly sized overload protection and neon pilot light. Manual starters shall be Square D Class 2510 or Allen-Bradley Bulletin 600 with stainless steel plates. Handles shall be lockable in open and closed position without modification.
- B. Heater units in all manual motor starters shall be sized for approximately 115 percent of full load motor current. Check and coordinate all thermal protective devices with the equipment they protect.

2.05 CIRCUIT AND MOTOR DISCONNECT SWITCHES:

- A. General: Provide circuit and motor disconnect switches in types, sizes, duties, features, ratings, and enclosures as indicated. All equipment with maximum fuse size listed in nameplate shall have fusible disconnect switch provided. Provide NEMA 1 enclosure. For outdoor switches and switches indicated as weatherproof, provide NEMA 3R enclosures with rain-tight hubs. For motor and motor starter disconnects, provide units with horsepower ratings suitable to the loads.
- B. Fusible Switches: Provide UL type "HD" 100 percent duty rated switches, with fuses of classes and current ratings indicated. Where current limiting fuses are indicated, provide switches with non-interchangeable feature suitable only for current limiting type fuses. All disconnect switches shall be fusible unless otherwise noted.
- C. Non-fusible Disconnects: Provide UL type "HD" 100 percent duty rated switches of classes and current ratings as indicated.
- D. Double-Throw Switches: Provide heavy duty switches of classes and current ratings as indicated.
- E. Switches for Classified (Hazardous) Locations: Provide heavy duty switches, with UL labels and listings for hazardous location classifications in which installed.
- F. Accessories:
 - 1. Electrical Interlocks: Provide number and arrangement of interlock contacts in switches as indicated or required.
 - 2. Special Enclosure Material: Provide special enclosure material as follows for switches indicated:
 - a. Stainless Steel Type 304: For NEMA Type 4.
 - b. Molded Fiberglass Reinforced Plastic: For NEMA Type 4x.
 - c. Heavy Cast Aluminum: For hazardous locations. NEMA Types 7 through 9.
 - 3. Handles shall be lockable in open and closed position without modification.
 - 4. Disconnect switches provided in the motor feeders between a VFD and the motor shall be provided with auxiliary contacts at the disconnect that de-energizes power to the VFD.

2.06 Motor Starters:

- A. See Division 23 for Requirements

2.07 AUXILIARY CONTROL DEVICES:

- A. Built in 120 volts control circuit transformer, fused from line side, where service exceeds 120 volts.

PART 3 - EXECUTION

3.01 INSPECTION:

- A. Inspect area and conditions under which electrical connections for equipment are to be installed and notify Contractor in writing of conditions detrimental to proper completion of the work. Do not proceed with the work until unsatisfactory conditions have been corrected in a manner acceptable to Installer.

3.02 INSTALLATION OF ELECTRICAL CONNECTIONS:

- A. Furnish, set in place, and wire (except as may be otherwise indicated) all heating, ventilating, air conditioning, plumbing and fire protection, elevator, etc., motors and controls in accordance with the following schedule and in accordance with equipment manufacturer's written instructions and with recognized industry practices, and complying with applicable requirements of UL, NEC and NECA's "Standard of Installation" to ensure that products fulfill requirements. Carefully coordinate with work performed under the Mechanical Division of these Specifications.
- B. Coordinate with other work, including wires/cables, raceway and equipment installation, as necessary to properly interface installation of electrical connections for equipment with other work.
- C. Connect electrical power supply conductors to equipment conductors in accordance with equipment manufacturer's written instructions and wiring diagrams. Mate and match conductors of electrical connections for proper interface between electrical power supplies and installed equipment.
- D. Maintain existing electrical service and feeders to equipment serving occupied areas and operational facilities, unless otherwise indicated, or when authorized otherwise in writing by Owner, or Architect/Engineer. Provide temporary service during interruptions to existing facilities. When necessary, schedule momentary outages for replacing existing wiring systems with new wiring systems. When that "cutting over" has been successfully accomplished, remove, relocate, or abandon existing wiring as indicated.
- E. Cover splices with electrical insulating material equivalent to, or of greater insulation resistivity rating, than electrical insulation rating of those conductors being spliced.
- F. Prepare cables and wires, by cutting and stripping covering armor, jacket, and insulation properly to ensure uniform and neat appearance where cables and wires are terminated. Exercise care to avoid cutting through tapes which will remain on conductors. Also avoid "ringing" copper conductors while skinning wire.
- G. Trim cables and wires as short as practicable and arrange routing to facilitate inspection, testing and maintenance.
- H. Tighten connectors and terminals, including screws and bolts, in accordance with equipment manufacturers published torque tightening values for equipment connectors. Accomplish

tightening by utilizing proper torqueing tools, including torque screwdriver, beam-type torque wrench, and ratchet wrench with adjustable torque settings. Where manufacturer's torqueing requirements are not available, tighten connectors and terminals to comply with torqueing values contained in UL's 486A.

- I. Install pre-finished cord set where connection with attachment plug is indicated or specified, or use attachment plug with suitable strain-relief clamps.
- J. Provide suitable strain relief clamps for cord connection to outlet boxes and equipment connection boxes.
- K. Make wiring connections in control panel or in wiring compartment of pre-wired equipment and interconnecting wiring in accordance with manufacturer's instructions.
- L. Install disconnect switches, controllers, control stations, and control devices such as limit switches and temperature switches as indicated or per manufacturer's instructions.
- M. Provide each motor with a fused disconnect switch for 3 phase motors and horsepower rated and/or thermal rated disconnect switch for single phase motors as shown on schedules or required. Coordinate with manufacturers of standalone, packaged and other equipment for factory installed and field installed motors and controllers.
- N. Provide circuit and motor disconnect switches as indicated and where required by Code. Comply with switch manufacturers printed installation instructions. Install within sight of motors.
- O. All splices in control panels, terminal junction boxes, low voltage control circuits and fire alarm conductors shall be on numbered terminal strip.
- P. Each branch circuit serving dedicated, isolated or emergency receptacles, multi-outlet assemblies or equipment connections shall be furnished with a dedicated neutral conductor. Neutrals common to more than one circuit shall only be permitted where specifically noted.
- Q. Where conduit is not required, plenum rated cable shall be provided in ceiling, floor or other air plenum spaces.
- R. Provide 4" concrete housekeeping pads for all floor mounted equipment.

3.03 FIELD QUALITY CONTROL:

- A. Upon completion of installation of electrical connections, and after circuitry has been energized with rated power source, test connections to demonstrate capability and compliance with requirements. Ensure that direction of rotation of each motor fulfills requirement. Correct malfunctioning units at site, then retest to demonstrate compliance.

3.04 EQUIPMENT CONNECTION SCHEDULES:

- A. Mechanical Equipment:
 - 1. Refer to Mechanical Equipment Schedule on the drawings.

2. It is suggested that all load voltage wiring shall be provided under Division 26.
3. Unless otherwise indicated, it is suggested that all equipment motors and control shall be furnished, set in place, and wired in accordance with the schedule contained herein. The exact furnishing and installation of the equipment is left to the Contractors involved. Contractor should note that the intent of this schedule is to have the Contractor responsible for coordinating all wiring as outlined, whether or not specifically called for by the Division 23 or Division 26 drawings and specifications. Comply with the applicable requirements of Division 26 for all electrical work which is not otherwise specified. No extras will be allowed for contractor's failure to provide for these required items. Contractor shall refer to the Division 26 and Division 23 specifications and plans for all power and control wiring and shall advise the Architect/Engineer of any discrepancies prior to bidding.

ITEM	FURNISHED BY	SET BY	CONTROL WIRING (non-load voltage)
1. Mechanical Equipment Motors	M	M	--
2. Special Equipment (i.e., elevators, etc.)			
a. Motors	G	G	--
b. Magnetic Motor Starters	G	E*	--
c. Disconnect Switches	E	E	--
d. Thermal OL Switches			
e. Manual Operating Switches			
3. Motor Starters, combination motor starter/disconnect and Variable Frequency Drives			
a. Automatically controlled, with or without HOA switches.	M	E*	M
b. Manually controlled.	M	E*	--
c. Starters integral with motor control center including control relays and transformers.	E	E	--
d. Combination Starter/Disconnects	M	E*	M
4. Pushbutton stations, pilot lights	M	E*	M
5. Disconnect switches, thermal overload switches, manual operating switches.	E	E*	M
6. Multi-speed switches	M	E*	M
7. Control relays, transformers.	M	M	M
8. Load voltage control items such as line voltage thermostats not connected to control panel systems.	M	M	E
9. Non-load voltage control items.	M	M	M
10. Electric thermostats, remote bulb thermostats, motor valves, float controls, etc., which are an integral part of mechanical equipment or directly attached to ducts, pipes, etc.	M	M	M

ITEM	FURNISHED BY	SET BY	CONTROL WIRING (non-load voltage)
11. Motor valves, damper motor, solenoid valves, EP and PE switches, VAV box controls, actuators, etc.	M	M	M**
12. Control circuit outlets	E	E	--
a. Load voltage control items such as line voltage thermostats not connected to control panel systems.	M	M	E
b. Non-load voltage control items.	M	M	M
c. Electric thermostats, remote bulb thermostats, motor valves, float controls, etc., which are an integral part of mechanical equipment or directly attached to ducts, pipes, etc.	M	M	M
d. Motor valves, damper motor, solenoid valves, EP and PE switches, VAV box controls, actuators, etc.	M	M	M**
e. Control circuit outlets	E	E	--
13. Load voltage control items such as line voltage thermostats not connected to control panel systems.	M	M	E
14. Non-load voltage control items.	M	M	M
15. Electric thermostats, remote bulb thermostats, motor valves, float controls, etc., which are an integral part of mechanical equipment or directly attached to ducts, pipes, etc.	M	M	M
16. Motor valves, damper motor, solenoid valves, EP and PE switches, VAV box controls, actuators, etc.	M	M	M**
17. Control circuit outlets	E	E	--
18. Load voltage control items such as line voltage thermostats not connected to control panel systems.	M	M	E
19. Non-load voltage control items.	M	M	M
20. Fire protection controls (Including flow switches)	M	M	M**
21. Duct smoke detectors, including relays for fan shutdown.	E	M	M**
22. Temperature Control Panel	M	M	M
23. Interlocks	M	M	M

G = General, Division 13 or 14
 M = Mechanical, Division 23
 E = Electrical, Division 26

- * For factory pre-wired equipment specified under other Divisions, all wiring within the equipment shall be by the manufacturer. All required field wiring between sections or other field connection details for power and/or control shall be clearly identified on shop drawings for contractor installation. Division 26 drawings show the provided electrical characteristics for equipment.

Manufacturer's equipment provided under other divisions which varies from what is shown on Division 26 drawings shall be the responsibility of the Contractor to complete and pay for any costs for those variations.
- ** Fire alarm system control modules and wiring from fire alarm contacts to fire alarm system shall be installed by Fire Alarm system installer and match other components of the system. Refer to Division 28. See details.
- *** Integral control wiring under Electrical Division as manufacturer supplied equipment. Control wiring for automatic control portion under Mechanical Division.

END OF SECTION 26 0583

SECTION 26 0923 - LIGHTING CONTROL DEVICES

PART 1 - GENERAL

1.01 SUMMARY:

- A. Extent of lighting control equipment work is indicated by drawings and schedules, and is hereby defined to include, but not by way of limitation, programmable controllers, data equipment, relays, switches, control wiring, and ancillary equipment.
- B. Types of lighting control equipment specified in this section include the following:
 - 1. Digital Programmable Lighting Controls
 - 2. Occupancy Sensors
 - 3. Time controlled switches
 - 4. Emergency Shunt Relays
 - 5. Photoelectric Relays
- C. Refer to other Division-26 sections for wires/cables, electrical boxes and fittings and wiring devices which are required in conjunction with lighting control equipment work.

1.02 SUBMITTALS:

- A. See Section 26 0500 Common Work Results for Electrical for Submittal requirements. Supplemental information is listed within this section.
- B. Shop Drawings: Submit layout drawings of lighting control equipment and components including, but not necessarily limited to, programmable controllers, manual override switches and stations, occupancy/vacancy sensors, dimmers, dimmer system components, daylight sensors, transceivers, printers, relays and other switches and equipment. Drawings shall show locations and associated addresses of all devices and equipment. In addition, show spatial relationship of lighting control equipment to other electrical equipment in proximity. List and verify that design sequence of operation and programmability including initial sensor/programed on/off times, override control settings, etc., have been provided for each lighting control zone.
- C. Submit lists of Driver and LED combinations compatible with dimmer systems, by manufacturer and catalog number.
- D. Wiring Diagrams: Submit wiring diagrams for lighting control equipment and components showing control and interconnection wiring, include connections to equipment components and electrical power feeders. Differentiate between portions of wiring that are manufacturer-installed and portions that are field-installed. Provide a voltage drop calculation for network cabling to verify EOL voltage compliance.
- E. Coordination Drawings: Submit evidence that lighting controls and devices are compatible with connected monitoring and control devices. Show interconnecting signal and control wiring and interfacing devices that prove compatibility of inputs and outputs. For networked controls, list

network protocols and provide statements from manufacturers that input and output devices meet interoperability requirements of the network protocol.

- F. Agreement to Maintain: Prior to time of final acceptance, the Installer shall submit an agreement for continued service and maintenance of lighting control equipment, for Owner's possible acceptance. Offer terms and conditions for furnishing parts and providing continued testing and servicing, including replacement of materials and equipment, for one year period with option for renewal of Agreement by Owner.
- G. Maintenance Manuals: Ensure manual includes operating instructions in addition to instructions for maintenance of the system's software package.
- H. Software licenses and upgrades required by and installed for operation and programming of digital and analog devices.
- I. Commissioning Report: Submit Preliminary and Final Commissioning Report for all Lighting Control Equipment. Preliminary report shall be submitted no later than 90 days of the date of receipt of the certificate of occupancy. Reports shall be organized and include information as required by the current edition of the IECC-International Energy Conservation Code.

1.03 QUALITY ASSURANCE:

- A. Manufacturer's Qualifications: Firms regularly engaged in manufacture of lighting control equipment and ancillary equipment, of types, ratings and capacities required, whose products have been in satisfactory use in similar service for not less than 5 years.
- B. Installer's Qualifications: Firm with at least 5 years of successful installation experience on projects with lighting control equipment work similar to that required for this project.
- C. Agreement to Maintain: Engage Installer who is willing to execute with the Owner, required agreement for continued maintenance of lighting control equipment.
- D. FCC Compliance: Comply with Part 68 of Federal Communications Commission Rules pertaining to telephone equipment registration by manufacturer.
 - 1. Provide telephone equipment with FCC labels indicating applicable FCC registration and numbering of equipment.
- E. Codes and Standards:
 - 1. Energy Code Compliance: Meet the requirements of the current edition of the IECC-International Energy Conservation Code. In addition, meet any additional requirements of the Local AHJ-Authority Having Jurisdiction.
 - 2. Electrical Code Compliance: Comply with applicable local electrical code requirements of the authority having jurisdiction and NEC as applicable to construction, installation of lighting control and communications equipment.
 - 3. Control wiring shall be in accordance with the NEC requirements for Class 2 remote control systems, Article 725 and manufacturer specification.
 - 4. UL Compliance: Comply with applicable requirements of UL Std. 486A, "Wire Connectors and Soldering Lugs for Use with Copper Conductors." Provide lighting control equipment

and components which are UL-listed and labeled. Lighting control panels shall be UL 916 and UL 924 Listed.

5. NEMA Compliance: Comply with applicable requirements of NEMA's Std. Pub No. 250, "Enclosures for Electrical Equipment (1000-Volts Maximum)."
6. EIA Compliance: Comply with applicable requirements of Electronic Industries Association standards pertaining to telephone and electronic systems.

1.04 DELIVERY, STORAGE AND HANDLING:

- A. Deliver lighting control equipment and components in factory-fabricated type containers or wrappings, which properly protect equipment from damage.
- B. Store lighting control equipment in original packaging and protect from weather and construction traffic. Wherever possible, store indoors; where necessary to store outdoors, store above grade and enclose with watertight wrapping.
- C. Handle lighting control equipment carefully to prevent physical damage to equipment and components. Do not install damaged equipment; remove from site and replace damaged equipment with new.

1.05 EXTRA MATERIALS

- A. Furnish extra materials described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 1. Electrically Held Relays: Equal to 5% of amount installed.
 2. Occupancy/Vacancy Sensors: Equal to 5% of the amount installed for each type.

PART 2 - PRODUCTS

2.01 MANUFACTURERS:

- A. Manufacturers: Subject to compliance with requirements, provide lighting control equipment of one of the following (for each type and rating of equipment):
 1. Digital programmable lighting controls:
 - a. Lighting Control & Design, Inc.
 - b. Wattstopper (The)
 - c. Sensor Switch
 - d. Encelium
 - e. Douglas
 - f. Leviton
 2. Occupancy/Vacancy Sensors:
 - a. Sensor Switch
 - b. Leviton
 - c. Lutron
 - d. Hubbell
 - e. WattStopper (The)
 3. Time Controlled Switches:

- a. WattStopper (The)
 - b. Leviton
 - c. Lutron
 - d. Hubbell
4. Automatic Load Control Relays (ALCR) and Emergency Shunt Relays (ESR):
- a. WattStopper (The)
 - b. LVS

2.02 digital programmable LIGHTING CONTROLS:

- A. General: Provide factory-fabricated lighting control equipment and ancillary components of sizes, types, ratings and electrical characteristics indicated; consisting of programmable controllers, data equipment, relays, switches, control wiring, interfaces to dimming systems, and interfaces to building management systems which comply with manufacturer's standard design, materials and components; and construct in accordance with published product information for duty indicated, and as required for a complete installation.
- B. Expandability: System shall be capable of increasing the number of control functions in the future by 100 percent of current capacity; to include equipment ratings, housing capacities, spare relays, terminals, number of conductors in control cables, and control software.
- C. Performance Requirements: Manual switches, an internal timing and control unit, and external sensors or other control signal sources send a signal to a programmable-system control module that processes the signal according to its programming and routes an open or close command to one or more relays in the power-supply circuits, or routes variable commands to one or more dimmers, for groups of lighting fixtures or other loads.
- D. Programmable Lighting Controller Description: Programmable, unit with graphic display and programming of system status and to override relay status; and to display status of local override controls and diagnostic information.
 1. Interoperability:
 - a. Controller shall be configured to connect to a BACnet-compliant network, resulting in extending control to any network-compliant devices such as occupancy/vacancy switches.
 - b. Mechanical Controls Interface: Where indicated, occupancy sensors within a control zone shall send occupied state or unoccupied state information to BAS, associated Network, or individual room equipment as identified by Mechanical Controls Contractor.
 - 1) Provide all necessary interface components to allow the lighting control system and BAS/Network/Equipment to seamlessly communicate.
 2. System Memory: Nonvolatile. System shall reboot program and reset time automatically without errors after power outages up to 90 days' duration.
 3. Software: Lighting control software shall be capable of linking switch inputs to relay outputs, retrieving links, viewing relay output status, controlling relay outputs, simulating switch inputs, setting device addresses, and assigning switch input and relay output modes.

4. Automatic Time Adjustment: System shall synchronize to real time through internet protocol, shall automatically adjust for leap year with manual time and date of adjustment selection, shall automatically adjust for daylight saving time with manual ON/OFF for this feature, and shall provide Time Controls utilizing 7 Day clock with minimum 7 different day times per week, and programmable auto Holiday "shutoff".
 5. Astronomic Control: Automatic adjustment of dawn and dusk switching based on exterior photoelectric sensor control.
 6. Automatic battery backup shall provide power to maintain program and system clock operation for 3 days' minimum duration when power is off.
 7. Flick Warning: Programmable momentary turnoff of lights shall warn that programmed shutoff will occur after a preset interval. Warning shall be repeated after a second preset interval before end of programmed override period.
 8. Diagnostics: When system operates improperly, software shall initiate factory-programmed diagnosis of failure and display messages identifying problem and possible causes.
 9. Automatic Control: System capable of activating building areas into user dictated pattern of ON-OFF array of relays, according to either weekly schedule divided into one-minute increments, or two one-day schedules.
 10. Automatic Control of Local Override: Automatic control shall switch lighting off if lighting has been switched on by local override. Utilize "Flick Warning" where indicated.
 11. Manual Controls: System capable of activating each lighting zone or single groups of relays ON-OFF with a momentary switch; Provide prioritization of manual controls.
 12. Manual Lockout: System capable of selecting, activating and locking-in any lighting pattern from central controller, and locking-out manual and automatic commands.
- E. Manual Switches and Plates
1. Switches: Provide momentary toggle type ON-OFF switches with spring return to center position; and as recommended by lighting systems manufacturer for services indicated. An integral pilot light shall indicate the status of circuit.
 2. Legend: Engraved or permanently silk-screened on wall plate where indicated. Use designations indicated on Drawings.
- F. Relays: Provide relays for control of inductive loads of 20 amperes at 120-volts, 50 to 60 Hz, as recommended by lighting systems manufacturer for services indicated.
- 2.03 Occupancy/vacancy Sensors:
- A. Wall or ceiling-mounting, solid-state units with a separate relay unit.
1. Passive Infrared, Ultrasonic, Microphonic, or Dual Technology. Provide Dual Technology Devices unless otherwise shown. Spacing and coverage per the manufacturer's recommendations.
 2. Unless otherwise indicated, turn lights on when covered area is occupied and off when unoccupied; with a time delay for turning lights off, adjustable over a minimum range of 1 to 30 minutes.
 3. Sensor Output: Contacts rated to operate the connected relay, complying with UL 773A. Sensor shall be powered from the relay unit.
 4. Relay Unit: Dry contacts rated for 20-A ballast/driver load at 120- and 277-V ac.

5. Indicator: LED, to show when motion is being detected during testing and normal operation of the sensor.
6. Bypass Switch: Override the on function in case of sensor failure.

2.04 MANUAL MODULAR DIMMING SYSTEMS:

1. Factory-fabricated equipment providing 1 to 4 channels of manual dimming control as indicated. Common on-off switching and components into a 2- or 3-gang wall box under a single flush wall plate.
2. System to be listed for control of the type of lighting unit used.
3. Unit to be rated at 1900 watts, minimum with each dimming channel rated 600 watts, minimum.

2.05 TIME CONTROLLED SWITCHES:

- A. Provide solid state programmable unit with alphanumeric display capable of periodically and automatically switching indoor and outdoor lamps both ON and OFF. Select switches with 7 Day clock which permits selection of at least 7 ON-OFF operations each day and allows timing durations of 1 to 24 hours; with ratings of 125-volts, 60 Hz, and with SPST switch of 40-amperes per pole. Provide indoor-outdoor mount enclosure, NEMA Type 3, with side hinged door and lock, mounting holes and knockouts; construct enclosure of 0.036" drawn steel. Provide timing switch with manual circuit by-pass switch and separate grounding terminal. Finish enclosure with manufacturer's standard gray finish.

2.06 Automatic Load Control Relays (ALCR)/ EMERGENCY Shunt relay UNITS (ESR):

- A. Self-contained ALCR/ESR units shall comply with and be listed under UL 924.
 1. Operation: Normally-closed electrically-held relay to be wired in parallel with control switch/relay. Relay automatically turns lamp on when power supply circuit voltage drops to 80 percent of nominal voltage or below. Unless otherwise indicated ALCR/ESR shall control as follows:
 - a. Emergency luminaires shown in rooms with other switched luminaires (Not indicated "NL" (night light) and/or connected to an always on emergency circuit) provide ALCR/ESR to allow indicated control of all luminaires in space. Provide room controller or other devices necessary to accommodate dimming and other control equipment and requirements. Emergency lights in space shall be brought to full brightness from emergency circuit whenever the normal circuit serving the room loses voltage. Sensing from panelboard feeders is not acceptable; sensing shall be accomplished at the branch circuit level. Normal lighting and controls shall be restored automatically when normal power is available.
 - b. Egress lighting shall meet requirements of NFPA 101.
 2. Test Push Button: Push-to-test type, in unit housing, simulates loss of normal power and demonstrates unit operability.
 3. LED Indicator Light: Indicates status of normal and emergency power.

2.07 PHOTOELECTRIC SENSORS:

- A. Ceiling-Mounted Photoelectric Switch: Solid-state, light-level sensor unit, with separate relay unit, to detect changes in lighting levels that are perceived by the eye. Cadmium sulfide photo-resistors are not acceptable.
 - 1. Sensor Output: Contacts rated to operate the associated relay, complying with UL 773A. Sensor shall be powered from the relay unit.
 - 2. Light-Level Monitoring Range: 10 to 1000 fc with an adjustment for turn-on and turn-off levels within that range.
 - 3. Time Delay: Adjustable from 5 to 300 seconds to prevent cycling, with dead-band adjustment.

- B. Outdoor Photoelectric Switch: Solid-state, light-level sensor unit to detect changes in lighting levels that are perceived by the eye.
 - 1. Light-Level Monitoring Range: 1.5 to 10 fc with an adjustment for turn-on and turn-off levels within that range.
 - 2. Time Delay: 30 second minimum to prevent cycling, with dead-band adjustment.
 - 3. Surge Protection: Metal-oxide varistor, complying with IEEE requirements for Category A1 locations.
 - 4. Mounting: Twist lock complying with IEEE C136.10, with base-and-stem mounting or stem-and-swivel mounting accessories as required to direct sensor to the north sky exposure.

2.08 Wireless Equipment:

- A. Wireless equipment and equipment containing batteries shall only be allowed where specifically shown or indicated.

PART 3 - EXECUTION

3.01 EXAMINATION:

- A. Examine areas and conditions under which lighting control equipment is to be installed and notify Contractor in writing of conditions detrimental to proper completion of the work. Do not proceed with the work until unsatisfactory conditions have been corrected in a manner acceptable to the Installer.

3.02 INSTALLATION OF LIGHTING CONTROL EQUIPMENT:

- A. Install lighting control system components and ancillary equipment as indicated, in accordance with equipment manufacturer's written instructions, and with recognized industry practices, to ensure that lighting control equipment complies with requirements. Comply with requirements of NEC, and applicable portions of NECA's "Standard of Installation" pertaining to general electrical installation practices.

- B. Low voltage control wiring terminations shall be made within electrical boxes.

- C. Coordinate with other electrical work, including raceways, and electrical boxes and fittings, as necessary to interface installation of lighting control equipment work with other work.
- D. Tighten electrical connectors and terminals, including screws and bolts, in accordance with equipment manufacturer's published torque tightening values for equipment connectors. Where manufacturer's torqueing requirements are not indicated, tighten connectors and terminals to comply with tightening torques specified in UL Std. 486A and B.
- E. Co-locate equipment as much as practical for ease of maintenance.
- F. Provide hardwired connections to each device, controller, sensor, etc. for control connections.

3.03 GROUNDING:

- A. Provide equipment grounding connections for lighting control equipment as indicated. Tighten connectors to comply with tightening torques specified in UL Std. 486A to assure permanent and effective grounding.

3.04 FIELD QUALITY CONTROL:

- A. Upon completion of installation and after circuitry has been energized, demonstrate capability and compliance of system with requirements. Where possible, correct malfunctioning units at site, then retest to demonstrate compliance; otherwise, remove and replace with new units, and proceed with retesting. Testing and retesting at no cost to Owner.
- B. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust all field-assembled components and equipment installation, including connections, and assist in field testing. Report results in writing with commissioning report.
- C. Perform the following field tests and inspections for each piece of equipment and each device and prepare test reports:
 - 1. Test for circuit continuity.
 - 2. Verify that the control module features are operational.
 - 3. Check operation of local override controls.
 - 4. Test system diagnostics by simulating improper operation of several components selected by facilities.
- D. Install and program software with initial settings of adjustable values. Make backup copies of software and user-supplied values and submit settings list with Testing and Equipment Settings Report. Provide current licenses for software in O&M manuals.
- E. Commissioning Report: Provide Commissioning services required to provide Preliminary and Final Commissioning Report for all Lighting Control Equipment. Preliminary report shall be submitted no later than 90 days of the date of receipt of the certificate of occupancy. Testing and Reports shall be organized and include information as required by the current edition of the IECC.

- F. Testing and training shall be provided at times scheduled with the owner and may need to be done off hours.

3.05 PERSONNEL TRAINING:

- A. Manufacturer's Field Service indicated above shall include Owner's maintenance personnel.
- B. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain lighting controls and software.
- C. Provide extra scheduled time with owner to make corrections to the system to meet the functionality/time control requirements desired by the owner. Record any changes in the Testing and Equipment Settings Report and submit final documents.

END OF SECTION 26 0923

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SECTION 26 2413 - SWITCHBOARDS

PART 1 - GENERAL

1.01 SUMMARY:

- A. This Section includes low-voltage power service and distribution switchboards and associated auxiliary equipment rated 600 V or less.

1.02 SUBMITTALS:

- A. See Section 26 0500 Common Work Results for Electrical for Submittal requirements. Supplemental information is listed within this section.
- B. Product data for each product and component specified.
- C. Shop drawings for each switchboard including dimensioned plans and elevations, component and device lists, and a single-line diagram showing main and branch bus current ratings and continuous and short-circuit ratings of switchboard.
- D. Shop drawings or other descriptive documentation of optional barriers specified for electrical insulation and isolation. Show front and side views of enclosures with dimensions; conduit entrance locations and requirements; nameplate legends, size and number of bus bars per phase, neutral, and ground; switchboard instrument details; instructions for handling and installation; voltage, frame size and trip ratings, withstand ratings, and time-current curves of all equipment and components, including fuses and breakers provided.
- E. Shop drawings of utility company metering provisions with indication of approval by utility company.
- F. Schedule of features, characteristics, ratings, and factory settings of individual protective devices.
- G. Manufacturer's Schematic Wiring Diagram.
- H. Point-to-Point Control Wiring Diagram: Differentiating between manufacturer-installed and field-installed wiring (may be submitted upon delivery of switchboard).
- I. Maintenance Data: Submit operation and maintenance data, schedule of recommended service and parts lists for materials and products. Include this data, product data, shop drawings, record drawings, and wiring diagrams in maintenance manual in accordance with requirements of applicable Division 26 Sections and Division 1.

1.03 QUALITY ASSURANCE:

- A. Listing and Labeling: Provide switchboard assemblies that are listed and labeled.
 - 1. The terms "listed" and "labeled": As defined in the National Electrical Code, Article 100.

- B. Product Selection for Restricted Space: The Drawings indicate maximum dimensions for switchboard equipment including clearances between switchboard and adjacent surfaces and items. Switchboards having equal performance characteristics and complying with indicated maximum dimensions may be considered.
- C. Manufacturer's Qualifications: Firms regularly engaged in the manufacture of switchboards, of types, sizes and capacities required, and whose products have been in satisfactory use in similar service for not less than 5 years.
- D. Installer's Qualifications: Firm with at least 5 years of successful installation experience on project utilizing switchboard units similar to that required for this project.

1.04 DELIVERY, STORAGE, AND HANDLING:

- A. Deliver switchboards and components properly packaged and mounted on pallets, or skids to facilitate handling of heavy items. Utilize factory-fabricated handling of heavy items. Utilize factory-fabricated type containers or wrapping for switchboards and components which protect equipment from damage. Inspect equipment to ensure that no damage has occurred during shipment.
- B. Deliver in shipping splits of lengths that can be moved past obstructions in delivery path as indicated.
- C. Store switchboard equipment in original packaging and protect from weather and construction traffic. Wherever possible, store indoors; where necessary to store outdoors, store above grade and enclose with watertight wrapping. Store so condensation will not occur on or in switchboards. Provide temporary heaters as required to assure avoiding condensation.
- D. Handle switchboard equipment carefully to prevent physical damage to equipment and components. Remove packaging, including the opening of crates and containers, avoiding the use of excessive hammering and jarring which would damage the electrical equipment contained therein. Do not install damaged equipment; remove from site and replace damaged equipment with new.

1.05 EXTRA MATERIALS:

- A. Touch-Up Paint: Furnish 3 half-pint containers.

1.06 SEQUENCING AND SCHEDULING:

- A. Schedule delivery of switchboard equipment which permits ready building ingress for large equipment components to their designated installation spaces. Coordinate delivery of equipment with the installation of other building components.
- B. Coordinate the size and location of concrete equipment pads.
- C. Coordinate with other electrical work including raceways, electrical boxes and fittings, and cabling/wiring, as necessary to interface installation of switchboards.

PART 2 - PRODUCTS

2.01 MANUFACTURERS:

- A. Manufacturers: Subject to compliance with requirements, provide products by the following:
 - 1. General Electric Co.
 - 2. Square D Co.
 - 3. Siemens Energy & Automation, Inc.
 - 4. Eaton

2.02 SWITCHBOARDS, GENERAL:

- A. Description: Front-connected, front-accessible, with fixed, individually mounted main device, panel-mounted branches, and sections rear aligned. Dead front, metal enclosed, self-supporting and conforming to NEMA PB2.
- B. Barriers: Between adjacent switchboard sections.

2.03 FABRICATION AND FEATURES:

- A. Enclosure: Steel. NEMA 1.
- B. Enclosure Finish for Indoor Units: Manufacture standard gray finish over a rust inhibiting primer on phosphatizing treated metal surface. Provide painted surfaces that conform to IEEE C37.20.1, "Standard for Metal-Enclosed Low-Voltage Power Circuit Breaker Switchgear."
- C. Hinged Front Panels: Provide to allow access to breaker, metering, accessory, and blank compartments.
- D. Pull Box on Top of Switchboard: Provide where indicated or where required by installation conditions, and include the following features:
 - 1. Adequate ventilation to maintain air temperature in pull box within same limits as switchboard.
- E. Buses and Connections: Three-phase, four-wire except as otherwise indicated. Features as follows:
 - 1. Phase and Neutral Bus Material: Hard-drawn copper, 98 percent conductivity with copper feeder circuit-breaker line connections. Where specifically shown on the drawings provide 1350 Aluminum, 61% conductivity with aluminum/copper feeder circuit-breaker line connections. Horizontal cross busses throughout shall be non-tapered – 100 percent rated. Size bus in accordance with NEMA PB2.
 - 2. Contact Surfaces of Buses: Tin plated for copper bus, Tin or copper plated for aluminum bus.
 - 3. Main Phase Buses, Neutral Bus, and Equipment Ground Bus: Uniform capacity the entire length of the switchboard main and distribution sections. Provide for future extensions from either end by means of bolt holes or other approved method and connecting links.
 - 4. Neutral Buses: 100 percent of the ampacity of the phase buses except as indicated.

5. Ground Bus: 1/4 inch by 2 inch minimum size, hard-drawn copper of 98 percent conductivity
 6. Provide two bolt CU/AL Mechanical Lugs for all incoming and outgoing feeders including neutral and ground connections.
 7. Provide for any outgoing or incoming bus or cabling as required for each breaker space (i.e. all spares, spaces, and utilized).
- F. Supports and Bracing for Buses: Adequate strength for indicated short-circuit currents. Busses shall be bolted with access for future torque maintenance.
- G. Provide four (4) spare two-hole CU/AL lugs for #2 AWG through #4/0 AWG conductors on load side of main circuit breakers.
- H. Provide lugs on load side of distribution device (breakers, switches, etc.), including neutral and ground lugs, as shown on the drawings and as necessary to meet or exceed capacity of OCPD.
- I. Provide internal bussing to output lugs or bus flange for each spare breaker provided. All spare cells shall be wired complete to match other cells being utilized. Provide output lugs or bus flange for each spare. Provide lugs unless flange is specifically noted.
- J. Barriers: Provide between adjacent switchboard sections.
- 2.04 OVERCURRENT PROTECTIVE DEVICES (OCPDs):
- A. Comply with requirements of Division 26 Section on Overcurrent Protective Devices for types of OCPDs indicated. Provide indicated features, ratings, characteristics, and settings.
- B. Future Devices: Where provision for future overcurrent protective devices or space is indicated, equip compartments with mounting brackets, supports, bus connections, and necessary appurtenances, designed for the OCPD types and ampere ratings indicated for future installation of devices.
- 2.05 OTHER CIRCUIT CONTROL AND PROTECTIVE DEVICES:
- A. General: Factory-installed and -tested devices of types listed below, with indicated ratings, settings, and features.
- B. Control Power: Where electrically operated/ shunt tripped circuit breakers/or other control power functions are required, provide 120 volt control circuits supplied through secondary disconnect devices from a control power transformer. Include the following features:
1. Control Power Transformers: Dry type. Separate compartments for units larger than 3 KVA and their fuses.
 2. Provide two control power transformers in separate compartments with necessary interlocking relays. Connect the primary of each control power transformer at the line side of the associated main circuit breaker. Connect the 120 volt secondary's through a relay or relays as a control bus.
 3. Control Power Fuses: Include primary and secondary fuses for current-limiting and overload protection.

4. Provide control power disconnecting means on line side of transformer.
 5. Provide control fuse status indication on front and contacts for remote alarm.
- C. SPD: Provide surge protective device for switchboards where required and/or indicated on the drawings. Refer to Division 26 Section - "Surge Protective Device" for requirements.
- 2.06 RATINGS:
- A. Provide nominal system voltage, continuous main bus amperage, and short-circuit-current ratings as indicated on the drawings.
- 2.07 IDENTIFICATION:
- A. General: Refer to Division 26 section on Electrical Identification. Identify units, devices, controls, and wiring with factory-applied labels and signs.
 - B. Compartment Nameplates: Engraved laminated plastic or metal nameplate for each compartment, mounted with corrosion-resistant screws.
 - C. UL nameplates shall be provided for all switchboards. Information shall include, but not be limited to, manufacturer, model number, serial number, plant or manufacturing location, ampere rating, voltage rating, wire and phase identification and bus short circuit bracing rating.

PART 3 - EXECUTION

- 3.01 INSTALLATION:
- A. General: Install switchboards and accessory items in accordance with manufacturers' written installation instructions and the following specifications:
 - B. Anchor each switchboard assembly to the leveled concrete base in accordance with manufacturer's recommendations. Attach by bolting using minimum of 3/8 inch bolts. Meet appropriate seismic zone requirements.
 - C. Temporary Lifting Provisions: Remove temporary lifting eyes, channels, and brackets and temporary blocking of moving parts from switchboard units and components.
 - D. Operating Instructions: Frame and mount printed, basic operating instructions. Include building main one line diagram for switchboards, including control and key interlocking sequences, and emergency procedures. Include building main one-line diagram. Fabricate frame and cover with clear acrylic plastic. Frame shall be open at the tope for easy removal of drawings for use and updating. Mount on the front of the switchboards.
- 3.02 IDENTIFICATION:
- A. Identify field-installed wiring and components and provide warning signs as specified in Division 26 section on Electrical Identification.

3.03 GROUNDING:

- A. Connections: As indicated. Tighten connections to comply with tightening torques specified in UL 486A and 486B.

3.04 CONNECTIONS:

- A. Tighten switchboard bus joint bolts and electrical connector and terminal bolts in accordance with manufacturer's published torque-tightening values. Where manufacturer's torque values are not stated, use those specified in UL 486A for copper and UL 486B for aluminum.

3.05 FIELD QUALITY CONTROL:

- A. General: Comply with applicable standards of the National Electrical Testing Association (NETA) including Standard ATS, "Acceptance Testing Specifications for Electrical Power Distribution Equipment and Systems."
- B. Manufacturers Field Testing and Start-Up: Manufacturer shall have NETA certified technician perform the following quality control testing, visual and mechanical inspections, electrical tests, and tests of the switchboard.
 - 1. Pretesting: Upon completing installation of the system, perform manufacturer's recommended testing, NETA testing, and the following preparations for tests:
 - a. Make insulation resistance tests of connecting supply, feeder and control circuits.
 - b. Make continuity tests of circuits.
 - c. Provide set of Record Documents. Include full updating on final system configuration and parameters where they supplement or differ from those indicated in original Contract Documents.
 - d. Provide manufacturer's instructions for installation and testing of switchboard assembly to Owner and Engineer.
 - e. Visual inspection of all factory and field wiring for proper live bus clearance and secured for fault currents.
 - 2. Quality Control Testing Program: Conform to the following:
 - a. Test Objectives: To assure switchboard installation meets specified requirements, is operational within specified tolerances, provides appropriate protection for system and equipment, and is suitable for energizing.
 - b. Procedures: Make field tests and inspections and prepare switchboard assemblies for satisfactory operation in accordance with NETA Standard ATS ("Acceptance Testing Specifications for Electrical Power, Distribution Equipment and Systems") applicable IEEE standards, manufacturer's recommendations, and these specifications.
 - c. Schedule tests and provide notification at least one week in advance of test commencement.
 - d. Reports: Prepare written reports of test results and observations. Report defective materials and workmanship. Include complete records of repairs and adjustments.
 - e. Labeling: Upon satisfactory completion of tests and related effort, apply a label to tested components indicated test results, date, and responsible person and organization.

- f. Visual and Mechanical Inspection: Include the following inspections and related work:
- 1) Inspect, for defects and physical damage, testing laboratory labels and nameplate compliance with current single-line diagrams. Verify smooth and proper operation of all doors, hinges, handles, latches, etc. Correct or replace as determined necessary by the Owner/Engineer.
 - 2) Verify that current transformers, potential transformers, and fuses meet specified requirements. Verify relays, meters, and instrumentation are checked and all connections are made properly. Introduce accurately metered currents and/or voltages to relays and other devices which will enable accurate determination of the tripping or activation characteristics.
 - 3) Perform mechanical operational tests in accordance with manufacturer's instruction manual. Manually exercise each operating mechanism, switches, circuit breakers, etc.
 - 4) Check switchgear anchorage, area clearances, and alignment and fit of draw-out components in compartments. Verify switchboard, switchboard supports and attachments are designed and installed for appropriate seismic zone.
 - 5) Check tightness of bolted electrical connections with calibrated torque wrench. Refer to manufacturer's instructions for proper torque values.
 - 6) Clean switchboard assembly using manufacturer's approved methods and materials.
- g. Electrical Tests: Include the following items performed in accordance with manufacturer's instruction:
- 1) Insulation resistance test of buses and portions of control wiring that disconnect from solid-state devices through normal disconnecting features. Insulation resistance less than 100 megohms is not acceptable. Tests shall be made phase to phase, phase to neutral, and phase to ground with switches in the open and closed positions.
 - 2) Ratio and polarity tests on current and voltage transformers, not integral with overcurrent protective devices.
 - 3) Ground resistance test on system and equipment ground connections.
 - 4) Calibration of ammeters and voltmeters at midscale.
 - 5) Verify appropriate capacity, overcurrent protection, and operating voltage of control power elements including control power transformer and control power wiring.
 - 6) Calibrate watt-hour and demand meters to 0.5 percent, and verify meter multipliers.
 - 7) Provide operational test of each automatic breaker, alarm and indication. Provide manual tests initially and proceed to full automatic testing that tests each manual and automatic function, sequence and scenario. Verify and document each sequence including interlock, relay, etc. operation.
 - 8) Tests of Overcurrent Protective Devices: Testing of overcurrent protective devices shall be conducted according to procedures outlined in overcurrent protective devices specification section.

- 9) Provide complete individual and system testing of ground fault devices and system.
 - h. Retesting: Correct deficiencies identified by tests and observations and retest switchboards. Verify by the retests that switchboards meet specified requirements.
- C. Provide Operating and Maintenance Instructions in electronic format covering all equipment furnished. Manuals shall include the following information:
- 1. Name, address and telephone number of authorized service organization to be contacted for each equipment item.
 - 2. Parts list and wiring diagram, operating and maintenance instructions for each piece of equipment.
 - 3. Record Set of Shop Drawings: Shop drawings corrected to show as-built conditions. Transfer modifications from field set.
 - 4. All wiring diagrams shall show color coding of all connections and mounting dimensions of equipment.
 - 5. Provide Testing and Equipment Settings Report for each device indicating final configurations and settings.
- 3.06 CLEANING:
- A. Upon completion of installation, inspect interior and exterior of switchboards. Remove paint splatters and other spots, dirt, and debris. Touch up scratches and mars of finish to match original finish.
- 3.07 PROTECTION:
- A. Temporary Heating: Apply temporary heat in accordance with manufacturer's recommendation within each section of switchboards throughout periods during which the switchboard is not in a space that is continuously under normal control of temperature and humidity.
- 3.08 DEMONSTRATION:
- A. Training: Demonstrate and test switchboards and train Owner's maintenance personnel
 - 1. Schedule training with at least seven days advance notification

END OF SECTION 26 2413

SECTION 26 2416 - PANELBOARDS

PART 1 - GENERAL

1.01 SUMMARY:

- A. This Section includes lighting and power panelboards and associated auxiliary equipment rated 600 V or less.

1.02 DEFINITIONS:

- A. Overcurrent Protective Device (OCPD): A device operative on excessive current that causes and maintains the interruption of power in the circuit it protects.

1.03 SUBMITTALS:

- A. See Section 26 0500 Common Work Results for Electrical for Submittal requirements. Supplemental information is listed within this section.
- B. Shop drawings from manufacturers of panelboards including dimensional data. Show tabulations of installed devices, major features, and voltage rating. Include the following:
 - 1. Enclosure type with details for types other than NEMA Type 1.
 - 2. Bus configuration and current ratings.
 - 3. Short circuit current rating of panelboard and circuit breakers.
 - 4. Features, characteristics, ratings, and factory settings of individual protective devices and auxiliary components.
- C. Wiring diagrams detailing schematic diagram including control wiring and differentiating between manufacturer-installed and field-installed wiring.
- D. Report of field tests and observations.
- E. Panel schedules for installation in panelboards. Submit final versions after load balancing.

1.04 QUALITY ASSURANCE:

- A. Listing and Labeling: Provide products specified in this Section that are listed and labeled.
 - 1. The terms "listed" and "labeled" shall be defined as they are in the National Electrical Code, Article 100.
- B. Manufacturer's Qualifications: Firms regularly engaged in manufacture of panelboards and enclosures, of types, sizes and ratings required, whose products have been in satisfactory use in similar service for not less than 5 years.
- C. Installer's Qualifications: A firm with at least 3 years of successful installation experience on projects utilizing panelboards similar to those required for this project.

1.05 EXTRA MATERIALS:

- A. Keys: Furnish six spares of each type for panelboard cabinet locks.
- B. Touchup Paint for panelboards: One half pint container.

PART 2 - PRODUCTS

2.01 MANUFACTURERS:

- A. Manufacturers: Subject to compliance with requirements, provide products by the following:
 - 1. ABB
 - 2. Schneider Electric
 - 3. Siemens
 - 4. Eaton

2.02 PANELBOARDS, GENERAL REQUIREMENTS:

- A. Overcurrent Protective Devices (OCPDs): Provide type, rating, and features as indicated. Comply with Division 26 Section on Overcurrent Protective Devices, with OCPDs adapted to panelboard installation. Tandem circuit breakers shall not be used. Multiple breakers shall have common trip.
- B. Enclosures: Cabinets, flush or surface mounted as indicated. NEMA Type 1 enclosure, except where the following enclosure requirements are indicated. Provide galvanized sheet steel cabinet type enclosures, in sizes and NEMA types as indicated, code-gauge, minimum 16-gauge thickness. Construct with multiple knockouts and wiring gutters. Provide fronts with baked gray enamel finish over a rust inhibitor coating. Design enclosures for recessed mounting. Provide enclosures which are fabricated by same manufacturer as panelboards, which mate and match properly with panelboards to be enclosed.
 - 1. NEMA 3R: Rain-tight
- C. Front: Hinged trim type. Front trim with a full-length piano hinge shall be designed to expose the wiring and circuit breakers when open. An inner door with concealed hinges shall expose only the circuit breakers when open. Provide flush latch(es) and lock(s) for inner door. All panelboard locks shall be keyed alike. Trim shall be secured to box with 1/4-20-large head slotted captive screws. Fronts for surface-mounted panels shall be same dimensions as box. Fronts for flush-mounted panels shall overlap box except as otherwise specified.
- D. Directory Frame: Metal, mounted inside each panel door with card and clear plastic cover. Directory shall match panelboard configuration, i.e., top to bottom, left to right. Provide permanent panelboard labels for each circuit number.
- E. Bus Material: Provide silver-plated, hard-drawn copper of 98 percent conductivity.
- F. Equipment Ground Bus: Adequate for feeder and branch-circuit equipment ground conductor's bonded to box.

- G. Provide lugs for incoming feeders and grounds compatible with bus and feeder material.
- H. Service Equipment Approval: Listed for use as service equipment for panelboards having main service disconnect.
- I. Provide minimum short circuit current ratings as indicated.
- J. Provision for Future Devices: Equip with mounting brackets, bus connections, fingers, and necessary appurtenances, for the OCPD ampere ratings indicated for future installation of devices.

2.03 LIGHTING AND APPLIANCE BRANCH CIRCUIT PANELBOARDS:

- A. Branch OCPDs: Bolt-on circuit breakers, replaceable without disturbing adjacent units.

2.04 DISTRIBUTION PANELBOARDS:

- A. Branch Circuit Breakers: Where OCPDs are indicated to be circuit breakers, use bolt-on breakers except circuit breakers 225ampere frame size and greater may be plugin type where individual positive locking device requires mechanical release for removal.

2.05 IDENTIFICATION:

- A. General: Refer to Division 26 Section on electrical identification for labeling materials.
- B. UL nameplates shall be provided for all panelboards. Information shall include, but not be limited to, manufacturer, model number, serial number, plant or manufacturing location, ampere rating, voltage rating, wire and phase identification and bus short circuit bracing rating.

PART 3 - EXECUTION

3.01 INSTALLATION:

- A. General: Install panelboards and accessory items in accordance with NEMA PB 1.1, "General Instructions for Proper Installation, Operation and Maintenance of Panelboards Rated 600 Volts or Less" and manufacturers' written installation instructions.
- B. Ground Fault Protection: Install panelboard ground fault circuit interrupter devices in accordance with installation guidelines of NEMA 289, "Application Guide for Ground Fault Circuit Interrupters."
- C. Mounting: Plumb and rigid without distortion of box. Mount flush panels uniformly flush with wall finish.
- D. Circuit Directory: Typed and reflective of final circuit changes required to balance panel loads. Obtain approval before installing.

- E. Install filler plates in unused spaces.
- F. Auxiliary Gutter: Install where two panels are vertically mounted. Use gutter for branch circuit wiring to lower panel.
- G. Wiring in Panel Gutters: Train conductors neatly in groups, bundle, and wrap with wire ties after completion of load balancing.
- H. Feeders to multiple section panelboards, from Sub-Feed Lugs or Feed-Through lugs shall match the feeders to the panelboard.

3.02 IDENTIFICATION:

- A. Identify field installed wiring and components and provide warning signs in accordance with Division 26 Section on electrical identification.

3.03 GROUNDING:

- A. Connections: Make equipment grounding connections for panelboards as indicated.
- B. Provide ground continuity to main electrical ground bus indicated.

3.04 CONNECTIONS:

- A. Tighten electrical connectors and terminals, including grounding connections, in accordance with 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. Upon completing installation of the system, perform the following tests:
 - 1. Make insulation resistance tests of panelboard buses, components, and connecting supply, feeder, and control circuits.
 - 2. Make continuity tests of circuits.
- B. Procedures: Make field tests and inspections and prepare panelboard for satisfactory operation in accordance with manufacturer's recommendations and these specifications.
- C. Schedule tests with at least one week in advance notification.
- D. Reports: Provide report written reports of tests and observations. Report defective materials and workmanship and unsatisfactory test results. Include records of repairs and adjustments made.
- E. Labeling: Upon satisfactory completion of tests and related effort, apply a label to tested components indicating results of tests and inspections, responsible organization and person, and date.

- F. Visual and Mechanical Inspection: Include the following inspections and related work:
 - 1. Inspect for defects and physical damage, labeling, and nameplate compliance with requirements of up-to-date drawings and panelboard schedules.
 - 2. Exercise and perform of operational tests of all mechanical components and other operable devices in accordance with manufacturer's instruction manual.
 - 3. Check panelboard mounting, area clearances, and alignment and fit of components.
 - 4. Check tightness of bolted electrical connections with calibrated torque wrench. Refer to manufacturer's instructions for proper torque values.
 - 5. Verify that proper grounding bushings/bonding/ and panel enclosure bonding is complete.
 - 6. Verify isolated neutral bar and neutral connections.

- G. Electrical tests: Include the following items performed in accordance with manufacturer's instruction:
 - 1. Insulation resistance test of buses. Insulation resistance less than 100 megohms is not acceptable.
 - 2. Ground resistance test on system and equipment ground connections.
 - 3. Test main and sub-feed overcurrent protective devices in accordance with Section "Overcurrent Protective Devices."

- H. Retest: Correct deficiencies identified by tests and observations and provide retesting of panelboards by testing organization. Verify by the system tests that the total assembly meets specified requirements.

3.06 CLEANING:

- A. Upon completion of installation, inspect interior and exterior of panelboards. Remove paint splatters and other spots, dirt, and debris. Touch up scratches and marks of finish to match original finish.

END OF SECTION 26 2416

SECTION 26 2726 - WIRING DEVICES

PART 1 - GENERAL

1.01 SUMMARY:

- A. The extent of wiring device work is indicated by drawings and schedules. Wiring devices are defined as single discrete units of electrical distribution systems which are intended to carry but not utilize electric energy.
- B. Types of electrical wiring devices in this section include the following:
 - 1. Receptacles.
 - 2. Ground-fault circuit interrupters.
 - 3. Switches.
 - 4. Wall-plates.
 - 5. Dimmers.
 - 6. Plugs and connectors.

1.02 QUALITY ASSURANCE:

- A. Manufacturers: Firms regularly engaged in manufacture of electrical wiring devices, of types, sizes, and ratings required, whose products have been in satisfactory use in similar service for not less than 3 years.
- B. Installer's Qualifications: Firm with at least 2 years of successful installation experience on projects utilizing wiring devices similar to those required for this project.
- C. Listing and Labeling: Provide products that are listed and labeled for their applications and installation conditions and for the environments in which installed.
 - 1. The Terms "Listed" and "Labeled": As defined in the "National Electrical Code", Article 100.
 - 2. Listing and Labeling Agency Qualifications: A "Nationally Recognized Testing Laboratory" (NRTL) as defined in OSHA Regulation 1910.7.

1.03 SUBMITTALS:

- A. See Section 26 0500 Common Work Results for Electrical for Submittal requirements. Supplemental information is listed within this section.
- B. Samples of device plates for color selection and evaluation of technical features shall be submitted.

1.04 COORDINATION:

- A. Wiring Devices for Owner Furnished Equipment: Match devices to plug connectors for Owner-furnished equipment.

- B. Cord and Plug sets: Match cord and plug sets to equipment requirements.

PART 2 - PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS:

- A. Manufacturers: Products shall be of the same manufacturer insofar as possible. Subject to compliance with requirements, provide wiring devices of one of the following:
 - 1. Devices, Cover Plates, Accessories:
 - a. Hubbell Inc.
 - b. Leviton Mfg. Co.
 - c. Pass and Seymour Inc.
 - d. Cooper Crouse-Hinds Co.
 - e. General Electric Co.
 - 2. Wiring Devices for Hazardous (Classified) Locations:
 - a. Crouse-Hinds Electrical Construction.
 - b. Hubbell-Killark Electrical Mfg. Co.
 - c. Pyle-National Co.
 - 3. Weatherproof Receptacle Covers:
 - a. Hubbell, Inc.
 - b. Pass & Seymour / Wiremold Co. / Legrand
 - c. Eaton Wiring Devices
 - d. Leviton

2.02 WIRING DEVICES:

- A. Color selection shall be verified with Architect/Engineer prior to ordering. Devices shall be White.
- B. Receptacles:
 - 1. All duplex, single, Isolated Ground, Tamper Resistant, Ground Fault Interrupter (GFCI), and other special receptacles shall be minimum, specification grade commercial series listed by Underwriter's Laboratories, UL 498 and Federal Specification FS W-C-596, 20 amp, nylon face and have a metal mounting strap with self-grounding and have a hex-head green grounding screw and be side and back wired. Each device shall bear the UL/FS Label. Meet NEMA standards for wiring devices including NEMA WD 1 for general requirements and NEMA WD 6 for dimensional standards.
 - a. Each device shall have terminal screws and clamps listed for use with stranded wire. Plug-tail device connections are acceptable.
 - 2. Convenience Receptacle Configuration: Duplex or Single as indicated on the drawings, Type 5-20R.
 - 3. Weather Resistant Receptacles: In addition to the above requirements all receptacles in damp and wet locations shall be WR (Weather Resistant) labeled.
 - 4. Special Purpose Receptacle Configuration: straight blade or locking as indicated on drawings, black face.

5. Tamper Resistant Receptacles: Where indicated or required provide Duplex receptacle with integral switch and contacts to prevent energization unless a plug is inserted. Provide receptacles that are UL listed and labeled "TR".
6. Ground-Fault Interrupter Receptacles: Where indicated or required provide "local reset" auto monitoring "self test" ground-fault circuit interrupters. Provide unit capable of being installed in a 2-3/4" deep outlet box without adapter, grounding type, Class A, Group 1 per UL Standard 943. Provide visual indication of lost protection.
7. Receptacles in Hazardous (Classified) Locations: Comply with NEMA Standard FB 11 "Plugs, Receptacles and Connectors on the Pin and Sleeve Type for Hazardous Locations" and UL Standard 1010 "Receptacle-Plug Combinations for Use in Hazardous (Classified) locations."
8. Pendant Cord/Connector Devices: Matching, locking type, plug and plug receptacle body connector, NEMA I5-20P and L5-20R, heavy-duty grade.
 - a. Bodies: Nylon with screw-open cable-gripping jaws and provision for attaching external cable grip.
 - b. External Cable Grip: Woven wire mesh type made of high strength galvanized-steel wire strand and matched to cable diameter and with attached provision designed for the corresponding connector.
9. Cord and Plug Sets: Match voltage and current ratings and number of conductors to requirements of the equipment being connected.
 - a. Cord: Rubber-insulated, stranded copper conductors, with type-SOW-A jacket. Grounding conductor has green insulation. Ampacity is equipment rating plus 30% minimum.
10. Plug: Male configuration with nylon body and integral cable-clamping jaws. Match to cord and to receptacle type intended for connection.

C. Switches:

1. Wall Switches for Lighting Circuits: NEMA WD1 and WD-6; FS W-S-896E; AC quiet type specification grade commercial series listed by Underwriter's Laboratories with toggle handle, rated 20 amperes at 120-277 volts AC, unless noted otherwise. Mounting straps shall be metal and be equipped with a green hex-head ground screw. Each switch shall bear the UL/FS Label.
 - a. Each device shall have terminal screws and clamps listed for use with stranded wire. Plug Tail device connections are acceptable.

2.03 WIRING DEVICE ACCESSORIES:

- A. Verify color and type with Architect/Engineer prior to ordering. Device color to match Wiring Device Color identified above. Verify location, height, mounting conditions, etc., of all devices with Architectural drawings prior to rough-in.
- B. Wall-plates: Provide wall-plates for single and combination wiring devices, of types, sizes, and with ganging and cutouts as indicated. Select plates which mate and match wiring devices to which attached. Construct with metal screws for securing plates to devices; screw heads colored to match finish of plates. Identify all wall plates used for receptacles with branch circuit number per requirements of section on Electrical Identification. Provide blank wall plates for all cable, data, telephone and junction and outlet boxes. Where cables are routed through the wall-plate,

provide grommets in wall-plate openings to protect cables. Provide plates possessing the following additional construction features:

1. Material and Finish: 0.04" thick, type 302 satin finished stainless steel.
2. Material and Finish: 0.04" thick, type 302 satin finished stainless steel for use in unfinished areas, mechanical, and electrical rooms.
3. Wrinkle Finish: Steel, finish to be painted, color to be ivory unless otherwise noted.
4. Gaskets: Resilient rubber or closed cell foam urethane.
5. Weather Proof, Exterior and other wet locations and where called out on the drawings as "WP", provide weatherproof junction box with gaskets and cover.
 - a. "In Use" type: Cover shall be rated "while in use". Use low profile type covers with UV rated and resistant polycarbonate.
 - b. Outlet box hood shall be listed as "extra duty".

PART 3 - EXECUTION

3.01 INSTALLATION OF WIRING DEVICES:

- A. Install wiring devices as indicated, in accordance with manufacturer's written instructions, applicable requirements of NEC and in accordance with recognized industry practices to fulfill project requirements.
- B. Coordinate with other work, including painting, electrical boxes and wiring work, as necessary to interface installation of wiring devices with other work.
- C. Install wiring devices only in electrical boxes which are clean; free from excess building materials, dirt, and debris.
- D. Install wiring devices after wiring work is completed.
- E. Install wall-plates after painting work is completed.
- F. Tighten connectors and terminals, including screws and bolts, in accordance with equipment manufacturer's published torque tightening values for wiring devices. Where manufacturer's torquing requirements are not indicated, tighten connectors and terminals to comply with tightening torques specified in UL Std. 486A.
- G. Provide GFCI type outlets as shown and as required in the NEC including article 210, including but not limited to: each above counter duplex receptacle shown within 6 feet-0 inches of sinks/lavatories; Bathrooms; Kitchens; Roof Tops; Outdoors; Indoor Wet locations; Locker Rooms; Shower Facilities; Garages; Service Bays; vending machines; etc. For above counter multi-outlet assemblies which do not contain duplex receptacles that can be replaced with GFCI devices, provide GFCI circuit breakers on the branch circuit(s) feeding the assembly. Where GFCI devices are required and/or shown but are not readily accessible when equipment is installed, i.e. vending machines, etc., provide blank face GFCI device and cover-plate ahead of inaccessible receptacles. Mount adjacent to equipment at switch height unless otherwise shown. Install individual GFCI devices at each location shown, feed through devices are only acceptable where specifically called for.

- H. Provide Dual function tamper-resistant AFCI/GFCI receptacles as shown and as required in the NEC including article 210.
- I. Receptacle Mounting: Mount device with front of device flush with the cover plate. Over the counter receptacles shall be mounted horizontally with ground to the right. Where switch and receptacles are mounted within one stud space align vertically. Vertically mounted receptacles shall be mounted with ground up.
- J. Switch Mounting: Switches shall be ganged and within 18" of the door jam on the strike side of the door openings unless otherwise shown. Verify door swings with Architectural drawings prior to rough-in. Switches connected to the life safety system shall not be ganged with other switches. Switch and receptacle combinations shall be installed in 2 gang box where both are of the same voltage. provide separate boxes where different voltages are present.

3.02 PROTECTION OF WALLPLATES AND RECEPTACLES:

- A. Upon installation of wall-plates and receptacles, advise Contractor regarding proper and cautious use of convenience outlets. At time of Substantial Completion, replace those items which have been damaged, including those burned and scored by faulty plugs.

3.03 GROUNDING:

- A. Provide equipment grounding connections for wiring devices, unless otherwise indicated. Tighten connections to comply with tightening torques specified in UL Std. 486A to assure permanent and effective grounds.

3.04 CLEANING:

- A. Internally clean devices, device outlet boxes and enclosures. Replace stained, cracked, damaged or improperly painted wall plates or devices. Remove temporary markings of labels.

3.05 TESTING:

- A. Prior to energizing circuitry, test wiring for electrical continuity, and for short-circuits. Ensure proper polarity of connections is maintained and prepare test reports. Subsequent to energization, test wiring devices to demonstrate compliance with requirements.
 - 1. The tests shall be diagnostic, indicating damaged conductors, high resistance at the circuit breaker, poor connections, inadequate fault current path, defective devices or similar problems.
 - 2. Tests for Convenience Receptacles:
 - a. Line Voltage: Acceptable range is 114 to 126 V.
 - b. Ground Impedance: Values of up to 2 ohms are acceptable.
 - c. Polarity: Test for correct neutral conduct to neutral terminal connection.
 - d. Using the test plug, verify that the device and its outlet box are securely mounted.
 - e. GFCI Receptacles: Test for tripping values specified in UL 1436 and UL 943. Test with both local and remote fault simulations in accordance with manufacturing recommendations.
 - f. SPD receptacle indicating lights for normal indication check.

3. Test Instruments:
 - a. Use instruments that comply with UL 1436.
 - b. Test Instrument for Convenience Receptacles: Digital wiring analyzer with digital readout or illuminated LED indicators of measurement.

- B. Correct Deficiencies and Report:
 1. Correct unsatisfactory conditions and retest to demonstrate compliance; replace devices as required to bring system into compliance.
 2. Correct malfunctioning units on-site, where possible and retest to demonstrate compliance; otherwise, replace with new units and retest.
 3. Prepare a report that identifies enclosure, units, conductors and devices checked and describe results. Include notation of deficiencies detected, remedial action taken, and observations and test results after remedial action.

END OF SECTION 26 2726

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SECTION 26 2800 - LOW VOLTAGE CIRCUIT PROTECTIVE DEVICES

PART 1 - GENERAL

1.01 SUMMARY:

- A. This section includes overcurrent protective devices (OCPD's) rated 600 V and below and switching devices commonly used with them.
- B. Panelboards, and Switchboards: Application, installation, and other related requirements for overcurrent protective device installations in distribution equipment are specified in other Division 26 sections.

1.02 DEFINITIONS:

- A. Overcurrent Protective Device (OCPD): A device operative on excessive current that causes and maintains the interruption of power in the circuit it protects.
- B. Ampere-Squared-Seconds: An expression of available thermal energy resulting from current flow. With regard to current-limiting fuses and circuit breakers, the ampere-squared-seconds during fault current interruption represents the energy allowed to flow before the fuse or breaker interrupts the fault current within its current limiting range.

1.03 SUBMITTALS:

- A. See Section 26 0500 Common Work Results for Electrical for Submittal requirements. Supplemental information is listed within this section.
- B. Product data for fuses, fusible switches, circuit breakers, and OCPD accessories specified in this Section, including descriptive data and time-current curves for all protective devices and let-through current curves for those with current limiting characteristics. Include coordination charts and tables and related data.
- C. Provide coordination study performed by a registered professional engineer in accordance with ANSI/IEEE Standards including 242 2001 Recommended Practice for Protection and Coordination of Industrial and Commercial Power Systems, where required to show proper coordination to the AHJ; when settings are not identified on the drawings; and where OCPD manufacturers other than those designated in the Device Settings Tables on the drawings or first in schedules or product listings in this specification are proposed for use, Study shall be a full coordination study showing graphically that the proposed OCPD's coordinate selectively with both upstream and downstream components. Include single line diagram with nodes corresponding to the system components as shown on the contract documents; coordinated time current curves and settings; device performance curves; fault current calculations adequate to demonstrate satisfactory component protection and selective coordination of protective devices; etc. Study shall include all Utility systems, overcurrent devices, transformers, buses, generator systems, grounding systems. etc., which comprises the AC power system, Bill

of materials for devices and settings proposed shall be coordinated per the applicable sections of the current edition of the NEC, as required by the Authority Having Jurisdiction, and as a minimum to 0.01 seconds for Emergency systems and to 0.1 seconds for other systems. Study shall be commissioned and paid for by the Contractor. Submit study with overcurrent protective devices, switchgear, switchboard, and panelboard submittals.

- D. Provide Electrical system Arc Flash Study performed by a registered professional engineer in accordance with ANSI/IEEE Standards. Submit a full coordination study with printed labels affixed to each piece of equipment. Include single line diagram with nodes corresponding to the system components, Arc Flash calculations identifying hazard levels, etc. Study shall include all utility systems, overcurrent devices, transformers, buses, generator systems, grounding systems. etc., which comprises the AC power system, Study shall be commissioned and paid for by the Contractor. Submit study with switchgear, switchboard and panelboard submittals.
- E. Submit documentation of compliance with Code and Specification requirements for circuit protective devices including but not limited to SCCR, Listings for use with downstream breakers/fuses and equipment where required, Ground Fault protection; Arc Flash reduction for breakers above 1200A; Surge Protection; Metering; Relaying; etc.

1.04 QUALITY ASSURANCE:

- A. Manufacturers: Firms regularly engaged in manufacture of overcurrent protective devices of types, sizes, and ratings required, whose products have been in satisfactory use in similar service for not less than 5 years.
- B. Each type of OCPD shall be the product of a single manufacturer.

1.05 EXTRA MATERIALS:

- A. Spare Fuses: Furnish spares of each type and rating of fuse for fusible devices amounting to one set of 3 fuses for each 9 fuses installed but not less than 3 fuses of each type.

PART 2 - PRODUCTS:

2.01 MANUFACTURERS:

- A. Manufacturers: Subject to compliance with requirements, provide products by the following:
 - 1. Cartridge Fuses:
 - a. Bussmann Div., Cooper Industries, Inc.
 - b. Littelfuse Inc.
 - c. Mersen
 - 2. Fusible Switches:
 - a. General Electric Co.
 - b. Square D Co.
 - c. Allen-Bradley Co.
 - d. Siemens Energy & Automation, Inc.
 - e. Eaton

3. Molded-Case Circuit Breakers:
 - a. Square D Co.
 - b. General Electric Co.
 - c. Siemens Energy & Automation, Inc.
 - d. Eaton
4. Combination Circuit Breaker and Ground Fault Circuit Interrupters:
 - a. General Electric Co.
 - b. Square D Co.
 - c. Siemens Energy & Automation, Inc.
 - d. Eaton
5. When mounting overcurrent protective devices in switchboards, switchgear, panelboards, MCC's, etc., provide equipment of same manufacturer as equipment into which they are being mounted.

2.02 OVERCURRENT PROTECTIVE DEVICES (OCPDs), GENERAL:

- A. General: Provide OCPDs in indicated types, as integral components of panelboards, switchboards, motor control centers, and other related equipment; and also as individually enclosed and mounted single units.
- B. Enclosures: NEMA 250 "Enclosures for Electrical Equipment (1,000 Volts Maximum)."
- C. Where OCPD's are to be installed in existing panelboards, switchboards, and motor control centers, they shall be of the same manufacture and type as those existing in the equipment. If this is not possible, provide devices which are compatible with the existing equipment and when installed will not void the U.L. label or reduce the short circuit rating of the equipment.
- D. All overcurrent devices shall be individually rated for the available fault current unless otherwise noted. Series ratings of equipment will only be allowed where specifically called out.
- E. Ground Fault Protection: Distribution circuit breakers: provide integral, self-powered type with mechanical ground fault indicator, test function, adjustable pick-up current and delay time with inverse and constant time characteristics, internal memory arranged to integrate intermittent arcing ground faults, and ground fault current sensor located as indicated or required. Provide combination devices for branch circuit protection as follows; where shown or required provide 30 mA Ground Fault circuit breakers for each circuit feeding Electrical Heat Trace to protect from overheating and fire and 5 mA Ground Fault circuit breakers for each circuit feeding receptacles to protect personnel. Coordinate with manufacturer's instructions.

2.03 CARTRIDGE FUSES:

- A. General: NEMA Standard FU1, "Low-Voltage Cartridge Fuses." Unless indicated otherwise, provide nonrenewable cartridge fuses of indicated types, classes, and current ratings that have voltage ratings consistent with the circuits on which used.
- B. All fuses used for main, feeder, or branch-circuit protection shall be Underwriters Laboratories listed, current-limiting fuses with 200,000 ampere interrupting rating and shall be so labeled.

Fuses used for supplementary protection (other than branch circuit protection) shall be as specified above or shall be U.L. approved or component recognized for such purposes. All fuses provided shall be furnished by the same manufacturer. Should equipment provided require a different U.L. Class or size of fuse, the engineer shall be furnished sufficient data to ascertain that system function will not be adversely affected.

- C. In order to simplify fuse replacement, reduce spare fuse inventory and insure adequate thermal protection, all fuses 600 amperes and below shall be true dual-element time-delay fuses with separate spring-loaded thermal overload elements in all ampere ratings. All ampere ratings shall be designed to open at 400 degrees F or less when subjected to a non-load oven test.
- D. To eliminate induction heating, all fuse ferrules and end caps shall be non-ferrous and shall be bronze or other alloy not subject to stress cracking.
- E. Class L Fuses: UL 198C, "High-Interrupting Capacity Fuses, Current-Limiting Type."
- F. Class RK1 Dual Element Time-Delay Fuses: UL 198E, "Class R Fuses."
- G. Class J Low-Peak dual Element Fuse: UL 198C

2.04 NONFUSIBLE SWITCHES:

- A. General: UL 98 "Enclosed and Dead Front Switches" and NEMA KS 1 "Enclosed Switches," quick-make, quick-break heavy-duty units.
- B. Rating: Load-breaking capacity in excess of the normal horsepower rating for the switch.
- C. Withstand Capability: In excess of the available.
- D. Operation: By means of external handle.
- E. Interlock: Prevents access to switch interior except when in "off" position.
- F. Enclosure for Independent Mounting: NEMA Type 1 enclosure except as otherwise indicated or required to suit environment where located.
- G. Contacts shall be NEMA rated 75 degrees C.
- H. Provide auxiliary contacts for disconnects supplied from variable frequency drives.

2.05 FUSIBLE SWITCHES:

- A. General: UL 98 "Enclosed and Dead Front Switches" and NEMA KS 1 "Enclosed Switches," quick-make, quick-break heavy-duty units.
- B. Rating: Load-breaking capacity in excess of the normal horsepower rating for the switch.

- C. Withstand Capability: In excess of the let-through current permitted by its fuse when subject to faults up to 100,000 RMS symmetrical amperes.
- D. Operation: By means of external handle.
- E. Interlock: Prevents access to switch interior except when in "off" position.
- F. Fuse Clips: Rejection type.
- G. Enclosure for Switchboard or Panel board Mounting: Suitable for panel mounting where indicated.
- H. Enclosure for Independent Mounting: Provide NEMA Type 1 enclosure except as otherwise indicated or required to suit environment where located.
- I. Contacts shall be NEMA rated 75 degrees C.
- J. Provide fuses for safety switches and other equipment of classes, types, and rating needed to fulfill electrical requirements for services indicated.
- K. Provide auxiliary contacts for disconnects supplied from variable frequency drives.

2.06 MOLDED-CASE CIRCUIT BREAKERS:

- A. General: UL 489, "Molded Case Circuit Breakers and Circuit Breaker Enclosures," and NEMA AB 1, "Molded Case Circuit Breakers."
- B. Construction: Provide bolt-in type, except breakers 225-ampere frame size and larger which may be plug-in type if held in place by positive locking device requiring mechanical release for removal.
- C. Characteristics: Indicated frame size, trip rating, number of poles, and a short-circuit interrupting capacity rating as indicated or required to match existing devices or equipment.
- D. Tripping Device: Quick-make, quick-break toggle mechanism with inverse-time delay and instantaneous overcurrent trip protection for each pole. Trip unit to be interchangeable within frame sizes for breakers 200 amperes or larger. Breakers 150 amperes and above shall have adjustable trip selection for trip units. All 120/208 volt rated breakers shall be rated and labeled "High Magnetic".
- E. Adjustable Instantaneous Trip Devices: Factory adjusted to low-trip-setting current values. Provide adjustable instantaneous trip devices for each circuit breaker supplying individual motor loads and where indicated.
- F. Enclosure for Switchboard or Panelboard Mounting: Suitable for panel mounting in switchboard or panelboards where indicated.
- G. Enclosure for Switchboard Mounting: Provide individual mounting where indicated.

- H. Enclosure for Independent Mounting: NEMA Type 1 enclosure, except as otherwise indicated or required to suit environment where located.

2.07 COMBINATION CIRCUIT BREAKERS AND GROUND FAULT CIRCUIT INTERRUPTERS:

- A. General: UL 943 "Ground Fault Circuit Interrupters," arranged for sensing and tripping for ground fault current in addition to overcurrent and short-circuit current. Provide features as follows:
 - 1. Match features and module size of panelboard breakers and provide clear identification of ground fault trip function.

2.08 OCPD ACCESSORIES:

- A. Key Interlocks: Arrange interlocking so keys are held captive at devices indicated. Where future key interlocking provisions are indicated, provide necessary mountings and hardware as required for the future installation.
- B. Provide adjustable-time-delay under-voltage trip devices where indicated.
- C. Provide shunt-trip devices for Circuit breakers where required or indicated. Arrange to trip breaker from an external source of power through a control switch or relay contact.
- D. Provide bell alarm contacts for tripped position.
- E. Lock-Out Devices: Provide padlocking provisions on each overcurrent protective device, lockable in the open or closed position. Provide 3 sets of lockout/tagout devices for each type of breaker or switch provided. Include tags, locks and all accessories necessary.

PART 3 - EXECUTION:

3.01 INSTALLATION:

- A. Independently Mounted OCPDs: Locate as indicated and install in accordance with manufacturer's written installation instructions. Install OCPDs level and plumb.
- B. OCPDs in new distribution and branch circuit equipment shall be factory installed. OCPD's in existing distribution and branch circuit equipment shall match existing for type and be provided with features as listed herein.
- C. Install fuses in fusible devices as indicated. Arrange fuses so that fuse ratings are readable without removing fuse.
- D. All fuses for new disconnect switches or MCC's feeding motors or motor starters shall be provided with Class J fuses.
- E. OCPDs and mounting accessories installed in existing equipment shall match the existing manufacturer and be rated for the available fault current.

3.02 IDENTIFICATION:

- A. Identify components in accordance with Division 26 Section on electrical identification.

3.03 CONTROL WIRING INSTALLATION:

- A. Install wiring between OCPDs and control/indication devices.

3.04 CONNECTIONS:

- A. Check connectors, terminals, bus joints, and mountings for tightness. Tighten field-connected connectors and terminals, including screws and bolts, in accordance with equipment manufacturer's published torque tightening values. Where manufacturer's torqueing requirements are not indicated, tighten connectors and terminals to comply with tightening torques specified in UL 486A and UL 486B.

3.05 GROUNDING:

- A. Provide equipment grounding connections for individually mounted OCPD units as indicated and as required by NEC. Tighten connectors to comply with tightening torques specified in UL Standard 486A to assure permanent and effective grounding.

3.06 FIELD QUALITY CONTROL:

- A. Reports: Prepare written reports on tests and observations. Report defective materials and workmanship, and unsatisfactory test results. Include complete records of repairs and adjustments made. Tests shall be made on all new and existing OCPD's provided and/or connected under this project in accordance with this section.
- B. Labeling: Upon satisfactory completion of tests and related effort, apply a label to tested components indicating test results, date, and responsible organization and person.
- C. Schedule visual and mechanical inspections and electrical tests with at least one week's advance notification.
- D. Upon completing installation of the system, perform the following tests on all new equipment and existing equipment as indicated on the drawings:
 - 1. Visual and mechanical inspection: Include the following inspections and related work.
 - a. Overcurrent-Protective-Device Ratings and Settings: Verify indicated ratings and settings to be appropriate for final system arrangement and parameters.
 - b. Inspect for defects and physical damage, NRTL labeling, and nameplate compliance with current single line diagram.
 - c. Exercise and perform operational tests of all mechanical components and other operable devices in accordance with manufacturer's instruction manual.
 - d. Check tightness of electrical connections of OCPD's with calibrated torque wrench. Refer to manufacturer's instructions for proper torque values.
 - e. Clean OCPD's using manufacturer's approved methods and materials.
 - f. Verify installation of proper fuse types and ratings in fusible OCPD's.

2. Electrical Tests: Perform the following tests in accordance with manufacturer's instructions:
 - a. Insulation resistance test of fused power circuit devices, insulated-case, and molded-case circuit breakers, 600-ampere frame size and over at 1000 degree V D.C. for one minute from pole to pole and from each pole to ground with breaker closed and across open contacts of each phase. Insulation resistance less than 100 megohms is not acceptable.
 - b. Make insulation resistance tests of OCPD buses, components, and connecting supply, feeder, and control circuits.
 - c. Make continuity tests of circuits.
 - d. Provide full rated primary current tests conforming to IETA testing standards of all new and existing breakers 800 amperes and greater including Ground Fault systems testing, connected under this project. Inspect breakers and provide test report. Set breakers to previous or new settings as directed prior to test.
 - e. Verify relay operation by introduction of accurately metered currents into overcurrent/ground fault/ and other circuitry at values which will enable accurate determination of the tripping or activation values.
 - E. Make adjustments for final settings of adjustable-trip devices.
 - F. Activate auxiliary protective devices such as ground fault or under-voltage relays, to verify operation of shunt-trip devices.
 - G. Check stored-energy charging motors for proper operation of motor, mechanism, and limit switches.
 - H. Check operation of electrically operated OCPDs in accordance with manufacturer's instructions.
 - I. Check key and other interlock and safety devices for operation and sequence. Make closing attempts on locked-open and opening attempts on locked-closed devices including moveable barriers and shutters.
 - J. Retest: Correct deficiencies identified by tests and observations and provide retesting of OCPDs by testing organization. Verify by the system tests that specified requirements are met.
- 3.07 CLEANING:
- A. Upon completion of installation, inspect OCPD's. Remove paint splatters and other spots, dirt, and debris. Touch up scratches and mars of finish to match original finish.
- 3.08 DEMONSTRATION:
- A. Training: Arrange and pay for the services of factory-authorized service representatives to demonstrate OCPD's and train Owner's maintenance personnel. //OR Demonstrate OCPD's and train Owner's maintenance personnel.

- B. Conduct a minimum of one half day of training in operation and maintenance as specified under in the Project Closeout Section of these specifications. Include both classroom training and hands-on equipment operation and maintenance procedures.
- C. Schedule training with at least seven days' advance notification.

END OF SECTION 26 2800

SECTION 26 4313 - SURGE PROTECTIVE DEVICE (SPD)

PART 1 - GENERAL

1.01 DESCRIPTION OF WORK:

- A. Extent of SPD work is indicated by drawings and by requirements of this section.
- B. These specifications describe the electrical and mechanical requirements for a high-energy surge protective device (SPD). The specified system shall provide effective, high-energy surge current diversion and be suitable for use as type 1 or Type 2, min. 20kA device per ANSI/UL 1449 Fourth edition.
- C. The system shall be constructed using multiple surge-current diversion thermally protected metal oxide varistors (TPMOV). The surge current circuit shall be designed and constructed in a manner that ensures surge current sharing. Use of gas tubes, silicon avalanche diodes or selenium cells are unacceptable unless documentation from a nationally recognized laboratory demonstrates current sharing of all dissimilar components at all surge current levels.
- D. The specified system shall be designed, manufactured, tested and installed in compliance with the latest Edition following codes and standards:
Underwriters laboratories; ANSI/UL 1449 4th Edition
UL1283
UL96A
American National Standards Institute and Institute of Electrical and Electronic Engineers
(ANSI/IEEE C62.34, C62.41, C62.45)
Institute of Electrical and Electronic Engineers 1100 Emerald Book
Federal Information Processing Standards Publication 94 (FIPS PUB 94)
National Fire Protection Association (NFPA 20, 70, 75 and 780)
International Standards Organization (ISO) Company certified ISO 9001 for manufacturing,
design and service
- E. The system shall be UL listed and labeled under ANSI/UL 1449 Fourth Edition and the Voltage Protection Ratings (VPRs) shall be permanently affixed to the SPD. Type 2 units of the product family shall also be Canadian underwriters laboratories (cUL) listed and labeled.

1.02 QUALITY ASSURANCE:

- A. Manufacturers: firms regularly engaged in manufacture of SPD equipment of types, ratings, capacities and characteristics required, whose products have been in satisfactory use in similar service for not less than 5 years.
- B. Installer's qualifications: firm with at least 5 years of successful installation experience with projects utilizing rectifier and inverter work similar to that required for this project.
- C. The specified system shall be factory-tested before shipment. Testing of each system shall include but shall not be limited to quality control checks, "hi-pot" tests at twice rated voltage

plus 1000 volts per UL requirements, IEEE c62.41 category b surge tests, UL ground leakage test, and operation and calibration tests.

- D. The SPD shall have been duty life cycle tested following suggested wait times as defined by ANSI/IEEE C62.41 and shall be capable of surviving 500 sequential category C surges of 10,000 amps without failure.
- E. The system shall be UL listed as a complete system under the currently adopted UL 1449 standard for surge protective device (SPD) and the rating shall be permanently affixed to the SPD.

1.03 SUBMITTALS:

- A. See Section 26 0500 Common Work Results for Electrical for Submittal requirements. Supplemental information is listed within this section.
- B. Shop drawings: submit drawings of SPD equipment indicating unit dimensions, weights, component and connection locations, mounting provisions, connection details and wiring diagrams.
- C. Test reports: documentation of specified system's UL 1449 listing, life cycle testing, overcurrent protection, noise attenuation, surge current capacity, and clamping voltage ratings shall be provided. This shall include computer generated graphs and oscillograms. Tests shall follow procedures outlined in ANSI/IEEE for installation category and applicable protection modes of SPD.

1.04 PRODUCT DELIVERY, STORAGE AND HANDLING:

- A. Deliver SPD equipment and accessories individually packaged in factory-fabricated containers. Mount units on shipping skids.
- B. Handle equipment carefully to prevent internal component damage, impact, breakage, denting, and scoring enclosure finishes. Do not install damaged equipment; replace and return damaged units to equipment manufacturer.
- C. Store equipment in clean dry space, protect units from dirt, fumes, water, construction debris and traffic.

1.05 WARRANTY:

- A. The manufacturer shall provide a full five year warranty from date of shipment against any part failure when installed in compliance with manufacturer's written instructions, UL listing requirements, and any applicable national or local electrical codes.

PART 2 - - PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS:

- A. Manufacturer: subject to compliance with requirements, provide SPD products of the following:
 - 1. Current technology
 - 2. GE/liebert
 - 3. Siemens

2.02 SYSTEM DESCRIPTION:

- A. Environmental Requirements:
 - 1. Storage Temperature: -67 °F to +185 °F (-55 °C to +85 °C).
 - 2. Operating Temperature: -40 °F to +122 °F (-40 °C to +50 °C).
 - 3. Relative Humidity: Operation shall be reliable in an environment with 0% to 95% non-condensing relative humidity.
 - 4. Audible Noise: The audible noise level of the specified system shall be less than 45 dBA at 5 feet.
 - 5. Operating Altitude: The system shall be capable of operating up to an altitude of 12,000 feet above sea level.
 - 6. Magnetic Fields: Unit shall not generate appreciable magnetic field, and shall be capable of use directly in computer rooms in any location without danger to data storage systems or devices.
- B. Electrical Requirements:
 - 1. System Operation Voltage: The nominal system operating voltage shall be 277/480V and 120/208V WYE, 4 wire plus ground, or as indicated on drawings.
 - 2. Maximum Continuous Operating Voltage (MCOV): The SPD maximum continuous operating voltage shall not be less than 115 percent of the nominal system operating voltage to ensure the ability of the system to withstand temporary RMS overvoltage conditions. Each system shall be factory tested at the MCOV for at least one (1) hour.
 - 3. Operating Frequency: The operating frequency range of the system shall be at least 47 to 63 Hertz.
 - 4. Protection Modes: The SPD shall provide protection as follows:
 - a. Line to line (Delta Configured System)
 - b. Line to ground
 - c. Neutral to ground (Wye Configured System)
 - d. Line to neutral (Wye Configured System)
- C. Performance Ratings: Provide SPD surge current capacity based on an 1.2x50 microsecond 20KV open circuit voltage, 8x20 microsecond short circuit current Category C3 Bi-wave per current Edition ANSI/IEEE C62.41 and C62.45 standards as follows: (A balanced surge current capacity shall also be applied Neutral to Ground and Line to Neutral where neutrals are present in the system).

Service Entrance	
Per Phase	300 kAmps
Line to Neutral	150 kAmps
Line to Ground	150 kAmps

Line to Line	150 kAmps
Subdistribution Per Phase	300 kAmps
Line to Neutral	150 kAmps
Line to Ground	150 kAmps
Line to Line	150 kAmps
Panelboards Per Phase	120 kAmps
Line to Neutral	60 kAmps
Line to Ground	60 kAmps
Line to Line	60 kAmps

2.03 SPD equipment:

- A. Components: The system shall be a symmetrically balanced, metal oxide varistor (MOV) array system, constructed using surge current diversion modules. Each module shall be capable of withstanding over 1000 pulses of the 10 kAmps IEEE C62.41 Category C surge current without degradation of clamping voltage. The module shall consist of multiple gap-less metal oxide varistors, with each MOV individually fused. The modules shall be designed and constructed in a manner which ensures reasonable MOV surge current sharing. No gas tubes or silicon avalanche diodes shall be used. The status of each varistor shall be monitored and green LED shall be illuminated if the module is in full working order. When module performance is degraded, such as if one or more fuses or varistors have failed, the LED shall indicate a failed module.
- B. High Frequency Tracking Filter: The unit shall include a UL 1238 high-frequency extended range tracking filter. The filter shall provide for high frequency transient filtering of up to 40 dB attenuation (per 50 Ohm Insertion Loss Methodology from MIL-STD E220A) for the band width extending from 10 KHZ to 100 MHZ. This filtering must remove low level surges and sharp wavefronts associated with fast rise-time transients, thus eliminating disturbances which may lead to "system upset".
- C. Connections: Terminals shall be provided for all of the necessary power and ground connections. The terminals shall accommodate wire sizes of #14 to #2/0 AWG for two conductors per required connection. The units shall use standard parallel wiring techniques.
- D. Internal Connections: All surge current diversion module intra-unit connections shall be by way of low impedance busbars or wiring. Surge current diversion modules shall use low impedance connections. All module mounting hardware and power wiring shall be captive or remain in place when a module is removed or replaced.
- E. Enclosure: The specified system shall be provided in NEMA type appropriate to installation conditions. When provided the cover of the enclosure shall be hinged and require a tool for access to internal components. A drawing pocket shall be provided inside the door for storage of unit drawings and installation/operation manual. Indication of surge current module status shall be visible without opening the door.

- F. Integral Test Point: The unit shall incorporate an integral test point allowing easy off-line diagnostic testing which verifies the operational integrity of the unit's suppression/filter system.

2.04 Overcurrent Protection:

- A. Fusing: all suppression components shall be thermally protected and rated to allow maximum specified surge current capacity. Devices that utilize a single fuse to protect two or more suppression paths are not accepted. Individual surge components shall be UL listed to be capable of interrupting up to 200 kA symmetrical fault current with 480 VAC applied. Replaceable fusing is unacceptable. Overcurrent protection that limits specified surge currents is not acceptable.

2.05 ACCESSORIES:

- A. LED indicators shall be provided on the hinged front cover to redundantly indicate unit module status. Additionally, a Form C (one N.O. and one N.C.) summary alarm contact rated for at least 120 VAC and 1 ampere shall be provided for remote annunciation of unit status. The summary alarm contact shall change state if any one or more of the surge current diversion modules has failed.
- B. SPD must have an SCCR rating above the available fault current.

PART 3 - EXECUTION

3.01 INSPECTION:

- A. Installer must examine areas and conditions under which SPD equipment is to be installed, and notify contractor in writing of those conditions detrimental to proper completion of work. Do not proceed with work until unsatisfactory conditions have been corrected in manner acceptable to installer.

3.02 INSTALLATION OF SPD EQUIPMENT:

- A. Install SPD as indicated, in accordance with manufacturer's written instructions and with recognized industry practices to ensure that SPD installation complies with requirements of NEMA standards and NEC, and applicable portions of NECA's "standard of installation," for installation of units.
- B. Coordinate with other work, including electrical wiring work, as necessary to interface installation of SPD with other work.
- C. Install electrical protective devices, if any, for each SPD unit.
- D. The installing contractor shall install the parallel SPD with short and straight conductors as practically as possible. The contractor shall twist the SPD input conductors together to reduce input conductor inductance.

- E. Field installation: the unit shall be installed as close as practical to the facility's wiring system in accordance with applicable national/local electrical codes and the manufacturer's recommended installation instructions. Connection shall be with #2 AWG copper conductor or larger and not be any longer than necessary, avoiding unnecessary bends. Notify engineer prior to installation if unit cannot be installed directly to bus or lead length within 18-24 inches or within manufacturer's required distances, whichever is shorter.
- F. Manufacturer shall make available (local, national) field engineering service support. Where direct factory employed service engineers are not locally available, travel time from the factory or nearest dispatch center shall be included if necessary.

3.03 ADJUSTING AND CLEANING:

- A. Touch-up scratched and marred surfaces of equipment to match original finishes; remove dirt and construction debris.

3.04 FIELD QUALITY CONTROL:

- A. Upon completion of installation of SPD equipment and after circuitry has been energized with rated power source. Verify that the equipment is operating properly. Where possible, correct malfunctioning units at site; otherwise remove and replace with new units and re-verify operation.

END OF SECTION 26 4313

SECTION 26 5000 - LIGHTING

PART 1 - GENERAL

1.01 SUMMARY:

- A. Extent, location, and details of lighting work are indicated on drawings and in schedules.
- B. Types of lighting in this section include the following:
 - 1. Light Emitting Diode (LED)

1.02 SUBMITTALS:

- A. See Section 26 0500 Common Work Results for Electrical for Submittal requirements. Supplemental information is listed within this section.
- B. Shop Drawings: Submit layout drawings of lighting and their spatial relationship to each other. In addition, submit luminaire cut sheets from the manufacturer. For standard products submit shop drawings; for non-standard products submit in booklet form with separate sheet for each luminaire, assembled by "luminaire type" with proposed luminaire and accessories clearly indicated on each sheet. Submit details indicating compatibility with ceiling grid system. Shop drawings shall detail luminaire dimensions, weights, methods of field assembly, mounting components, features and accessories. All features and accessories shall be clearly defined.
- C. Wiring Diagrams: Submit wiring diagrams for lighting showing connections to electrical power panels, switches, dimmers, controllers, and feeders. Differentiate between portions of wiring which are manufacturer-installed and portions which are field- installed.
- D. Samples: Submit one complete operating unit for each type of custom luminaire specified.
- E. Illumination Data: Submit lighting calculations identified below for all products not listed first in the luminaire schedule and where otherwise noted.
 - 1. Interior: Provide isofootcandle (isolux) plot diagram of footcandles on horizontal workplane surface which shows composite values of illuminance projected from the arrangement of light sources from indicated luminaire locations and heights. Show on the graphic plots the locations, spacing's and heights of luminaires. Indicate values of maximum, average, minimum, max/min ratios, and Lumen Maintenance factor utilized.
 - 2. Exterior: Provide isofootcandle (isolux) plot diagram of footcandles on horizontal pavement surface which shows composite values of illuminance projected from the arrangement of light sources from indicated luminaire locations and heights. Show on the graphic plots the locations, spacing's, heights of luminaires, and the Lumen Maintenance factor used.

1.03 QUALITY ASSURANCE:

- A. Manufacturer's Qualifications: Firms regularly engaged in manufacture of lighting of sizes, types and ratings required, whose products have been in satisfactory use in similar service for not less than 5 years.
- B. Installer's Qualifications: Firms with at least 3 years of successful installation experience on projects with lighting work similar to that required for this project.

1.04 DELIVERY, STORAGE, AND HANDLING:

- A. Deliver lighting in factory-fabricated containers or wrappings, which properly protect luminaires from damage.
- B. Store lighting in original packaging. Store inside well-ventilated area protected from weather, moisture, soiling, extreme temperatures, humidity, laid flat and blocked off ground.
- C. Handle lighting carefully to prevent damage, breaking, and scoring of finishes. Do not install damaged units or components; replace with new.

1.05 SEQUENCING AND SCHEDULING:

- A. Coordinate with other work including wires/cables, electrical boxes and fittings, and raceways, to properly interface installation of lighting with other work.
- B. Sequence lighting installation with other work to minimize possibility of damage and soiling during remainder of construction.

1.06 EXTRA MATERIALS:

- A. LED Modules: Furnish replacement modules amounting to 3% of each type.
- B. Deliver replacement stock as directed to Owner's storage space.

PART 2 - PRODUCTS

2.01 MANUFACTURERS:

- A. Luminaire Manufacturers: Subject to compliance with requirements, provide luminaires as listed in the luminaire schedule or elsewhere on the drawings or specification.
- B. LED Manufactures:
 - 1. Philips Lighting Co.
 - 2. Lumiled
 - 3. CREE
 - 4. Nichia
 - 5. Osram Sylvania

- C. All other manufacturers shall request prior approval and supply test data from an independent testing laboratory and comparison report to substantiate compliance with specifications and specified equipment.

2.02 EQUIPMENT:

- A. General: Provide lighting of sizes, types and ratings indicated; complete with, but not limited to, housings, energy-efficient lamps, lamp holders, reflectors, energy efficient ballasts, starters and wiring. Ship luminaires factory-assembled, with those components required for a complete installation. Design luminaire with concealed hinges and catches, with metal parts grounded as common unit, and so constructed as to dampen ballast generated noise and as to disconnect ballast when door is opened for HQI lamps.
- B. Lamps:
 - 1. Provide LED's that retain 70% of lamp life after 50,000 hours. LED's shall be binned to NEMA standard SSL 3-2010. *Indoor luminaires shall have remote phosphors. The LED light assembly shall be replaceable separate from the luminaire housing. The LED driver shall be dimming where indicated on the drawings. The dimmer switch shall be compatible with the driver, unless otherwise noted.*
 - a. *Indoor luminaires shall have remote phosphor technology for "white" LED's.
 - b. *All LED products and information to be in accordance with IES Standards LM79 & LM80.
 - 2. Provide all lamps with CRI 85 or higher unless otherwise indicated. It is important that color fidelity (color rendering aspects of lamp sources) and color appearance (the consistent appearance of the light source) are provided for all lamps.
- C. All lenses listed as .125" minimum shall be 9.1 oz/sq ft.
- D. LED Drivers: THD less than 10%. All 0-10V drivers shall be provided with isolation on the secondary analog side to eliminate secondary voltage on the 0-10V channel.

PART 3 - EXECUTION

3.01 EXAMINATION:

- A. Examine areas and conditions under which lighting is to be installed, and substrate for supporting lighting. Notify Contractor in writing of conditions detrimental to proper completion of the work. Do not proceed with work until unsatisfactory conditions have been corrected in manner acceptable to Installer.

3.02 INSTALLATION:

- A. Install lighting at locations and heights as indicated, in accordance with manufacturer's written instructions, applicable requirements of NEC, NECA's "Standard of Installation", NEMA standards, and with recognized industry practices to ensure that lighting fulfills requirements.

- B. Provide luminaires and/or outlet boxes with hangers to properly support luminaire weight. Submit design of hangers, method of fastening, other than indicated or specified herein, for review by Architect.
 - 1. Luminaires shall be positively attached to the suspended ceiling system. The attachment device shall have a capacity of 100% of the luminaire weight acting in any direction.
 - 2. When intermediate systems are used, No. 12 gauge hangers shall be attached to the grid members within 3" of each corner of each luminaire.
 - 3. When heavy-duty systems are used, supplemental hangers are not required if a 48" modular hanger pattern is followed. When cross runners are used without supplemental hangers to support luminaires, these cross runners shall provide the same carrying capacity as the main runner.
 - 4. Luminaires weighing less than 56 pounds shall have, in addition to the requirements above, two No. 12 gauge hangers connected from the luminaire housing to the structure above. These wires may be slack.
 - 5. Luminaires weighing 56 pounds or more shall be supported directly from the structure above by four No. 12 gauge hangers connected from the luminaire housing to the structure above. These wires may be slack.
- C. Install flush mounted luminaires properly to eliminate light leakage between frame and finished surface.
- D. Provide plaster frames for recessed luminaires installed in other than suspended grid type acoustical ceiling systems. Brace frames temporarily to prevent distortion during handling.
- E. Fasten luminaires securely to structural supports; and ensure that pendant luminaires are plumb and level. Provide individually mounted pendant luminaires longer than 2 feet with twin stem hangers. Provide stem hanger with ball aligners and provisions for minimum one inch vertical adjustment. Mount continuous rows of luminaires with an additional stem hanger greater than number of luminaires in the row.
 - 1. Pendant hung luminaires shall be supported directly from the structure above with No. 9 gauge wire or approved alternate support without using the ceiling suspension system for direct support.
 - 2. Luminaires mounted in areas of high seismic activity shall be mounted from a rigid stem to restrain sway. If mounted from a non-rigid stem, luminaires to be mounted such that their sway under seismic conditions does not impact another luminaire within 45° swing from nadir.
- F. Tighten connectors and terminals, including screws and bolts, in accordance with equipment manufacturer's published torque tightening values for equipment connectors. Where manufacturer's torquing requirements are not indicated, tighten connectors and terminals to comply with tightening torques specified in UL Stds 486A and B, and the National Electrical Code.
- G. Support surface mounted luminaires greater than 2 feet in length at a point in addition to the outlet box stud.

- H. Set units plumb, square, level and secure according to manufacturer's written instructions and shop drawings. Refer to specification section 26 5613, "Poles and Standards" for other requirements.

3.03 FIELD QUALITY CONTROL:

- A. Replace defective and burned out lamps for a period of one year following the Date of Substantial Completion.
- B. Refer to Division-1 sections for the replacement/ restoration of lamps in lighting where used for temporary lighting prior to Date of Substantial Completion.

3.04 ADJUSTING AND CLEANING:

- A. Clean lighting of dirt and construction debris upon completion of installation. Clean fingerprints and smudges from lenses and reflectors.
- B. Protect installed luminaires from damage during remainder of construction period.
- C. Adjust aimable luminaires to provide required light intensities and in compliance with design intent.

3.05 GROUNDING:

- A. Provide equipment grounding connections for lighting as indicated. Tighten connections to comply with tightening torques specified in UL Std 486A to assure permanent and effective grounds.
- B. Ground luminaires according to Section 26 0526, "Grounding," and Section 26 5613, "Poles and Standards."

3.06 WARRANTY

- A. The Contractor shall guarantee all equipment including ballasts, lamps, luminaires, wiring, etc. free from inherent mechanical and electrical defects. Warranty period shall be from date of acceptance as set forth in the general conditions with periods as follows:
 - 1. Luminaires, wiring, etc. - 1 year
 - 2. LED and Driver – Five year manufacturer's warranty.

3.07 DEMONSTRATION:

- A. Upon completion of installation of lighting and after building circuitry has been energized, apply electrical energy to demonstrate capability and compliance with requirements. Where possible, correct malfunctioning units at site, then retest to demonstrate compliance; otherwise, remove and replace with new units, and proceed with retesting.

END OF SECTION 26 5000

SECTION 27 0526 - GROUNDING AND BONDING FOR COMMUNICATIONS SYSTEMS

PART 1 - GENERAL

1.01 SUMMARY:

- A. Provide all services, labor, materials, tools, and equipment required for the complete and proper installation of telecommunications grounding and bonding for the Structured Cabling System as called for in these specifications and related drawings.

1.02 SYSTEM DESCRIPTION:

- A. Each Telecommunications Room (TR) in a building shall have a Telecommunications Grounding Busbar (TGB) properly connected per TIA-607-B.
- B. Relevant bonding and grounding infrastructure acronyms:
 - 1. EK (Equipment Bonding Conductor): An insulated copper conductor that bonds metallic items and equipment to the TMGB and TGB.
 - 2. IC (Interconnecting Bonding Conductor) (referred to in TIA-607-B as the Bonding Conductor for Telecommunications): The copper conductor that bonds the TMGB to the service equipment (power) ground.
 - 3. TBB (Telecommunications Bonding Backbone): An insulated copper conductor extending from the TMGB to each TGB.
 - 4. TGB (Telecommunications Grounding Busbar): A copper ground reference busbar, typically installed in telecommunications rooms (TR) that is bonded to the TMGB by the TBB. The TGB references metallic entities in the TR space to ground.
 - 5. TMGB (Telecommunications Main Grounding Busbar): A copper ground reference busbar, typically installed in the entrance facility or entrance room that is bonded to the service equipment (power) ground by the IC.

1.03 ACTION SUBMITTALS:

- A. Refer to Section 27 0500 Common Work Results for Communications

1.04 QUALITY ASSURANCE:

- A. Comply with Section 27 0500.
- B. All work shall conform to Article 250-Grounding and Article 800-Communications of the National Electrical Code (NEC) for grounding, bonding, and protecting electrical and communications circuits.
- C. Materials and work specified herein shall comply with the applicable requirements of TIA-607-B Commercial Building Grounding and Bonding Requirements for Telecommunications.
- D. Materials and work specified herein shall comply with the applicable requirements of IEEE-426.

- E. If there is a conflict between the grounding standards, follow IEEE-426 as the primary standard.
- F. Delivery, storage and handling.
- G. Comply with Section 27 0500.

PART 2 - PRODUCTS

2.01 MATERIALS AND FABRICATION:

- A. Telecommunication Main Grounding Busbar (TMGB) shall be 1/4" x 4" x 20" insulated copper ground bar in size.
- B. Telecommunication Grounding Busbar (TGB) shall be 1/4" x 4" x 10" insulated copper ground bar in size.
- C. Equipment Rack Busbars shall be 1/4" x 1" x 19" rack ground bar in size.
- D. Bonding Conductors:
 - 1. All bonding conductors shall be insulated copper. The exception is the use of flat, braided, aluminum ground straps utilized for bonding sections of aluminum cable trays.
 - 2. Unless otherwise specified, the IC (Interconnecting Bonding Conductor) (referred to in TIA-607 as the Bonding Conductor for Telecommunications) shall be insulated, copper, No. 3/0 AWG.
 - 3. Unless otherwise specified, the TBB (Telecommunications Bonding Backbone) shall be green-colored (or identified as a grounding wire every 10 feet) insulated, copper, No. 3/0 AWG.
 - 4. Unless otherwise specified, the EK (Equipment Bonding Conductor) shall be green-colored insulated, copper, No. 6 AWG.
- E. Bonding conductor terminations acceptable materials:
 - 1. Two-hole compression lugs: Color coded to appropriate cable, high conductivity wrought copper, electro tin plated, or approved equal.
 - 2. One-hole compression lugs: Color coded to appropriate cable, high conductivity wrought copper, electro tin plated, or approved equal.

PART 3 - EXECUTION

3.01 EXAMINATION:

- A. Comply with Section 27 0500.

3.02 INSTALLATION:

- A. Provide all local bonding as specified on the drawings and in the specifications.

- B. Bonding conductors shall be continuous and routed in as direct a route as possible to the point of termination.
- C. All insulated ground bars must be isolated from the structural support by a 2-inch minimum separation, using manufacturer's recommended insulating stand-offs and hardware.
- D. Clean ground bars prior to terminating conductors.
- E. Label all telecommunications bonding conductors as close as possible to their termination point.
- F. Confirm that the electrical contractor bonded the TMGB to the service equipment (power) ground, typically located in the electrical entrance facility, utilizing the most direct route possible to minimize conductor length.
- G. Bond the following when present:
 - 1. Metallic equipment racks.
 - 2. Cable shields.
 - 3. All metal raceways and cable trays.

END OF SECTION 27 0526

Pivot North Architecture
100% Construction Set
March 17, 2023

TWIN FALLS TRAINING FACILITY
SECTION 27 0526
GROUNDING AND BONDING FOR COMMUNICATIONS SYSTEMS

SECTION 27 0544 - SLEEVES AND SLEEVE SEALS FOR COMMUNICAITONS PATHWAYS 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. 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. 07 84 13 Penetration Firestopping

1.03 ACTION SUBMITTALS

- A. Refer to Section 27 0500 Common Work Results for Communications

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 (0.6-mm) 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:

SLEEVES AND SLEEVE SEALS FOR COMMUNICATIONS PATHWAYS AND CABLING

- a. For sleeve cross-section rectangle perimeter less than 50 inches (1270 mm) and with no side larger than 16 inches (400 mm), thickness shall be 0.052 inch (1.3 mm).
- b. For sleeve cross-section rectangle perimeter 50 inches (1270 mm) or more and one or more sides larger than 16 inches (400 mm), thickness shall be 0.138 inch (3.5 mm).

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 or Plastic.
 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. Sleeve-seal fittings in this article are used for conduit penetrations in slabs-on-grade and in exterior walls. These fittings are made to match conduit OD, so they must be selected to match the penetrating piping size. They are available for NPS 1/2 to 6 (DN 15 to 150) piping.
- B. 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 07 9200 "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 (6.4-mm) annular clear space between sleeve and pathway or cable unless sleeve seal is to be installed.
 - 4. Install sleeves for wall penetrations unless core-drilled holes or formed openings are used. Install sleeves during erection of walls. Cut sleeves to length for mounting flush with both surfaces of walls. Deburr after cutting.
 - 5. Install sleeves for floor penetrations. Extend sleeves installed in floors 2 inches (50 mm) 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]** **[cast-iron]** pipe sleeves and mechanical sleeve seals. Select sleeve size to allow for 1-inch (25-mm) 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 (25-mm) 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. Refer to Section 27 0500 Common Work Results for Communications

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.
- D. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes.
 - 1. Differential values in "Temperature Change" Subparagraph below (for aluminum in particular) are suitable for most of the United States.
 - 2. Temperature Change: 120 deg F (67 deg C), ambient; 180 deg F (100 deg C), material surfaces.

2.02 COLOR AND LEGEND REQUIREMENTS

- A. 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 of raceway or cable they identify, that stay in place by gripping action.
- C. Self-Adhesive Wraparound Labels: Preprinted, 3-mil- (0.08-mm-) thick, polyester or vinyl 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 or Vinyl, 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 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.

2.06 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.

2.07 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 (150 mm) 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 (150 mm) 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 (150 mm) 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- (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.
- 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 (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.
- 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. Patch Panels: //Label individual rows in each rack, starting at top and working down, with self-adhesive labels.
 - 3. Data Outlets: Label each outlet with a self-adhesive label indicating the following, in the order listed:
 - a. Room number being served.
 - b. Cable/Port number.
 - c. Faceplate number.
- F. Backbone Cables: Label each cable with a 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 self-adhesive wraparound label indicating the following, in the order listed:
 - 1. Room number.
 - 2. Cable/Port number.
 - 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: Self-adhesive labels.
 - 1. Apply to exterior of door, cover, or other access.
- K. Equipment Identification Labels:
 - 1. Indoor Equipment: Self-adhesive label.
 - 2. 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.
- g. Patch Panels.
- h. Cables.
- i. Conduit.
- j. Grounding conductors and busbars.

END OF SECTION 27 0553

SECTION 27 0600 - SCHEDULES FOR COMMUNICATIONS SYSTEMS

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

- A. General provisions of Contract, including General and Supplementary Conditions and Division-1 Specification sections.
- B. Architectural, Electrical, Structural, Civil, Mechanical, Plumbing, Fire Protection, and Technology Drawings & Specifications. Other systems drawings may apply. Division 26 Basic Electrical Materials and Methods sections apply to work of this section.

1.02 SUMMARY

- A. This section includes the associated equipment schedules appendices for all other sections. Refer to each section for specific details related to the equipment schedules below.
- B. The manufacturers and part numbers listed are the basis of design. Part numbers and manufacturers may be substituted with products that meet or exceed the performance listed. Submit substitution requests to the Technology Consultant prior to bidding.
- C. Four manufacturers are listed in the COMMUNICATIONS HORIZONTAL CABLING SCHEDULES section. Any of the four can be selected in their entirety but mixing material between several manufacturers is not permitted.

PART 2 - MATERIALS

2.01 SECTION 27 1100 – COMMUNICATIONS EQUIPMENT ROOM FITTINGS

Line	Description	Manufacturer	Part Number
1	12"W X 10' BLACK LADDER RACK	CHATSWORTH	10250-712
2	CABLE RUNWAY, E-BEND 12", BLACK	CHATSWORTH	10822-712
3	OUTSIDE RADIUS BEND, 12" BLACK	CHATSWORTH	10723-712
4	INSIDE RADIUS BEND, 12" BLACK	CHATSWORTH	10724-712
5	BUTT-SPLICE KIT, BLACK	CHATSWORTH	1103-701
6	JUNCTION-SPLICE KIT, BLACK	CHATSWORTH	11302-701
7	HEAVY-DUTY BUTT-SPLICE KIT, BLACK	CHATSWORTH	11299-701
8	HEAVY-DUTY JUNCTION SPLICE KIT,	CHATSWORTH	11298-701
9	ADJUSTABLE JUNCTION SPLICE KIT,	CHATSWORTH	10616-701
10	90° RUNWAY-SPLICE KIT, BLACK	CHATSWORTH	11314-701
11	45° RUNWAY-SPLICE KIT, BLACK	CHATSWORTH	11313-701
12	BUTT SWIVEL SPLICE KIT, BLACK	CHATSWORTH	10487-701
13	JUNCTION SWIVEL SPLICE KIT, BLACK	CHATSWORTH	10488-701
14	VERTICAL SWIVEL SPLICE KIT, BLACK	CHATSWORTH	10489-701
15	GROUNDING KIT, ZINC	CHATSWORTH	12061-001
16	TRIANGULAR SUPPORT BRACKET, FOR 6"-12" WIDE LADDER RACK, 100 LB. CAPACITY, BLACK	CHATSWORTH	11312-712

17	WALL ANGLE SUPPORT KIT, FOR 12"	CHATSWORTH	11421-712
18	FOOT KIT, STEEL, GOLD	CHATSWORTH	11309-001
19	ADJUSTABLE FLOOR SUPPORT CHANNEL, FOR 12" WIDE LADDER RACK	CHATSWORTH	11241-712
20	CENTER SUPPORT KIT, FOR 12" LADDER	CHATSWORTH	12362-712
21	RACK-TO-RUNWAY MOUNTING PLATE, FOR 9" TO 12" WIDE LADDER RACK	CHATSWORTH	10595-112
22	TWO-POST RACK 19" RACK	CHATSWORTH	55053-703
23	6" VERTICAL WIRE MANAGER	CHATSWORTH	30095-703
24	10" VERTICAL WIRE MANAGER	CHATSWORTH	30096-703
25	HORIZONTAL WIRE MANAGER	CHATSWORTH	30130-719
	THE ABOVE MATERIAL LISTED BY CHATSWORTH MAY BE SUBSTITUTED WITH MATERIAL BY B-LINE OR HOFFMAN		

2.02 SECTION 27 1500 – COMMUNICATIONS HORIZONTAL CABLING SCHEDULES

Line	Description	Manufacturer	Part Number
	COMMSCOPE SOLUTION		
1	CATEGORY 6 CABLING	COMMSCOPE	CS37
2	MODULAR JACK, CAT6, RJ45,	COMMSCOPE	UNJ600-XX
3	24 PORT PATCH PANEL CAT 6	COMMSCOPE	UNP-6-DM-1U-24
4	48 PORT PATCH PANEL CAT 6	COMMSCOPE	UNP-6-DM-2U-48
5	PATCH PANEL LABEL	COMMSCOPE	760199570
6	LE TYPE FLUSH MOUNTED FACEPLATE - 1	COMMSCOPE	M10LE-148
7	LE TYPE FLUSH MOUNTED FACEPLATE - 2	COMMSCOPE	M12LE-148
8	LE TYPE FLUSH MOUNTED FACEPLATE - 4	COMMSCOPE	M14LE-148
	BELDEN SOLUTION		
1	CATEGORY 6 CABLING	BELDEN	3613
2	MODULAR JACK, CAT6, RJ45,	BELDEN	RV6MJKUBK
3	24 PORT PATCH PANEL CAT 6	BELDEN	RV6PPF2U24BK
4	48 PORT PATCH PANEL CAT 6	BELDEN	RV6PPF2U48BK
5	LE TYPE FLUSH MOUNTED FACEPLATE - 1	BELDEN	AX103922-XX
6	LE TYPE FLUSH MOUNTED FACEPLATE - 2	BELDEN	AX103923-XX
7	LE TYPE FLUSH MOUNTED FACEPLATE - 4	BELDEN	AX102248-XX
	SUP/ESSEX SOLUTION		
1	CATEGORY 6 CABLING	SUP/ESSEX	77-272-XB
2	MODULAR JACK, CAT6, RJ45,	ORTRONICS	OR-TJ600
3	24 PORT PATCH PANEL CAT 6	ORTRONICS	OR-SP6U24
4	48 PORT PATCH PANEL CAT 6	ORTRONICS	OR-SP6U48
5	LE TYPE FLUSH MOUNTED FACEPLATE - 1	ORTRONICS	KSFP1-XX
6	LE TYPE FLUSH MOUNTED FACEPLATE - 2	ORTRONICS	KSFP2-XX

7	LE TYPE FLUSH MOUNTED FACEPLATE - 4	ORTRONICS	KSFP3-XX
	LEV/BERK-TEK SOLUTION		
1	CATEGORY 6 CABLING	LEV/BERK-TEK	CX6000
2	MODULAR JACK, CAT6, RJ45,	LEV/BERK-TEK	61SJK-RX6
3	24 PORT PATCH PANEL CAT 6	LEV/BERK-TEK	69270-U24
4	48 PORT PATCH PANEL CAT 6	LEV/BERK-TEK	69270-U48
5	LE TYPE FLUSH MOUNTED FACEPLATE - 1	LEV/BERK-TEK	42080-XXX
6	LE TYPE FLUSH MOUNTED FACEPLATE - 2	LEV/BERK-TEK	42080-XXX
7	LE TYPE FLUSH MOUNTED FACEPLATE - 4	LEV/BERK-TEK	42080-XXX
9	PENDENT MOUNT WAP ENCLOSURE	OBERON	900-HC-WT

END OF SECTION

SECTION 27 1100 - COMMUNICATIONS EQUIPMENT ROOM FITTINGS

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

- A. General provisions of Contract, including General and Supplementary Conditions and Division-1 Specification sections.
- B. Architectural, Electrical, Structural, Civil, Mechanical, Plumbing, Fire Protection, and Technology Drawings & Specifications. Other systems drawings may apply. Division 26 Basic Electrical Materials and Methods sections apply to work of this section.

1.02 SUMMARY

- A. Provide all services, labor, materials, tools, and equipment required for the complete and proper installation within the Telecommunications Room as called for in these specifications and related drawings.
- B. This section includes minimum requirements and installation methods for the following:
 - 1. Equipment Racks and Cable Routing Hardware
 - 2. Copper Termination Equipment
 - 3. Fiber Termination Equipment
 - 4. Coaxial Termination Equipment
 - 5. Grounding and Bonding

1.03 QUALITY ASSURANCE

- A. All installation work in the Telecommunications Rom shall be performed in a neat and workmanlike manner. All methods of construction that are not specifically described or indicated shall be subject to the control of the Owner.
- B. Equipment and materials shall be of the quality and manufacture indicated. The equipment specified is based on the acceptable manufacturers listed. Where “approved equal” is stated, equipment shall be equivalent in every way to that of the equipment specified and subject to approval of the Owner based on submittals provided.
- C. Installations, materials, equipment and workmanship shall conform to the specifications and drawings and all applicable provisions of the most recent versions of the following regulations, codes, and standards including all applicable addenda:
 - 1. ANSI/NFPA 70 – National Electrical Code including, but not limited to, the following articles:
 - a. 250 – Grounding and Bonding
 - b. 300 – Wiring Methods
 - c. 645 – Information Technology Equipment
 - d. 725 – Class 1, Class 2, and Class 3 Remote Control, Signaling, and Power-Limited Circuits

- e. 770 – Optical Fiber Cables and Raceways
- f. 800 – Communications Circuits
- 2. ANSI/TIA-568-C.0 – Generic Telecommunications Cabling for Customer Premises
- 3. ANSI/TIA-568-C.1 – Commercial Building Telecommunications Cabling Standard
- 4. ANSI/TIA-568-C.2 – Balanced Twisted-Pair Telecommunications Cabling and Components Standard
- 5. ANSI/TIA-568-C.3 – Optical Fiber Cabling Components Standard
- 6. ANSI/TIA-568-C.4 – Broadband Coaxial Cabling and Components Standard
- 7. ANSI/TIA-569-C – Commercial Building Standard for Telecommunications Pathways and Spaces
- 8. ANSI/TIA-604 Series – Fiber Optic Connector Intermateability Standards
- 9. ANSI/TIA-606-B – Administration Standard for Commercial Telecommunications Infrastructure
- 10. ANSI/TIA-607-B – Generic Telecommunications Bonding and Grounding (Earthing) for Customer Premises
- 11. BICSI Telecommunications Distribution Methods Manual
- 12. BICSI Telecommunications Cabling Installation Manual
- 13. FCC CFR 47 Part 68 – Direct Connection of Terminal Equipment to the Public Switched Telephone Network (PSTN)

PART 2 - MATERIALS

2.01 EQUIPMENT AND MATERIALS REQUIREMENTS

- A. Refer to Sheet Notes and Specification 27 06 00 Schedules for Communications for product data and part numbers.

PART 3 - EXECUTION

3.01 LADDER RACK:

- A. Provide all components of the ladder rack system (ladder rack, turns, splices, supports, and accessories) from a single manufacturer.
- B. Ladder rack shall be installed with side stringers facing down so that the ladder forms an inverted U-shape and so that welds between the stringers (sides) and cross members (middle) face away from cables.
- C. Ladder rack shall be secured to the structural ceiling, building truss system, wall, floor or the tops of equipment racks and/or cabinets using the manufacturer's recommended supports and appropriate installation hardware and methods as defined by local code or the authority having jurisdiction (AHJ).
- D. Ladder rack splices will be made in mid-span, not over a support, with the manufacturer's recommended splice hardware.

- E. Ladder rack shall be supported every 5' or less in accordance with TIA-569-C. Ladder rack shall be supported within 2' of every splice and within 2' on both/all sides of every intersection. Support ladder rack within 2' on both sides of every change in elevation. Support ladder rack every 2' when attached vertically to a wall.
- F. Heavy-duty splices are recommended for ladder rack in excess of 18" width (18" wide ladder rack). Heavy-duty splices are required for any splice formed in the vertical orientation including changes in elevation formed using vertical-to-horizontal 90° turns or horizontal-to-vertical 90° turns. Use heavy-duty splices to secure all overhead turns to the overhead horizontal pathway(s).
- G. When the pathway is overhead, ladder rack shall be installed with a minimum clearance of 12" above the ladder rack. Leave a minimum of 12" in between ladder rack and ceiling/building truss structure. Leave a minimum of 3" in between ladder rack and the tops of equipment racks and/or cabinets. Multiple tiers of ladder rack shall be installed with a minimum clearance of 12" in between each tier of ladder rack. When located above an acoustical drop ceiling, leave a minimum of 3" clearance between the top of the drop ceiling tiles and the bottom of the ladder rack.
- H. When installed under a raised floor, ladder rack shall be installed with a minimum 3" clearance between the top of the ladder rack and the bottom of the floor tiles or floor system stringers, whichever is lower in elevation. Maintain a 3" clearance between ladder racks wherever ladder racks cross.
- I. Within each Telecommunications Room, ladder rack should be bonded together, electrically continuous, and bonded to the Telecommunications Grounding Busbar (TGB), unless otherwise noted in the specifications and contract documents. Ladder rack and turns shall be bonded across each splice with a bonding kit. Ladder rack shall be bonded to the Telecommunications Grounding Busbar (TGB) using an approved ground lug on the ladder rack and a minimum #6 grounding wire or as recommended by the AHJ.
- J. Remove factory paint from the ladder rack where bonding/ground lugs contact the ladder rack so that the lug will contact bare metal. Use antioxidant joint compound in between the bare metal on the ladder rack and ground lug. Use antioxidant joint compound in between the bus bar and the ground lug. Verify continuity through the bonds at splices and intersections between individual ladder rack sections and connection points to the TGB.
- K. The quantity of cables within the ladder rack will not exceed a whole number value equal to 50% of the interior area of the ladder rack divided by the cross-sectional area of the cable. The interior area of ladder rack will be considered to be the width of the ladder rack multiplied by a height of 2", unless cable retaining posts are added to the ladder rack. The interior area of ladder rack equipped with cable retaining posts will be considered to be the width of the ladder rack multiplied by a height of 6". Actual cable fill for ladder rack that is not equipped with cable retaining posts will not exceed 2" in height. Actual cable fill for ladder rack equipped with cable retaining posts will not exceed 6" in height.

- L. The combined weight of cables within the ladder rack will not exceed the stated load capacity of the ladder rack as stated in the manufacturer's product specifications or load/design tables.
 - M. Cables (cable bundles) will be secured to the cross members of ladder rack with $\frac{3}{4}$ " wide reusable straps. Straps are not required when ladder rack is equipped with cable retaining posts.
 - N. Add 8" high cable retaining posts to the open sides of ladder rack when cable fill exceeds 2" in height or when cable bundles cannot be secured directly to the ladder rack cross members with a strap. Cable fill within any ladder rack should not exceed 6" in height.
 - O. When a single ladder rack supports different types of cable media, the cable media will be separated within the pathway by cable spools that attach to the cross members on the ladder rack. Treat each type of cable media and divided area of the ladder rack separately when determining cable fill limits.
 - P. Use a radius drop to guide cables wherever cable exits overhead ladder rack to access a rack, frame, cabinet or wall-mounted rack, cabinet or termination field. If necessary, provide a moveable cross member also to attach and align the radius drop in between the welded cross members of a ladder rack.
 - Q. Cover the exposed ends of cable runway that do not terminate against a wall, the floor or the ceiling with end caps or an end closing kit.
 - R. Use auxiliary support brackets that attach to the side stringer of the ladder rack to support interconnect cabling (patch cords, equipment cords, jumper cords) that is routed between racks using the ladder rack. Auxiliary support brackets can be used to support other conductors that should be physically separated from cables within the ladder rack as defined by local code or the authority having jurisdiction (AHJ).
 - S. Whenever possible, maintain a 2' separation between ladder rack used for communications cables and pathways for other utilities or building services.
 - T. The installer will provide touch-up paint color-matched to the finish on the ladder rack and will correct any minor cosmetic damage (chips, small scratches, etc.) resulting from normal handling during the installation process prior to delivery to the owner. If a component is cosmetically damaged to the extent that correction in the field is obvious against the factory finish, the component will be replaced with a new component finished from the factory. If a component is physically damaged due to mishandling or modification during the installation process, it shall not be used as part of the ladder rack system.
- 3.02 HORIZONTAL CABLE MANAGERS:
- A. When more than one horizontal cable manager is used on a rack/frame/cabinet or group of racks/frames/cabinets, use the same make, and style of cable manager on the rack/frame/cabinet or racks/frames/cabinets.
 - B. The color of the rack(s)/frame(s)/cabinet(s) and cable manager(s) must match.

- C. Attach horizontal cable managers to the rack/frame/cabinet with four screws according to the manufacturer's installation instructions. Each cable manager should be centered within the allocated rack-mount space (RMU).
- D. Horizontal managers will be located so that the number of ports (cables) they support will not exceed the cable fill capacity of the cable manager.
- E. Covers should be attached to the cable manager and in the closed position after cabling is complete.

3.03 VERTICAL CABLE MANAGERS:

- A. Attach vertical cable managers to the side of the rack/frame using the manufacturer's installation instructions and included hardware.
- B. When a single vertical cable manager is used in between two racks/frames, attach the vertical cable manager to both racks/frames.
- C. When more than one cable manager is used on a rack/frame or group of racks/frames, use the same make, style and size of vertical cable manager on the rack/frame or in between racks/frames.
- D. The color of the rack(s)/frame(s) and cable manager(s) must match.
- E. Doors should be attached to the cable manager and in the closed position after cabling is complete.

3.04 COAXIAL TERMINATION EQUIPMENT INSTALLATION

- A. Other than equipment specifically designed for rack-mounting, all equipment intended for CATV distribution shall be wall mounted.
- B. All active and passive wall-mounted equipment shall be attached using mounting plates and hardware providing a solid installation.
- C. All equipment shall be mounted so that adequate air flow is provided for heat dissipation.
- D. All backbone connectors shall be attached and tightened to product specifications.
- E. Heat shrink tubing shall be used on Outside Plant (OSP) cable connections. It will not be used on any inside cable not having flooding compound.

END OF SECTION 27 1110

SECTION 27 1500 – COMMUNICATIONS HORIZONTAL CABLING

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

- A. General provisions of Contract, including General and Supplementary Conditions and Division-1 Specification sections.
- B. Architectural, Electrical, Structural, Civil, Mechanical, Plumbing, Fire Protection, and Technology Drawings & Specifications. Other systems drawings may apply. Division 26 Basic Electrical Materials and Methods sections apply to work of this section.

1.02 SUMMARY

- A. Provide all services, labor, materials, tools, and equipment required for the complete and proper installation and termination of new horizontal “station” cabling as called for in these specifications and related drawings.
- B. The horizontal portion of the telecommunications cabling system extends from the work area telecommunications outlet to the termination in the Telecommunications Room (TR).
- C. This section includes minimum requirements and installation methods for the following:
 - 1. Copper Horizontal Cabling
 - 2. Fiber Optic Horizontal Cabling
 - 3. Work Area Faceplates
 - 4. Copper Modular Jacks
 - 5. Fiber Modular Jacks and Connectors
 - 6. Coaxial Horizontal Cabling

1.03 QUALITY ASSURANCE

- A. All horizontal “station” cable installation and termination shall be performed in a neat and workmanlike manner. All methods of construction that are not specifically described or indicated shall be subject to the control of the Owner.
- B. Equipment and materials shall be of the quality and manufacture indicated. The equipment specified is based on the acceptable manufacturers listed. Where “approved equal” is stated, equipment shall be equivalent in every way to that of the equipment specified and subject to approval of the Consultant and the Owner based on submittals provided.
- C. Installations, materials, equipment and workmanship shall conform to the specifications and drawings and all applicable provisions of the most recent versions of the following regulations, codes, and standards including all applicable addenda:
 - 1. ANSI/NFPA 70 – National Electrical Code including, but not limited to, the following articles:
 - a. 300 – Wiring Methods

- b. 645 – Information Technology Equipment
- c. 725 – Class 1, Class 2, and Class 3 Remote Control, Signaling, and Power-Limited Circuits
- d. 770 – Optical Fiber Cables and Raceways
- e. 800 – Communications Circuits
- f. ANSI/TIA-568-C.0 – Generic Telecommunications Cabling for Customer Premises
- g. ANSI/TIA-568-C.1 – Commercial Building Telecommunications Cabling Standard
- h. ANSI/TIA-568-C.2 – Balanced Twisted-Pair Telecommunications Cabling and Components Standard
- i. ANSI/TIA-568-C.3 – Optical Fiber Cabling Components Standard
- j. ANSI/TIA-568-C.4 – Broadband Coaxial Cabling and Components Standard
- k. ANSI/TIA-604 Series – Fiber Optic Connector Interchangeability Standard
- l. ANSI/TIA-606-B – Administration Standard for Commercial Telecommunications Infrastructure
- m. ANSI/ICEA S-83-596 – Indoor Optical Fiber Cables
- n. BICSI Telecommunications Distribution Methods Manual
- o. BICSI Telecommunications Cabling Installation Manual

PART 2 - MATERIALS

2.01 EQUIPMENT AND MATERIALS REQUIREMENTS

- A. Refer to Sheet Notes and Specification 27 06 00 Schedules for Communications for product data and part numbers.

2.02 INSTALLATION MATERIALS, EQUIPMENT, AND TOOLS

- A. Furnish all required materials, equipment, and tools necessary to properly complete the horizontal copper UTP, coaxial CATV, and fiber optic cabling system installation including, but not limited to: tools for pulling and terminating the cables, mounting hardware, cable ties, bolts, anchors, clamps, hangers, kits of consumables, lubricants, communication devices, stands for cable reels, cable wenchers, etc.
- B. Poly line: poly pull line with a minimum pull tensile strength of 200 pounds.

PART 3 - PART 3 - EXECUTION

3.01 CABLES

- A. Backbone and horizontal station telecommunications cabling shall be placed in separate dedicated pathways. Cable trays shall be clearly divided between backbone and horizontal station cabling.
- B. Telecommunications pathways shall be dedicated for use for the Owner voice, data, CATV and AV cabling. Other services on the Owner's cables (intercom, audio, video, security, fire, BAS, DAS, etc.) may be placed in telecommunications pathways only with prior written approval from

the Owner. Horizontal cabling for other services may be allowed within the Owner's pathways per the following guidelines and acceptance of written approval from the Owner. The Owner must understand and accept the services to be used on the Horizontal cabling as to not create interference with other services within the pathways. The Owner will be the sole owner of the horizontal cabling with jacks on both ends that will be installed and tested per this Division 27 standard. Other terminations and systems can be reviewed by the Consultant but all Horizontal cabling for other services must be approved in writing from the Owner.

- C. All horizontal cabling terminating within a single faceplate must be routed to and terminated in the same TR.

3.02 HORIZONTAL CABLING INSTALLATION

- A. Install faceplates with UTP copper, coax and fiber jacks at each work area outlet location as indicated on the project drawings. Place the jacks in the faceplates beginning with position A and placing the copper jacks before the CATV coaxial and/or fiber adapter jacks. Place blank covers in the unused openings on each faceplate.
- B. Faceplates shall be secured with mechanical fasteners. Adhesive fasteners shall not be allowed.
- C. Install copper UTP, coaxial, and/or fiber optic horizontal cable from each work area outlet location indicated on the drawings to the TR designated on the project drawings.
- D. Where any portion of the horizontal cable will be routed outside, or under slab, Outside Plant (OSP) rated cable shall be installed. OSP horizontal cabling shall be fully enclosed in conduit for the entire route from the outlet to the TR.
- E. All horizontal cabling terminating within a single faceplate must be routed to and terminated in the same TR.
- F. Install one back box and one Category 6 jack at each Wireless AP location.
- G. Perform all horizontal cable installation in conformance with manufacturer's installation guidelines.
- H. Ensure that maximum pulling tensions of specified cables are not exceeded and cable bends maintain the proper radius during placement.
- I. The horizontal cable distribution system design uses conduit J-hooks for support from the outlet location to the TR or ER as shown on the project drawings. Coordinate as necessary with electrical contractor for placement of horizontal cable pathways and outlet boxes.
- J. Horizontal telecommunications cabling shall be placed in dedicated pathways separate from backbone and other cabling.
- K. All horizontal cables within the TRs shall be bundled with Velcro cable every 8 to 12 inches from the patch panels to the point where the cables exit the room. The Velcro cable ties shall hold,

but not deform, the cables, and shall overlap a minimum of 2" to allow for more cable to be added in the future. Cable bundles shall have no more than 32 cables per bundle.

- L. A small drip loop is required on the horizontal cables at the patch panel for trouble shooting and future changes. The drip loop on the horizontal cable should be approximately 2RU from the jack in the panel to the bottom of the loop.
- M. The horizontal cabling routing from each jack on the back of the patch panels shall route to the nearest side of the panel and shall not cross the center line of the panel. The only exception is for hinged swing-out wall racks, where the horizontal cabling will route from each jack to the hinged side of the panel to allow the rack to swing open for future installations and maintenance.
- N. Install new Poly line in all conduits and cable trays while pulling in new horizontal cables.
- O. Ceiling tile shall be removed as necessary for the cable installation and put back in place without damaging or dirtying any of the tiles or supporting framework. Ceiling tile shall be handled with clean hands so that no fingerprints or marks are left on the tiles. The contractor is responsible for the cost of repair or replacement of any damaged or dirtied tiles or ceiling hardware.
- P. All cables in the ceiling space:
 - 1. Shall be supported in conduit J-hooks at approved intervals;
 - 2. Shall not be run "wild" (unsupported by conduit, J-hooks) for distances greater than four feet;
 - 3. Shall not be attached to the suspended ceiling structure or laid directly on the ceiling grid as a means of support;
 - 4. Shall not be supported by or attached by any means to fire sprinkler heads or delivery systems, any environmental sensor, or the exterior of any conduit or raceway;
 - 5. Shall be routed at right angles to the electrical power circuits where the cable is not enclosed in conduit or in cable tray.
- Q. Where specifically allowed by the Owner, J-hooks shall be specifically designed and installed for the purpose of supporting telecommunications cables. The J-hooks shall be attached to the building structure and framework at a maximum of four-foot intervals.
- R. All cables in J-hooks shall be bundled with plenum rated Velcro cable ties every 8 to 12 inches. The Velcro cable ties shall hold, but not deform, the cables, and shall overlap a minimum of 2" to allow for more cable to be added in the future. Cable bundles shall have no more than 32 cables per bundle.
- S. The total length of any horizontal station cable from the jack location at the outlet to the termination in the TR shall not exceed 295 feet. Where building or infrastructure conditions prohibit meeting this requirement, notify the Owner's Construction Manager (CM) and Consultant immediately for resolution.
- T. Dress and manage excess cable for the entire horizontal cable run to avoid excess cable kinking.

- U. For copper UTP or coaxial cable in J-hooks or non-metal pathways, maintain the following clearances from EMI sources:
 - 1. Unshielded power lines or equipment less than 5 kVA: 12"
 - 2. Unshielded power lines or equipment equal to or greater than 5 kVA: 24"
 - 3. Power lines enclosed in grounded metal conduit less than 5 kVA: 6"
 - 4. Power lines enclosed in grounded metal conduit equal to or greater than 5 kVA: 12"
 - 5. Fluorescent fixtures: 12"
 - 6. Motors or transformers: 48"

- V. For copper UTP or coaxial cable in grounded metal pathways (conduit), maintain the following clearances from EMI sources:
 - 1. Unshielded power lines or equipment less than 5 kVA: 6"
 - 2. Unshielded power lines or equipment equal to or greater than 5 kVA: 12"
 - 3. Power lines enclosed in grounded metal conduit less than 5 kVA: 3"
 - 4. Power lines enclosed in grounded metal conduit equal to or greater than 5 kVA: 6"
 - 5. Fluorescent fixtures: 6"
 - 6. Motors or transformers: 36"

- W. Do not splice or bridge tap the horizontal cable.

- X. All cables shall be tied and dressed neatly with a minimum bend radius of 10 times the cable diameter. Provide necessary hardware to maintain proper bend radius at corners.

- Y. All cables shall be firmly held in place. Fastenings and supports shall be adequate to support loads with ample safety factors.

- Z. Failure to follow appropriate guidelines for cable installation will require the Contractor to provide, in a timely fashion, the additional material and labor necessary to rectify the situation. This shall apply to any and all damages sustained to the cables during installation.

- AA. The Contractor shall be responsible for all damage to the cable during placement.

- BB. Cables with jackets that are chaffed or burned exposing internal conductor insulation or have any bare copper (shiners) shall be replaced.

- CC. Do not roll or store cable reels without an appropriate underlay.

- DD. Firestop the insides of all sleeves through fire rated barriers with a UL approved system after cable installation is complete.

- EE. Test, label and document final horizontal cable installation including outlet numbering on as-built drawings.

- FF. Remove existing cable and terminations that will no longer be used as specified and shown on project drawings.

- GG. Remove existing cable and terminations that will no longer be used as specified and shown on project drawings.

- HH. Coordinate as necessary with electrical contractor for removal of existing horizontal cable pathways and outlet boxes.
- II. A single gang vertical cover shall be installed for securing voice and data patch connections at such locations as kiosks, as shown on the project drawings.

3.03 COPPER CABLE TERMINATION

- A. Terminate all pairs on both ends of the copper UTP horizontal cable on the jack with TIA T568B pin- pair assignments per manufacturer's guidelines.
- B. With prior written approval from Owner only, match existing termination practice for horizontal cables to 110-type blocks.
- C. All cables shall be terminated with proper strain relief to the terminating equipment.

3.04 COAXIAL HORIZONTAL CABLING

- A. All drops shall be home-run from the distribution tap to the face plate, with no drop splitters or amplifiers to be used. Variations of this requirement shall be made only with express written approval from the Owner, CATV Operations.
- B. Terminate both ends of the coaxial cable on F-connectors.
- C. At the work area outlet, place the terminated coaxial cable in the F-connector pass-through in the faceplate.
- D. All F-connectors being attached to distribution taps and pass-through in the faceplate shall be tightened to 20-30 inch pounds measured with a torque wrench intended for this purpose.
- E. All cables shall be terminated with 6" - 12" slack at the distribution tap so as not to pull tight on the terminating equipment.
- F. Label all coaxial terminations according to the Owner's standards. This will be a double-sided "flag" label at the distribution tap.

3.05 TESTING/WARRANTY

- A. Balanced Twisted Pair Cable Testing
 1. Testing of all balanced twisted pair wiring shall be performed prior to system cutover.
 2. All copper cable will be tested and all test results must comply with the specifications of ANSI/EIA/TIA 568-C.1 and C.2, including TSB-155, Additional Guidelines for 4-pair Category 6A Cabling for 10GBase-T Applications. Category 6A cables must be tested for 550 MHz operation for the ANSI/EIA/TIA Category 6A standard. Additional Guidelines for 4-pair Category 6 Cabling for 1GBase-T Applications. Category 6 cables must be tested for 250 MHz operation for the ANSI/EIA/TIA Category 6 standard. Testing will include the end-to-end link. The following testing standards shall apply:

- a. Test equipment shall be suitable for certifying all ANSI/EIA/TIA 568C.2 specifications or Category 6A as applicable. Performance requirements for testers will meet the level II-E accuracy. The contractor shall provide proof of current factory calibration of all test equipment.
 - b. Tests shall be in accordance with TSB-67 Level II-E accuracy.
 - c. Test and certify all station cable for all ANSI/EIA/TIA 568C.2 Additional Transmission Performance Guidelines.
 - d. Provide test reports in electronic flat ASCII file format. (Microsoft Excel compatible copy) to the Owner and Technology Consultant.
- B. Installations by outside contractor shall be certified and warranted by the manufacturer for operation at current ANSI/EIA/TIA 568C.I 550 MHz for a period of not less than 20 years.Fiber Optic Cable Testing:
1. Optical test equipment shall be suitable for measuring the attenuation and optical characteristics of the installed fiber optic plant. Provide records of recent factory calibration of all test equipment. The following fiber optic testing standards shall apply:
 - a. TIA 526-7 (OFSTP-7) Measurement of Optical Loss of Single mode Fiber Optic Cable Plant.
 - b. TIA 526-14-A (OFSTP-14) Measurement of Optical Loss of Multi-mode Fiber Optic Cable Plant.
 2. Pre-Installation Testing:
 - a. Both factory and onsite on-reel certification shall be performed on the cable prior to installation.
 3. Post-Installation Testing:
 - a. Two optical tests shall be performed: Optical Time Domain Reflectometer (OTDR) test and attenuation (power meter) test per the following standards:
 - 1) TIA 526-7 (OFSTP-7) Measurement of Optical Loss of Singlemode Fiber Optic Cable Plant.
 - 2) TIA 526-14-A (OFSTP-14) Measurement of Optical Loss of Multimode Fiber Optic Cable Plant.
 4. The OTDR test shall be used to determine the adequacy of the cable installations. The OTDR test shall be measured in both directions. A reference length of fiber, 328 feet minimum, used as the delay, line shall be placed before the new connector and after the far end patch panel connectors for inspection of connector signature.
 5. End-to-end attenuation measurements shall be made on all fiber optic cables, in both directions, using the appropriate light source for the window in test.
 6. The Contractor shall provide test reports, in electronic flat ASCII file format (Microsoft Excel compatible) to the Owner and Technology Consultant. Additionally, the Contractor shall provide one licensed copy of test equipment software that provides a means for viewing both copper and fiber test results in the format matching that of the original test equipment.

END OF SECTION 27 1500

SECTION 28 3111 - FIRE DETECTION AND ALARM

PART 1 - GENERAL

1.01 SUMMARY:

- A. Provide system suitable for type and occupancy as defined by local Building Code,, as approved by local Fire Marshal, and local authority having jurisdiction. Drawings indicate general design intent and do not indicate all equipment or devices or the full extent of the System. Provide complete design of the Fire Alarm System.
- B. Provide an Analog/Addressable System which is defined as a system in which initiating devices and interface modules transmit their address via a binary or multiplex code over a common pair of wires. This address is converted to an English language display giving a custom description for each reporting device. In addition, the system will provide analog information about the sensitivity of each photoelectric, and heat sensing device. The system control panel will maintain a log of this information which can be reviewed on demand. The system will also provide a maintenance alert when the sensitivity of any detector has been outside of a preset range for a period of 24 hours.

1.02 QUALITY ASSURANCE:

- A. Manufacturer's Qualifications: Firms regularly engaged in manufacture of fire alarm systems of types, sizes, and electrical characteristics required, and whose products have been in satisfactory use in similar service for not less than 5 years.
- B. Installer's Qualifications: Firm with at least 5 years of successful installation experience on projects with fire alarm systems work similar to that required for this project.
 - 1. Firm with manufacturer's factory trained personnel.
 - 2. Firm with factory authorized service organization and spare parts stock within 50 miles of the project and with a 24 hour response time.
 - 3. Installation shall be accomplished by or supervised by NICET II or higher.
- C. Codes and Standards
 - 1. Each and every item of the fire alarm system shall be listed as the product of a single fire alarm system manufacturer under the appropriate category by Underwriters Laboratory, Inc. (UL) and shall bear the UL label on all devices, appliances and panels comprising the system. All control equipment shall be listed under the category UOJZ as a single control unit and cross listed with the base loop fire alarm system. Partial listings shall be unacceptable.
 - 2. The complete installation shall conform to the applicable sections of NFPA and Local Code Requirements, and the National Electrical Code with particular attention to article 760. All control equipment must have transient protection to comply with UL 864 requirements or Standard #497B as applicable.
 - 3. FM Compliance: Provide fire alarm systems and accessories which are FM approved.
 - 4. The fire alarm system and devices shall comply with ADA 1990 and UL 1971 requirements.

1.03 SUBMITTALS:

- A. See Section 26 0500 Common Work Results for Electrical for Submittal requirements. Supplemental information is listed within this section.
- B. Product Data: Submit manufacturer's technical product data including specifications, data sheets, wiring diagrams, equipment ratings, dimensions, finishes, and description of system operation.
- C. Shop Drawings: Provide shop drawing submittal for approval by the local Fire Department and/or The Authority having jurisdiction. The Contractor shall arrange to have the Fire Alarm System shop drawing submittal prepared, sealed, and signed by a professional engineer and NICET III or NICET IV in Fire Alarm Systems if/as required by the authority having jurisdiction. Preparer shall assume the duty of Engineer of Record for the Fire Alarm System design. Provide shop drawings showing system components, including panels and cabinets, locations, quantities, and full schematic of system wiring showing conductor routings and quantities, and connection details. Provide updated room names and numbers that match the names and numbers as labeled at the building. Room names and numbers shown on the contract documents are not necessarily those that are currently being used in the building. The fire alarm manufacturer shall coordinate with the contractor and owner on existing and new work and survey the site on existing work to identify the proper names and numbers. All conduit routing must be submitted to, and accepted by, the Architect/Engineer. Shop drawing documents must be submitted simultaneously with sprinkler system documents and prior to installation.
- D. This information shall be submitted on 1/8 inch = 1foot scale building floor plans. No other systems shall be included on these plans. Reproduction of contract drawing will not be acceptable. The following information shall be included in the shop drawings:
 - 1. Occupancy group and use.
 - 2. Number of stories.
 - 3. Indicate extent of building sprinkler system.
 - 4. Indicate addition to/modifications of existing system.
 - 5. One-line diagram showing/indicating number of devices and appliances per zone/circuit.
 - 6. Wire sizes, color coding, type(s) and voltage drop calculations.
 - 7. Indicate annunciation method and include graphic zone map.
- E. Submit manufacturer's installation instructions, including outlet or back box requirements for each piece of equipment.
- F. Submit manufacturer's certificate that system meets or exceeds specified requirements.
- G. Submit sequence of operation and verification of system operation by manufacturer or his authorized representative.
- H. Submit back-up battery calculations.
- I. All shop drawings, battery and voltage drop calculations shall be submitted to the authority having jurisdiction for review after review by the Architect/Engineer.

- J. Submit graphic annunciator and/or map layouts for review by the Architect/Engineer prior to fabrication.
 - K. Indicate whether fire alarm system is required or non-required and list code sections required by and applicable to.
 - L. List all variances and attach as required.
 - M. Include brief description of scope of work.
 - N. Submit Zone schedule.
 - O. Submit device address schedule.
 - P. Submit interior and exterior front elevations of the FACP and exterior front elevations of other panels.
- 1.04 DELIVERY, STORAGE, AND HANDLING:
- A. Handle fire alarm equipment carefully to prevent damage, breaking, and scoring. Do not install damaged equipment or components; replace with new.
 - B. Store fire alarm equipment in clean, dry place. Protect from weather, dirt, fumes, water, construction debris, and physical damage.
- 1.05 EXTRA MATERIALS:
- A. General: Provide extra materials as listed below in addition to that required to complete the work. The additional stock shall not be used unless specifically authorized by the Owners Representative.
 - B. Lamps: Furnish spare/replacement lamps and LED's amounting to not less than three (3) lamps of each type and of each color.
 - C. Devices:
 - 1. Furnish spare/replacement detection bases amounting to 5 percent of the quantity installed by this work, but not less than two (2) of each type, including duct detector housings.
 - 2. Furnish spare/replacement detectors amounting to 5 percent of the quantity installed by this work, but not less than two (2) of each type.
 - 3. Furnish spare/replacement adaptor modules and relays amounting to 5 percent of the quantity installed by this work, but not less than one (1) of each type.
 - 4. Furnish spare/replacement speakers/horns, combination speaker/horn/strobe units, and strobe units amounting to 5 percent of the quantity installed by this work but not less than one (1) of each type.
 - D. Provide an additional spare/replacement addressable device communication card in the FACP which can be programmed for connection to future initiating devices.

1.06 OPERATION:

- A. The system alarm operation subsequent to the alarm activation of any manual station, automatic detection device, or sprinkler flow switch shall be as follows:
 - 1. All audible alarm indicating appliances shall sound a distinctive and continuous fire alarm signal until silenced by the alarm silence switch at the control panel or at the remote annunciator.
 - 2. All visible alarm indicating appliances shall flash continuously until the system is reset. Visual alarm devices shall continue to operate when audible devices are silenced, when allowed by the AHJ. Any subsequent zone alarm shall reactivate the alarm indicating appliances.
 - 3. All doors normally held open by door control devices shall release.
 - 4. A supervised signal to notify the monitoring center shall be activated. Signal shall indicate separately, a fire detector zone in alarm, fire alarm system trouble, sprinkler tamper (supervisory), sprinkler flow or individual alarm point address and description, including system troubles and other monitored signals.
 - 5. Activation of a sprinkler flow device shall cause the exterior horn/light to operate continuously until the flow has ceased.
 - 6. Activation of a duct detector shall alarm the system and shut down the associated air handling unit.

- B. The alarm shall be displayed on an 80 character LCD display. The top line of 40 characters shall be the point label and the second line shall be the device type identifier. The system alarm LED shall flash on the control panel and the remote annunciator until the alarm has been acknowledged. Once acknowledged, this same LED shall latch on. A subsequent alarm received from another zone shall flash the system alarm LED on the control panel and remote annunciator. The LCD display shall show the new alarm information.

- C. A pulsing alarm tone shall occur within the control panel until the event has been acknowledged.

- D. The activation of any system addressable smoke detector shall initiate an Alarm Verification operation whereby the panel will reset the activated detector and wait for a second alarm activation. If within one (1) minute after resetting, a second alarm is reported from the same or any other smoke detector, the system shall process the alarm as described previously. If no second alarm occurs within one minute the system shall resume normal operation. The Alarm Verification shall operate only on addressable smoke detector alarms. Other activated initiating devices shall be processed immediately. The alarm verification operation shall be selectable by zone.
 - 1. The control panel shall have the capability to display the number of times (tally) a zone has gone into a verification mode. Should this mode verification tally reach a pre-programmed number, a trouble condition shall occur.

- E. The control panel shall have a dedicated supervisory service LED and a dedicated supervisory service acknowledge switch.
 - 1. The activation of any standpipe or sprinkler valve supervisory (tamper) switch shall activate the system supervisory service audible signal and illuminate the LED control

- panel and the remote annunciator. Differentiation between valve tamper activation and opens and/or ground on the initiation circuit wiring shall be provided.
2. Pressing the Supervisory Service Acknowledge Key will silence the supervisory audible signal while maintaining the Supervisory Service LED "ON" indicating the off-normal condition.
 3. Restoring the valve to the normal position shall cause the Supervisory Service LED to extinguish, indicating restoration to normal.
- F. A manual evacuation (drill) switch shall be provided to operate the alarm indicating appliances without causing other control circuits to be activated. However, should a true alarm occur, all alarm functions would occur as described previously.
- G. The system shall have a single key that will allow the operator to display all alarms, troubles, and supervisory service conditions including the time of each occurrence.
- H. The actuation of the "enable walk test" program at the control panel shall activate the "Walk Test" mode of the system which shall cause the following to occur:
1. The city circuit connection shall be bypassed.
 2. Control relay functions shall be bypassed.
 3. The control panel shall show a trouble condition.
 4. The alarm activation of any initiation device shall cause the audible signals to code a number pulses to match the zone number.
 5. The panel shall automatically reset itself after signaling is complete.
 6. Any momentary opening of an initiating or indicating appliance circuit wiring shall cause the audible signals to sound for 4 seconds indicating a trouble condition.
 7. The system shall have the capacity of 8 distinctive walk test groups. Such that only a portion of the system need be disabled during testing.
- 1.07 SUPERVISION:
- A. There shall be supervisory service initiation device circuits for connection of all sprinkler valve supervisory switches (tamper). Device activation shall cause a supervisory alarm at the control panel.
 - B. There shall be independently supervised and independently fused indicating appliance circuits for alarm speakers and flashing alarm lamps. Disarrangement conditions of any circuit shall not affect the operation of other circuits.
 - C. Auxiliary manual control shall be supervised so that an "off normal" position of any switch shall cause an "off normal" system trouble.
 - D. Each independently supervised circuit shall include a discrete LCD readout to indicate disarrangement conditions per circuit.
 - E. The incoming power to the system shall be supervised so that any power failure must be audibly and visually indicated at the control panel and the remote annunciator. A green "power on" LED shall be displayed continuously while incoming power is present.

- F. The system batteries shall be supervised so that a low battery condition or disconnection of the battery shall be audibly and visually indicated at the control panel.
- G. The System Modules shall be electrically supervised for module placement. Should a module become disconnected the system trouble indicator shall illuminate and the audible trouble signal shall sound.
- H. The system shall have provisions for disabling and enabling all circuits individually for maintenance or testing purposes.

PART 2 - PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS:

- A. Manufacturers: Subject to compliance with requirements, provide fire alarm systems by the following:
 - 1. Simplex
 - 2. Siemens
 - 3. Notifier
 - 4. Johnson Control, Autocall
 - 5. EST
 - 6. H.R. Kirkland Co, Inc. - Graphic/Directory Annunciators and Maps.
 - 7. Honeywell
 - 8. Silent Knight
- B. Fire Alarm Cable
 - 1. West Penn
 - 2. Belden
 - 3. Annixter

2.02 FIRE ALARM AND DETECTION SYSTEMS:

- A. General: Provide complete fire alarm products of types, sizes and capacities indicated, which comply with manufacturer's standard design, materials, components; construct in accordance with published product information, and as required for complete installation. Provide fire alarm and detection systems for applications indicated.
- B. Wiring System Materials: Provide basic wiring materials which comply with Division-26 sections; "Raceways", Wires and Cables" and "Electrical Boxes and Fittings".
 - 1. Provide wire and cable in accordance with requirements of manufacturer. Wire insulation shall comply with NEC Article 760.
 - 2. Provide individual solid copper conductor sizes AWG #14, or larger.
 - 3. Provide multi-conductor cables for wire sizes smaller than AWG #16.
 - 4. Provide conductors which are UL listed for the installation and location, and approved for fire alarm usage.

5. Initiating circuits shall be color coded red for positive, red with black stripe for negative. Indicating circuits shall be color coded red with yellow stripe for positive, red with brown stripe for negative.
 6. All conductors shall be numbered and their numbers shall correspond to the terminal block numbering they are connected to. Provide conductor wiring and terminal block numbering.
 7. Wiring styles shall be as follows: Class B-IDC, Class B, Style 4-SLC, Class B-NAC. Style D-IDC between buildings.
 8. Provide multiple audible zones and alternate zones per floor.
- C. Power Requirements:
1. The control panel shall receive 120 VAC power via a dedicated circuit. The system shall include an integral, transient voltage surge suppression device (SPD) on the incoming 120-volt power. SPD device shall be UL 1449 rated for 380 volts/Type B.
 2. The system shall be provided with sufficient battery capacity to operate the entire system upon loss of normal 120 VAC power in a normal supervisory mode for a period of 4 hours with 15 minutes of alarm operation at the end of this period. The system shall automatically transfer to the standby batteries upon power failure. All battery charging and recharging operations shall be automatic.
 3. All external circuits requiring system operating power shall be 24 VDC and shall be individually fused at the control panel.

2.03 FIRE ALARM CONTROL PANEL:

- A. Control Panel construction shall be modular with solid state, microprocessor based electronics that are compatible with current codes and current UL requirements. It shall display only those primary controls and displays essential to operation during a fire alarm condition. Keyboards or keypads shall not be required to operate the system during fire alarm condition.
- B. A local audible device shall sound during Alarm, Trouble or Supervisory conditions. This audible device shall sound differently during each condition to distinguish one condition from another without having to view the panel. This audible device shall also sound during each keypress to provide an audible feedback to ensure that the key has been pressed properly.
- C. The following primary controls shall be visible through a front access panel:
1. Eighty character liquid crystal display
 2. Individual red system alarm LED
 3. Individual yellow supervisory service LED
 4. Individual yellow trouble LED
 5. Green "power on" LED
 6. Alarm acknowledge Key
 7. Supervisory Acknowledge Key
 8. Trouble Acknowledge Key
 9. Alarm Silence Key
 10. System Reset Key
- D. The following secondary control switches and LED's shall be available behind an access door:

1. City disconnect/switch
 2. Manual evacuation (drill)
 3. Elevator bypass
 4. Door holder release bypass
 5. Smoke damper control switches
- E. The control panel shall provide the following:
1. Setting of time and date
 2. LED testing
 3. Alarm, trouble, and abnormal condition listing
 4. Enabling and disabling of each monitor point separately
 5. Change in operator access levels
 6. Walk Test enable and disable
 7. Running diagnostic functions
 8. Displaying software revision level
 9. Displaying historical logs
 10. Displaying card status
 11. Point listing
- F. For maintenance purposes the following lists shall be available from the point lists menu.
1. All points list by address
 2. Monitor point list
 3. Signal/speaker list
 4. Auxiliary control list
 5. Feedback point list
 6. LED/switch status list
 7. Device sensitivity points list
- G. Scrolling thru menu options or lists shall be accomplished in a self-directing manner in which prompting messages shall direct the user. These controls shall be located behind an access door.
- H. The Control Panel shall have a 2 line x 40 character liquid crystal display which shall be backlit for enhanced readability. So as to conserve battery standby power, it shall not be lit during an AC power failure unless an alarm condition occurs or there is keypad activity.
- 2.04 SYSTEM FRONT PANEL OPERATION AND CAPABILITIES:
- A. Under normal condition the front panel shall display a "System is Normal" message and the current time and date.
- B. Should an abnormal condition be detected the appropriate LED (Alarm, Supervisory or Trouble) shall flash. The panel audible signal shall pulse for alarm conditions and sound steady for trouble and supervisory condition.
- C. The LCD shall display the following information relative to the abnormal condition of a point in the system.
1. 40 character custom location label

2. Type of device (i.e., smoke, pull station, water flow)
 3. Point status (i.e., alarm, trouble)
- D. Pressing the appropriate acknowledge button shall globally acknowledge every point in the list. These acknowledge functions may be pass code protected if the user has insufficient privilege to acknowledge such conditions. A message shall indicate insufficient privilege but allow the user to view the points without acknowledging them. Should the user have sufficient privilege to acknowledge, a message will be displayed informing the user that the condition has been acknowledged.
- E. After all points have been acknowledged, the LED's shall glow steady and the audible alarm will be silenced. The total number of alarms, supervisory and trouble conditions shall be displayed along with a prompt to review each list chronologically. The end of the list shall be indicated by an end of list message "END OF LIST."
- F. Alarm Silencing: Should the "Alarm Silence" button be pressed, all audible alarm signals shall cease operation.
1. Signals shall not be silenced during alarm silence inhibit mode.
- G. System Reset: The SYSTEM RESET button shall be used to return the system to its normal state after an alarm condition has been remedied. The LCD display shall step the user thru the reset process with simple English Language messages.
1. Should an alarm condition continue to exist the message, "SYSTEM RESET IN PROGRESS" will be followed by the message "SYSTEM RESET ABORTED", and the system will remain in an abnormal state.
 2. Should the Alarm Silence Inhibit function be active, the "SYSTEM RESET" key press will be ignored. The message, "SYSTEM RESET INHIBITED" will be displayed for a short time to indicate the action was not taken.
- H. History Logging: The system shall be capable of logging and storing 300 events in an alarm log and 300 events in a trouble log. These events shall be stored in a battery protected random access memory. Each recorded event shall include the time and date of that event's occurrence.
- I. Silent Walktest with History Logging (Field Selectable): The system shall be capable of being tested by one person. While in testing mode the alarm activation of an initiating device circuit shall be silently logged as an alarm condition in the historical data file. The panel shall automatically reset itself after logging of the alarm. The momentary disconnection of an initiating or indicating device circuit shall be silently logged as a trouble condition in the historical data file. The panel shall automatically reset itself after logging of the trouble condition. After testing is considered complete, testing data may be retrieved from the system in chronological order to ensure device/circuit activation.
1. Should the walk test feature be on for an inappropriate amount of time, it shall revert to the normal mode automatically.
 2. The control panel shall be capable of supporting up to 8 separate testing groups whereby one group or points may be in a testing mode and the other (non-testing) groups may be active and operate as programmed per normal system operation.

3. Should an alarm condition occur from an active point, not in walk test mode, it shall perform operations described in Paragraph 1.6.
 - J. LED Supervision: All slave module LED's shall be supervised for burnout or disarrangement. Should a problem occur, the LCD shall display the module and LED location numbers to facilitate location of that LED.
 - K. System Trouble Reminder: Should a trouble condition be present within the system and the audible trouble signal silenced, the trouble signal shall resound at preprogrammed time intervals to act as reminder that the fire alarm system is not 100% operational. Both the time interval and the trouble reminder signal shall be programmable to suit the Owner's application.
 - L. Access Levels: There shall be four (4) access levels with level 4 being the highest level. Level 1 actions shall not require a passcode. Changes to passcodes shall only be made by authorized personnel. Access to a level will only allow the operator to perform all actions within that level plus all actions of lower levels, not higher levels. All keys, switches, and buttons shall have levels associated with them.
 - M. RS-232-C Output: Fire Alarm Control Panel shall be capable of operating remote CRT's and/or printers; output shall be ASCII format and EIA RS-232-C connection with an adjustable baud rate.
 - N. Auxiliary Devices:
 1. Fire alarm auto dialer, call box, serial line, etc., and connections shall be coordinated and provided per owner requirements for interface to monitoring company or local fire department. Monitoring company shall be UL Listed. Provide one year of monitoring service with system.
 2. Smoke Control: Where required or indicated the fire alarm panel shall be provided with "OPEN/CLOSE/AUTO" switches to allow manual operation of the exhaust smoke dampers on each floor.
 - O. Equipment Enclosures: Provide cabinets of sufficient size to accommodate the aforementioned equipment. Cabinet shall be equipped with locks and transparent door panel providing freedom from tampering yet allowing full view of the various lights and controls.
- 2.05 ADDRESSABLE COMMUNICATION NETWORK:
- A. The system must provide communication with addressable initiating and control devices individually. Each of these devices will be individually annunciated at the control panel. Annunciation shall include the following conditions for each point:
 1. Alarm
 2. Trouble
 3. Open
 4. Short
 5. Device missing/failed
 - B. All addressable devices shall have the capability of being disabled or enabled individually.
 - C. Systems that require factory reprogramming to add or delete devices are unacceptable.

- D. The communication format must be a completely digital poll/response protocol to allow tapping of the circuit wiring.
- E. Each addressable device must be uniquely identified by an address code entered on each device at time of installation. The use of jumpers to set address will not be acceptable. Device identification schemes that do not use uniquely set addresses but relay on electrical position along the communication channel are unacceptable.
- F. There shall be no limit to the number of detectors, zone adapter modules, or stations which may be activated or "IN ALARM" simultaneously.
- G. All devices shall be supervised for trouble conditions. The system control panel will display the type of trouble condition in plain English. Should any device fail, it will not prevent the operation of other devices.
- H. Spare capacity shall be provided to allow for 20 percent more addressable points to be added to the fire alarm system without adding additional components after system is complete.

2.06 ADDRESSABLE DEVICE TYPES:

- A. General: Devices will be located as shown on the drawings. The location of addressable devices will be selected to optimize the system layout in order to provide the level of protection, zone identification and control as shown on the drawings.
- B. Environmental Compensation Analog Sensors:
 - 1. Smoke sensors shall be a smoke density measuring device having no self-contained alarm set point. The alarm decision for each sensor shall be determined by the control panel. The control panel shall determine the condition of each sensor by comparing the sensor value to stored values. The control panel shall maintain a moving average of the sensors smoke chamber value. Systems that do not automatically maintain a constant smoke obscuration sensitivity for each sensor by compensating for environmental factors are deemed unacceptable.
 - 2. The detector shall automatically indicate when an individual sensors needs cleaning. When a sensor's average value reaches a predetermined value, a "Dirty Sensor" trouble condition shall be audibly and visually indicated at the control panel. Additionally, the LED on the sensor base shall glow steady giving a visible indication at the sensor location. If a "Dirty Sensor" is left unattended, and its average value increases to a second predetermined value, an "Excessively Dirty Sensor" trouble condition shall be indicated at the control panel for the individual sensor.
 - 3. The control panel shall automatically perform a daily self-test on each sensor. Checking the electronics in the sensor's base ensures the accuracy of the values being transmitted to the control panel. A sensor that fails the self-test will cause a "Self-Test Abnormal" trouble condition at the control panel. A sensor self-test which must be manually initiated by the operator shall not be acceptable.
- C. Addressable Detector Bases: All addressable smoke and heat detector heads will plug into their bases. The base will contain electronics that communicate the detector status (normal, alarm,

trouble) to the control panel over two wires. The same two wires shall also provide power to the base and detector. Detector heads (smoke or heat) must be interchangeable. Upon removal of the head, a trouble signal will be transmitted to the control panel.

1. Carbon Monoxide (CO) sensor bases: Where indicated or required provide multi-point addressable CO sensor bases with CO sensing module providing CO toxic gas monitoring. Listed to UL 268 Smoke Detectors for Fire Alarm Signaling Systems and UL 2075 Gas and Vapor Detectors and Sensors (allowing systems to be listed to Standard 2034, Single and Multiple Station Carbon Monoxide Alarms shall be Listed by ULC to CSA 6.19-01. Residential Carbon Monoxide Alarming Devices shall be one of three types of CO influenced operation as follows: UL 2034 CO alarm detection; UL 2075 CO (OSHA) level monitoring for ventilation control; and multi-criteria fire sensor analysis with algorithms that combines optical and CO gas monitoring information. Provide control panel modifications necessary to monitor and alarm CO sensors. Provide piezoelectric sounder where required.
- D. Photoelectric Detector Head: Photoelectric type detectors shall be of the solid state photoelectric type and shall contain no radioactive material. They will use a pulsed infrared LED light source and be sealed against rear air flow entry. The detector shall fit into an addressable base that is common with both the heat and photoelectric type detectors.
- E. Thermal Detector Head: Thermal detector heads must be UL listed. They will be a combination rate-of-rise and fixed temperature (135 degrees F) type, automatically restorable unless fixed temperature (190 degrees F.) type are specifically required. The detector shall fit into an addressable base that is common with both the photoelectric and ionization type detectors. Provide addressable module for automatic restoring detectors that are not addressable.
- F. Pull Stations: Pull stations shall contain electronics that communicate the station's status (alarm, normal) to the control panel over two wires which also provide power to the pull station. The address will be set on the station. They will be manufactured from high impact red Lexan. Station will mechanically latch upon operation and remain so until manually reset by opening with a key common to all system locks. Pull stations will be single/double action. The front of the station is to be hinged to a back-plate assembly and must be opened with a key to reset the station. The key shall be common with the control panels. The addressable manual station shall be Underwriters' Laboratories Inc. listed for operation with the control panel.
- G. Duct Smoke Detectors: The detector shall be non-polarized 24VDC type which is compatible with the fire alarm panel and obtains its operating power from the supervisory current of the addressable loop. The detector head shall be the same as the addressable photoelectric detector heads used in the rest of the system. Provide duct detectors compatible with the air velocities within the duct to be installed (i.e. for low velocity ducts, provide an in-duct style detector). It shall be possible to test the detector by use of a remote alarm test switch. The duct detector housing shall contain the addressable electronics necessary to communicate with the control panel. For maintenance purposes, it shall be possible to clean the sampling tubes by access through the detector housing. To minimize false alarms, voltage and transient suppression techniques shall be employed as well as automatic alarm verification circuitry and insect screens.

1. Each duct detector shall be provided with a remote alarm LED indicator and a Magnet Type RTS. Plates shall be labeled with the name of the device/equipment served.
 2. Interlock each fan with its associated duct detector.
 3. Provide access door(s) for in-duct style duct detectors.
- H. Adaptor Module: Adapter Modules shall be used for monitoring of water flow, valve tamper, non-addressable detectors, and for control of smoke dampers, door holders, and other output control functions. Adapter Modules will be capable of mounting in a standard electric outlet box. Adapter Modules will include cover plates to allow surface or flush mounting. Adapter Modules will receive their 24VDC power from a separate two wire pair running from an appropriate power supply. There shall be two types of devices: Type 1; Monitor Adapter Modules - for conventional 2-wire thermal detector and/or contact device monitoring with Class B or Class A wiring supervision. Type 2; Control Adapter Modules - for signals, speakers, fire fighter phone jacks and other device control with Class B or Class A wiring supervision.
1. Air Handling Equipment: Provide modules as required for monitor and control of Air Handling units such that the unit shall shut down upon detection of smoke at the unit or from any detector alarm within the space. Provide relays as required.
 2. Provide modules as required to monitor existing hardwired zones. Existing zone quantities and configurations shall remain, unless otherwise indicated or shown on the plans.

2.07 ALARM SIGNAL DEVICES:

- A. Fire Alarm Horn/Strobe Combination: Provide high impact resistant red LEXAN Horn/strobe combination devices as shown on the plans. Each assembly shall consist of two independent devices which are manufactured as compatible with each other and with the control equipment. Each assembly shall provide a terminal strip or wire leads for true in-out wiring connections. The strobe unit shall have a candela-second rating in compliance with ADA requirements and be rated at 24 VDC. Strobes shall be clear with red letters "FIRE" on two sides.
1. Provide wall mounting as shown on the plans. Verify manufacturer mounting requirements prior to rough in.
- B. Individual Strobe Unit: Provide strobe units mounted where shown. Units shall match those used in the combination horn/strobe or speaker/strobe specified.
- C. Where multiple strobe units are visible from a single location and the potential visible flash rate is 5 hz or more, provide synchronizing modules and strobes compatible for synchronizing as required. Provide additional wiring, conduit, and power supplies as necessary.
- D. Speakers/Horns have been located on the drawings. It is the Contractor's responsibility to provide adequate coverage to achieve the required 15 dBA above ambient at all locations throughout the building. If locations shown are inadequate, provide additional speakers/horns on shop drawing submittal. Additional speakers/horns will be added at no additional cost to the contract including conduit wiring, power supplies, etc. System shall meet NFPA 72 Intelligibility Standards required by AHJ.

2.08 AUXILIARY DEVICES/EQUIPMENT:

- A. Magnetic Door Holder Devices: Provide door holders as shown on the plans. Release of doors occurs on a verified alarm or after a general AC power failure in the building. Coordinate all door hardware with door hardware supplier if applicable.

2.09 DIRECTORY ANNUNCIATOR:

- A. General: The annunciator shall consist of a display with LEDs to indicate alarm status of the fire alarm system including location of devices in alarm. The annunciator shall be Underwriters Laboratory listed. Mounting location shall be approved by the local Fire Marshall or the authority having jurisdiction.
 - 1. The annunciator shall communicate with the control panel via one twisted shielded pair of wires. Operating power shall be 24 VDC and shall be fused at the control panel.
- B. Display: The display shall be a black image on a white, 1/8 inch acrylic backing with ultraviolet coating.

2.10 GRAPHIC MAP:

- A. The graphic map shall be a full color image on a white background mounted on a rigid backing and shall have an ultraviolet inhibitor laminated on the front. Provide a clear, anti-glare, LEXAN panel cover and mount map within a black anodized aluminum frame. Provide a concealed secured hanging system. Location of map shall be approved by the local Fire Marshall or the authority having jurisdiction. The graphic map shall include, but not be limited to, the following information:
 - 1. Building outline, including address and adjacent streets.
 - 2. All exterior doors.
 - 3. Fire alarm control panel.
 - 4. Sprinkler control valves.
 - 5. Utility controls (electrical, natural gas, water).
 - 6. Fire department connection.
 - 7. Main area separations.
 - 8. Compass direction reference (orient the map).
 - 9. Map location ("YOU ARE HERE" with arrow).
 - 10. Map location, fire alarm control panel, sprinkler valves and Fire Department connections must be highlighted in RED.
 - 11. Zone area separations and designations.
 - 12. Room names and numbers as labeled in the building.
 - 13. Each duct detector; indicate HVAC unit designation and function (i.e., supply or return).
 - 14. Legend of devices and other symbology.
 - 15. Location of all individual devices.
 - 16. Each fire detection and alarm device with addresses at each addressable device.
- B. Provide building zone map showing each floor at each remote annunciator and include essential escape information unless otherwise specified.

PART 3 - EXECUTION

3.01 EXAMINATION:

- A. Examine areas and conditions under which fire alarm systems are to be installed. Do not proceed with work until unsatisfactory conditions have been corrected in manner acceptable to Installer.

3.02 IDENTIFICATION:

- A. Provide electrical identification in accordance with Division-26 section on Electrical Identification. SLC and NAC Devices shall be labeled with System Device Address and EOL locations shall be identified at each EOL device.

3.03 INSTALLATION OF BASIC WIRING SYSTEM MATERIALS:

- A. Install all wiring in raceways.
- B. Install wiring, raceways, and electrical boxes and fittings in accordance with Division 26 sections; "Raceways", "Wires and Cables", and "Electrical Boxes and Fittings".
- C. Install wiring in exposed ivory colored surface metal raceway where specifically noted as allowed on wall or ceilings.
- D. Install wires and cables without splices. Make connections at terminal strips in cabinets or at equipment terminals. Make soldered splices in electronic circuits in control cabinets.

3.04 INSTALLATION OF FIRE ALARM SYSTEMS:

- A. Install fire alarm system as indicated, in accordance with equipment manufacturer's written instructions and complying with applicable portions of NEC and NECA's "Standard of Installation."
- B. Wiring: Wiring of fire alarm system is not specifically detailed on drawings. Refer to the manufacturer's shop drawings for detailed wiring and connection information.
 - 1. Complete wiring in accordance with manufacturer's requirements. Provide Striped Color coded wiring and install per manufacturer's point-to-point wiring diagram. Determine exact number of wires for each fire area zone from number and types of devices installed. Connect each device with sufficient wiring to complete its intended operation.
 - 2. Where there are a number of power requiring devices such as smoke detectors, fan relays, door holders and smoke damper operators installed in a circuit, group in numbers so power required does not exceed 80 percent of manufacturer's power supply rating. Provide extra wiring, or extra power supplies required to fulfill that requirement. In addition, provide extra or larger size wiring to alleviate voltage drops which makes device operate beyond voltage limits for which it was designed. Determine above with manufacturer's representative while equipment is being installed.
 - 3. Where an existing system is present it shall remain in operation while the new system is being installed, tested, and accepted.

4. Mount audible and visual devices per Americans with disabilities Act (ADA) 1990 requirements.
5. SLC T-Tapping is acceptable, IDC and NAC T-Tapping is not allowed.

3.05 FIELD QUALITY CONTROL:

- A. Connection and Supervision: Make connections to panel under manufacturer's supervision. Run wiring to main terminal cabinet located adjacent to main fire alarm panel. Complete connections from this cabinet to panel utilizing Manufacturer's technicians.
- B. System Test and Approval: Submit shop drawings for function and operation only, pre-approved by authority having local jurisdiction.
 1. Prior to final acceptance of system, manufacturer shall, in presence of Contractor and Owner's Representative, test each sensing or detection and alarm device including devices and equipment interlocks such as equipment shutdown and smoke dampers. Schedule test with Owner prior to testing.
 2. The completed fire alarm system shall be fully tested in accordance with NFPA-72 by the contractor in the presence of the Owner's representative and the Local Fire Marshal. Upon completion of a successful test, the contractor shall so certify in writing to the owner and general contractor.
 3. The contractor shall coordinate the testing of each fire alarm detector added or relocated under this project with the fire department and forward a completed checklist showing each detector operated properly and that proper indication of detector operation occurred at all control panels, annunciator panels, remote indicators, remote test switches, etc. In addition, proper interlocks, door release, etc. shall be documented with specific equipment affected listed by identifier.
 4. Submit copy of test results in duplicate after signed by Owner's Representative to Architect/Engineer, Owner, and local Fire Protection Authority. Mount copy of inspection record in Lexan enclosed frame assembly on control panel.
 5. Provide Record of Completion Documentation per NFPA-72.

3.06 MAINTENANCE CONTRACT:

- A. The equipment manufacturer shall make available to the owner a maintenance contract proposal to provide a minimum of two (2) inspections and tests per year in compliance with NFPA-72 guidelines.

3.07 WARRANTY:

- A. The Contractor shall guarantee all equipment and wiring free from inherent mechanical and electrical defects for a period of one year from the date of acceptance as set forth in the general conditions.

3.08 OPERATING AND MAINTENANCE INSTRUCTIONS:

- A. On completion of the work, the equipment manufacturer shall provide training for two maintenance personnel to a level equal to a "Factory-Certified Technician". The training shall be conducted at the vendor's local office or the Factory.

3.09 PAINTING AND PATCHING:

- A. Contractor shall paint all exposed conduit to match adjacent surfaces. All surfaces or finishes damaged as a result of this work shall be properly patched, painted and/or repaired by trained craftsmen of the trade involved.
- B. Blank plates shall be painted to match adjacent surfaces.

END OF SECTION 28 3111

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Removing existing vegetation.
2. Clearing and grubbing.
3. Removing above- and below-grade site improvements.
4. Disconnecting, capping or sealing, protecting and abandoning site utilities in place.
5. Temporary erosion and sedimentation control measures.

B. Related Sections:

1. Division 01 Sections
2. Division 31 "Earth Moving".
3. Idaho Standards for Public Works Construction, Current Edition.
4. City of Twin Falls Revisions to the Idaho Standards for Public Works Construction, 2017.
5. Geotechnical Engineering Report and Addenda as prepared by Materials Testing & Inspection, MTI File Number: T200068g.
6. SWPPP Documents.

1.2 DEFINITIONS

- A. Subsoil: All soil beneath the topsoil layer of the soil profile, and typified by the lack of organic matter and soil organisms.
- B. Surface Soil: Soil that is present at the top layer of the existing soil profile at the Project site. In undisturbed areas, the surface soil is typically topsoil; but in disturbed areas such as urban environments, the surface soil can be subsoil.
- C. Vegetation: Trees, shrubs, groundcovers, grass, and other plants.

1.3 MATERIAL OWNERSHIP

- A. Except for stripped topsoil and other materials indicated to be stockpiled or otherwise remain Owner's property, cleared materials shall become Contractor's property and shall be removed from Project site. Conform to applicable code for disposal of debris.
- B. The Owner has secured a Dump Site for disposal of unsuitable and excess fill material scheduled to be removed from the Project Site.
1. The Dump Site is located at the Magic Valley Regional Airport, 492 Airport Loop, Twin Falls, ID 83301, approximately 6-miles from the Project Site.

2. Access to the Dump Site will be via gravel road off N 2800 E/Grandview Dr S directly east of the Magic Valley Speedway.
3. Contractor shall supply a full-time Gate Guard to provide security and monitoring of trucks and equipment entering/exiting the secure Dump Site.
4. All operations for fill disposal shall be coordinated with Matt Barnes, Airport Operations Supervisor via phone at 208-308-7236 and/or email at mbarnes@tfid.org.

1.4 SUBMITTALS

- A. Operations & Maintenance Data: Submit Record Drawings identifying and accurately showing locations of utilities and other subsurface structural, electrical, and mechanical conditions.

1.5 PROJECT CONDITIONS

- A. Traffic: Minimize interference with adjoining roads, streets, walks, and other adjacent occupied or used facilities during site-clearing operations.
 1. Do not close or obstruct streets, walks, or other adjacent occupied or used facilities without permission from Owner and authorities having jurisdiction.
 2. Provide alternate routes around closed or obstructed traffic ways if required by Owner or authorities having jurisdiction.
- B. Salvable Improvements: Carefully remove items indicated to be salvaged and store on Owner's premises where indicated.
- C. Utility Locator Service: Notify utility locator service for area where Project is located before beginning site clearing operations. Contact locator service at 811 or (208) 342-1585.
- D. Do not commence site clearing operations until temporary erosion and sedimentation measures are in place.
- E. Soil Stripping, Handling, and Stockpiling: Perform only when the topsoil is dry or slightly moist. Refer to Geotechnical Evaluation for Soft Subgrade Construction Approach Recommendations.
- F. Dust Control: Per Agency Having Jurisdiction.

1.6 WARRANTY

- A. Contractor shall warrant work as provided by the General and Supplementary Conditions and Division 01 Specifications.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Satisfactory Soil Material: Requirements for satisfactory soil material are specified in Division 31 Section "Earthmoving"
 - 1. Obtain approved borrow soil material off-site when satisfactory soil material is not available on-site.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Protect and maintain benchmarks and survey control points from disturbance during construction.
- B. Protect existing site improvements to remain from damage during construction.
 - 1. Restore damaged improvements to their original condition, as acceptable to Owner's Representative.

3.2 TEMPORARY EROSION AND SEDIMENTATION CONTROL

- A. Provide temporary erosion and sedimentation control measures to prevent soil erosion and discharge of soil-bearing water runoff or airborne dust to adjacent properties and walkways, according to requirements of Agencies Having Jurisdiction.
- B. Verify that flows of water redirected from construction areas or generated by construction activity do not enter or cross protection zones.
- C. Inspect, maintain, and repair erosion- and sedimentation-control measures during construction until permanent vegetation has been established.
- D. Remove erosion and sedimentation controls and restore and stabilize areas disturbed during removal.
- E. Coordinate with SWPPP documents.

3.3 EXISTING UTILITIES

- A. Contractor shall coordinate with Owner's Representative to arrange for disconnecting and sealing indicated utilities that serve existing structures before site clearing.
 - 1. Verify that utilities have been disconnected and capped before proceeding with site clearing.

- B. Locate, identify, disconnect, and seal or cap utilities indicated to be removed or abandoned in place.
 - 1. Arrange with utility companies to shut off indicated utilities.
- C. Interrupting Existing Utilities: Do not interrupt utilities serving facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary utility services according to requirements indicated:
 - 1. Notify Owner's Representative not less than two (3) days in advance of proposed utility interruptions.
 - 2. Do not proceed with utility interruptions without Owner Representative's written permission.
- D. Excavate for and remove underground utilities indicated to be removed. Backfill & compact excavated utility trenches per specification section 312000.

3.4 CLEARING AND GRUBBING

- A. Comply with Geotechnical Engineering Report.
- B. Remove trees, shrubs, and other vegetation to permit installation of new construction.
- C. Remove debris, obstructions, pipes, excess soil, etc. to permit installation of new construction.
- D. Fill depressions caused by clearing and grubbing operations with satisfactory soil material unless further excavation or earthwork is indicated.
 - 1. Place fill material in horizontal layers not exceeding a loose depth of 6-Inches and compact each layer to a density equal to adjacent original ground.
 - 2. All fill material placed must be compacted and tested. Coordinate with Owner's Representative for testing.

3.5 TOPSOIL STRIPPING

- A. Comply with Geotechnical Engineering Report.
- B. Contractor shall remove all organic, disturbed or undocumented fill soils beneath proposed pavements, flatwork, floor slabs, structural fills and building foundations.
- C. All organic or disturbed soils shall be removed to depths of 12-inches minimum and stockpiled for later use in landscape areas or removed from site. Stripping depths shall be adjusted in the field to ensure that the entire root zone, disturbed zone or topsoil are removed prior to placement and compaction of structural fill materials.
- D. Exact removal depths should be determined during grading operations by the Geotechnical Engineer and should be based upon subgrade soil type, composition, and firmness or soil stability.

- E. Stripped topsoil may be stockpiled and used in future landscape areas only. Topsoil shall not be used as structural fill.

3.6 SITE IMPROVEMENTS

- A. Remove existing above- and below-grade improvements as indicated and necessary to facilitate new construction.
- B. Remove slabs, paving, curbs, gutters, and aggregate base as indicated.
 - 1. Unless existing full-depth joints coincide with line of demolition, neatly saw-cut adjacent to line of existing pavement to remain before removing adjacent existing pavement. Saw-cut faces vertically.
 - 2. Paint cut ends of steel reinforcement in concrete to remain with two coats of antirust coating, following coating manufacturer's written instructions. Keep paint off surfaces that will remain exposed.
- C. If underground storage tanks, underground utilities, wells, or septic systems are discovered during construction activities, they must be decommissioned then removed or abandoned in accordance with governing Federal, State, and local agencies. Excavations developed as a result of such removal must be backfilled with structural fill materials. See section 312000.

3.7 DISPOSAL OF SURPLUS AND WASTE MATERIALS

- A. Remove surplus soil material, unsuitable topsoil, obstructions, demolished materials, and waste materials including trash and debris, and legally dispose of them off Owner's property.
- B. Disposal of unsuitable and excess fill material at the Dump Site shall be free of garbage, organic material, large diameter branches or logs (3-inch diameter or larger), root wads, large concrete rubble or debris, metal, plastic pipe, etc.
 - 1. Concrete and asphalt debris shall not exceed 3-feet in measurement in any direction and must be broken up or omitted from disposal at the Dump Site.
- C. Separate recyclable materials produced during site clearing from other non-recyclable materials. Store or stockpile without intermixing with other materials and transport them to recycling facilities. Do not interfere with other Project work.

END OF SECTION

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Excavation and backfilling for slabs-on-grade, walks, pavements and landscape areas.
2. Excavation and backfilling for building floor slabs, building foundations and structures.
3. Excavation and backfilling for storm drainage systems.
4. Excavation and backfilling trenches for utilities and pits for buried utility structures.
5. Excavation and backfilling geotechnical test pits and demolished utilities.
6. Temporary erosion and sedimentation control measures.

B. Related Sections:

1. Division 01 Sections.
2. Division 03 Section "Cast-in-Place Concrete" for vapor retarder beneath the slab-on-grade.
3. Division 23, 26 and 27 Sections for installing underground mechanical, electrical and telecommunications utilities and buried mechanical and electrical structures.
4. Division 31 Section "Site Clearing" for site stripping, grubbing, stripping topsoil, and removal of above- and below-grade improvements and utilities.
5. Division 33 Sections for underground site utilities.
6. Idaho Standards for Public Works Construction, Current Edition.
7. City of Twin Falls Revisions to the Idaho Standards for Public Works Construction, 2017.
8. Geotechnical Engineering Report and Addenda as prepared by Materials Testing & Inspection, MTI File Number: T200068g.
9. SWPPP Documents.

1.2 DEFINITIONS

A. Backfill: Soil material or controlled low-strength material used to fill an excavation.

1. Initial Backfill: Backfill placed beside and over pipe in a trench, including haunches to support sides of pipe. Initial backfill shall be Bedding Course.
2. Final Backfill: Backfill placed over initial backfill to fill a trench. Final Backfill shall be Bedding Course or Granular Structural Fill.

B. Base Course (Crushed Aggregate Base): Aggregate layer placed between the base course and hot-mix asphalt paving or concrete flatwork or cast in place concrete.

C. Subbase Course (Structural Fill): Aggregate layer placed between the subgrade and Base Course.

- D. Bedding Course: Aggregate layer placed over the excavated subgrade in a trench before laying pipe.
- E. Borrow Soil: Satisfactory soil imported from off-site for use as fill or backfill.
- F. Drainage Course: Aggregate layer supporting the slab-on-grade that also minimizes upward capillary flow of pore water.
- G. Excavation: Removal of material encountered above subgrade elevations and to lines and dimensions indicated.
- H. Fill: Soil materials used to raise existing grades.
- I. Satisfactory Soil: Soil material in compliance with the Geotechnical Engineering Report.
- J. Structures: Buildings, footings, foundations, retaining walls, slabs, tanks, curbs, mechanical and electrical appurtenances, or other man-made stationary features constructed above or below the ground surface.
- K. Subgrade: Uppermost surface of an excavation or the top surface of a fill or backfill immediately below subbase, drainage fill, drainage course, base course or topsoil materials.
- L. Utilities: On-site underground pipes, conduits, ducts, and cables, as well as underground services within buildings.

1.3 SUBMITTALS

- A. Product Data: For each type of the following manufactured products required:
 - 1. Geotextiles and warning tapes.
- B. Material Test Reports: For each on-site and borrow soil material proposed for fill and backfill as follows:
 - 1. Classification according to ASTM D 2487.
 - 2. Laboratory compaction curve according to ASTM D 1557 (for rigid structures) or ASTM D 698 (for flexible pavements).
 - 3. Sieve analysis for all structural fill materials.
- C. Operations & Maintenance Data: Submit Materials Testing reports for compaction testing of all subgrades and fill materials.

1.4 QUALITY ASSURANCE

- A. Pre-excavation Conference: Conduct conference at Project site.
- B. All gravel, base course, subbase, and other imported fill materials other than landscape fill and topsoil shall only be stockpiled in proposed impervious areas. No gravel or rock

materials shall be stockpiled or temporarily placed in proposed landscape areas in order to prevent landscape areas from being contaminated with rock materials. If landscape areas become contaminated, the contractor shall restore them to specified requirements at no cost to the Owner.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Bulk Materials:

1. Do not dump or store bulk materials near structures, utilities, walkways and pavements, or on existing turf areas or plants.
2. Provide erosion-control measures to prevent erosion or displacement of bulk materials; discharge of soil-bearing water runoff, and airborne dust reaching adjacent properties, water conveyance systems, or walkways.
3. Accompany each delivery of bulk materials with appropriate certificates.

1.6 PROJECT CONDITIONS

A. Traffic: Minimize interference with adjoining roads, streets, walks, and other adjacent occupied or used facilities during earthwork operations.

1. Do not close or obstruct streets, walks, or other adjacent occupied or used facilities without permission from Owner and authorities having jurisdiction.
2. Provide alternate routes around closed or obstructed traffic ways if required by Owner or authorities having jurisdiction.

B. Utility Locator Service: Notify utility locator service for area where Project is located before beginning earth moving operations. Contact locator service at 811 or 208-342-1585.

C. Do not commence earthwork operations until temporary erosion- and sedimentation-control measures are in place.

D. Soft Subgrade Conditions: This site contains shallow fine-grained soils that are relatively high in moisture content and prone to pumping and rutting from rubber-tired construction equipment. Earth Moving methods which limit destabilizing areas of the site during earth moving activities shall be employed.

E. Construction operations during dry, warm weather conditions will help to limit development of unstable subgrade conditions. Construction during wet weather may not be possible, depending on the amount of precipitation.

F. SWPPP: Coordinate with SWPPP documents.

G. Dust Control: Per Agency Having Jurisdiction.

1.7 WARRANTY

A. Contractor shall warrant work as provided by the General and Supplementary Conditions and Division 01 Specifications.

PART 2 - PRODUCTS

2.1 SOIL MATERIALS

- A. General: Provide borrow soil materials when sufficient satisfactory soil materials are not available from excavations. Materials shall be in compliance with the Geotechnical Engineering Report.
- B. Structural Fill: Soils classified as GW, GP, SW, and SP in accordance with the USCS (ASTM D2487) as identified by the geotechnical engineer. Use of silty soils (USCS designation of GM, SM, and ML) as structural fill may be acceptable. However, use of silty soils and lean clay soils (GM, SM, CL, and ML) as structural fill below footings and building floor slabs is prohibited.
- C. Subbase Course (Granular Structural Fill): 6-Inch minus select, clean, granular soil with no more than 50 percent oversize (greater than 3/4-Inch) material and no more than 12 percent fines (passing No. 200 sieve). Refer to the ISPWC Section 801 for material gradation and requirements.
- D. Base Course (Crushed Aggregate Base):
- 3/4" maximum size- complying with ISPWC Section 802 – 3/4-inch (Type I) for material gradation and requirements.
 - Crushed Aggregate Base as defined herein shall be used as Free Draining Granular Mat as indicated by the geotechnical engineering report.
- E. Bedding Course (Utility Trench Bedding):
- Type I bedding material Per ISPWC Section 305 – in compliance with the following material gradation:

Sieve Size	Percent Passing
1-inch	100
3/4-inch	80-100
3/8-inch	20-70
No. 4	5-20
No. 8	0-5
No. 200	0-3

- F. Drain Rock:
- Per ISPWC Section 801 – in compliance with the following material gradation:

Sieve Size	Percent Passing
3-inch	100
1-inch	25-60
3/8-inch	0-4
No. 200	0-2

- Drain rock shall have a minimum of 35% Air Voids as determined by AASHTO T 19.

G. Filter Sand:

1. Per ISPWC Section 801 – in compliance with the following material gradation:

Sieve Size	Percent Passing
3/8-inch	100
No. 4	95-100
No. 16	45-80
No. 50	10-30
No. 100	2-10
No. 200	0-4

2.2 GEOTEXTILES

- A. Drainage Geotextile: Nonwoven needle-punched geotextile, manufactured for subsurface drainage applications, made from polyolefins or polyesters; with elongation greater than 50 percent; complying with AASHTO M 288 and the following, measured per test methods referenced:

1. Survivability: Class 2; AASHTO M 288.
2. Grab Tensile Strength: 157 lbf; ASTM D 4632.
3. Sewn Seam Strength: 142 lbf; ASTM D 4632.
4. Tear Strength: 56 lbf; ASTM D 4533.
5. Puncture Strength: 56 lbf; ASTM D 4833.
6. Apparent Opening Size: No. 70 sieve, maximum; ASTM D 4751.
7. Permittivity: 0.5 per second, minimum; ASTM D 4491.
8. UV Stability: 50 percent after 500 hours' exposure; ASTM D 4355.

- B. Woven Geotextile: Woven geotextile fabric, manufactured for subgrade stabilization and soil improvements complying with the following minimum properties, measured per test methods referenced:

1. CBR Puncture: 700 lb; ASTM D 6241.
2. Grab Tensile Strength: 200 lb; ASTM D 4632.

2.3 ACCESSORIES

- A. Warning Tape: Acid- and alkali-resistant, polyethylene film warning tape manufactured for marking and identifying underground utilities, 6 inches wide and 4 mils thick, continuously inscribed with a description of the utility; colored as follows:

1. Red: Electric.
2. Yellow: Gas, oil, steam, and dangerous materials.
3. Orange: Telephone and other communications.
4. Blue: Water systems.
5. Green: Sewer systems.
6. Purple: Irrigation mainline systems.

PART 3 - EXECUTION

3.1 SITE PREPARATION

- A. Refer to Geotechnical Engineering Report for additional information.
- B. Protect structures, utilities, sidewalks, pavements, and other facilities from damage caused by settlement, lateral movement, undermining, washout, and other hazards created by earthwork operations.
- C. Protect and maintain erosion and sedimentation controls during earthwork operations.
- D. Protect subgrades and foundation soils from freezing temperatures and frost. Remove temporary protection before placing subsequent materials.
- E. The site shall be watered as required to moisture condition the native soils.
- F. Notify Owner's Representative of unexpected subgrade conditions and discontinue affected work in area until notified to resume work.

3.2 EXCAVATION: GENERAL

- A. Refer to Geotechnical Engineering Report for additional information.
- B. All excavation depths noted in this section shall be from existing ground surface. Total excavation depth from existing ground elevation may be greater than depth listed. Coordinate with drawings for more information.
- C. Identify required lines, levels, contours and datum.
- D. Protect above and below grade utilities which are to remain.
- E. Grade top perimeter of excavation to prevent surface water from draining into excavation.
- F. Following excavation to subgrade and prior to fill placement; subgrade surfaces shall be proof rolled in the presence of the geotechnical engineer. Correct Soft Subgrade Soil areas as identified and directed by the Geotechnical Engineer. Proof rolling of subgrade soils shall be accomplished using a heavy rubber-tired, fully loaded, tandem-axle dump truck or equivalent.
- G. Inspection & compaction testing shall be completed per the Division 01 Specifications.

3.3 EXCAVATION AND BACKFILL AT GEOTECHNICAL TEST PITS & DEMOLISHED UTILITIES

- A. Refer to Geotechnical Engineering Report for location and depth of test pits.
- B. Excavate full depth of test pit or utility until undisturbed, native subgrade is encountered.

- C. Place Granular Structural Fill to total depth necessary to bring test pit to proposed subgrade elevation. Place in maximum 12-inch loose lifts and compact to a minimum of 95% per ASTM D1557.
- D. Surface of compacted structural fill shall be smooth, even surface. Remove ridges and fill depressions.
- E. Coordinate placement and grade with Excavation for Structures, Building Slabs, Building Foundations, Concrete Flatwork & Pavements, this section.
- F. Inspection & compaction testing shall be completed per the Division 01 Specifications.

3.4 EXCAVATION FOR STRUCTURES, BUILDING SLABS AND BUILDING FOUNDATIONS

- A. Excavate to indicated lines, cross sections, elevations, and subgrades.
- B. All excavation depths noted in this section shall be from existing ground surface.
- C. Existing top soil material must be completely removed from below building slabs and building foundation elements. Coordinate with specification section 31 10 00.
- D. Uncontrolled fill materials must be completely removed from below proposed structures, building slabs and foundations. Minimum excavation depth shall be in accordance with Geotechnical Engineering Report. Extend excavation 10-feet beyond wall locations. Remove excavated soil material and dispose of off Owner's property.
- E. The exposed subgrade shall be proof-rolled and approved by the Geotechnical Engineer.
- F. Repair soft subgrade soil areas as identified and directed by the Geotechnical Engineer.

3.5 EXCAVATION FOR CONCRETE FLATWORK AND PAVEMENTS

- A. Excavate to indicated lines, cross sections, elevations and subgrades.
- B. The exposed subgrade shall be proof-rolled and approved by the Geotechnical Engineer.
- C. If uncontrolled fill remains below the removal depth noted in the Geotechnical Engineering Report, the exposed subgrade shall be compacted to 95% of the maximum dry density as determined by ASTM D698.
- D. Repair soft subgrade soil areas as identified and directed by the Geotechnical Engineer.
- E. Excavate to adequate depth for placement of Structural Fill, Subbase Course and/or Base Course Soil Materials.

3.6 EXCAVATION FOR UTILITY TRENCHES

- A. Comply with the requirements of the ISPWC and the Local Agency Having Jurisdiction Standard Specifications.
- B. Excavate trenches to indicated gradients, lines, depths and elevations. Utility cover shall be per Division 33 and the Drawings.
- C. Excavate trenches to a minimum width of 24" plus pipe or conduit outside diameter. Provide uniform clearance on each side of pipe or conduit. Excavate trench walls vertically from trench bottom to 12 inches higher than top of pipe or conduit unless otherwise indicated.
- D. Trench Bottoms: Excavate and shape trench bottoms to provide uniform bearing and support of pipes and conduit. Shape subgrade to provide continuous support for bells, joints, and barrels of pipes and for joints, fittings, and bodies of conduits. Remove projecting stones and sharp objects along trench subgrade.
 - 1. Excavate trenches 6 inches deeper than elevation required in rock or other unyielding bearing material, 4 inches deeper elsewhere, to allow for bedding course.

3.7 EXCAVATION FOR LANDSCAPE AREAS

- A. Excavate to indicated lines, cross sections, elevations and subgrades.
- B. The exposed subgrade shall be visually inspected to confirm it is firm and unyielding.
- C. Subgrade upper 6-inches shall be compacted to 92% of ASTM D698.
- D. Repair soft subgrade soil areas as identified and directed by the Geotechnical Engineer.
- E. Excavate to adequate depth for placement of Topsoil at all landscape areas, coordinate with drawings.

3.8 SUBGRADE INSPECTION

- A. Notify Owner's Representative when excavations have reached required subgrade elevations.
- B. Prior to placement of subbase course and base course material at building and paved areas, the exposed subsoil surface should be proof-rolled under the observation of the Geotechnical Engineer.
- C. Cut out soft or otherwise unsuitable areas of subgrade not capable of supporting structural loads. Backfill with Granular Structural Fill and compact to density equal to or greater than requirements for subsequent backfill material. Prior to placing Granular Structural Fill, the Geotechnical Engineer shall evaluate the over-excavated subgrade to determine if a Geotextile should be placed on the over-excavated subgrade.

- D. Reconstruct subgrades damaged by freezing temperatures, frost, rain, accumulated water, or construction activities, as directed by the Owner's Representative.

3.9 STORAGE OF SOIL MATERIALS

- A. Stockpile borrow soil materials and excavated satisfactory soil materials without intermixing. Place, grade, and shape stockpiles to drain surface water. Protect as necessary to prevent windblown dust.
 - 1. Stockpile soil materials away from edge of excavations.
 - 2. Coordinate stockpile requirements with the requirements of the Agency Having Jurisdiction and acceptable BMP's.

3.10 BACKFILL - GENERAL

- A. Upon approved preparation and compaction of subgrade, placement of Structural Fill, Subbase Course and Base Course Fill shall proceed.
- B. Place Backfill materials evenly on all sides of structures to required elevations, and uniformly along the full length of each structure.
- C. Surface of Backfill shall be smooth, even surface. Remove ridges and fill depressions as required to meet finish grades.
- D. Coordinate placement with Specification Section 033000 and Civil, Architectural and Structural Drawings.

3.11 STRUCTURAL FILL - GENERAL

- A. Soils for use as Structural Fill shall be as defined the by Geotechnical Engineering Report and this section.
- B. Place Structural Fill as required to achieve correct subgrade elevation for placement of Subbase Course and Base Course fill.
- C. Structural Fill materials should be placed in layers not to exceed 6-inches in loose thickness.
- D. Structural Fill material should be moisture-conditioned to achieve optimum moisture content prior to compaction.
- E. Each layer of fill should be compacted to the following density:
 - 1. Below Rigid Pavements: A minimum of 95% of maximum dry density, as determined by ASTM D 1557.
 - 2. Below Flexible Pavements: A minimum of 92% of ASTM D1557 or 95% of ASTM D698.

3.12 GRANULAR STRUCTURAL FILL - GENERAL

- A. Soils for use as Granular Structural Fill shall be as defined by this section.
- B. Fill materials should be placed in layers not to exceed 12-inches in loose thickness.
- C. Granular Structural Fill material should be moisture-conditioned to achieve optimum moisture content prior to compaction.
- D. Each layer of fill should be compacted to the following density:
 - 1. Below Structures and Rigid Pavements: A minimum of 95% of maximum dry density, as determined by ASTM D 1557.
 - 2. Below Flexible Pavements: A minimum of 92% of ASTM D1557 or 95% of ASTM D698.

3.13 UTILITY TRENCH BACKFILL

- A. Place backfill on subgrades free of mud, frost, snow or ice.
- B. Place and compact bedding course on trench bottoms and where indicated. Shape bedding course to provide continuous support for bells, joints, and barrels of pipes and for joints, fittings, and bodies of conduits.
- C. Backfill utility trenches using Bedding Course or Granular Structural Fill, compacted as specified below. Sufficient backfill should be placed over the utility before compacting with heavy equipment to prevent damage.
- D. Subbase Course Fill should be placed and compacted to density equal to or greater than requirements for subsequent backfill material.
- E. Place Subbase Course Fill at the following maximum loose depths prior to compaction:
 - 1. Bedding Course: 6-Inch lifts prior to compaction
 - 2. Granular Structural Fill: 12-Inch lifts prior to compaction.
- F. Place and compact final backfill of satisfactory soil to final subgrade elevation.
- G. Install warning tape directly above utilities, 12-inches below finished grade, except 6-inches below subgrade under pavements and slabs.

3.14 SUBBASE COURSE FILL

- A. Upon approved preparation and observed proof-rolling of subgrade, placement of Subbase Course Fill shall proceed.
- B. Place Granular Structural Fill as required to achieve correct subgrade elevation for placement of Base Course fill and indicated surface improvements. Place Subbase Course fill in maximum 12-inch loose lifts and compact as noted below.
- C. Surface of Subbase Course Fill shall be smooth, even surface. Remove ridges and fill depressions as required to meet finish grades.

- D. Coordinate with Specification Section 033000 and Architectural and Structural Drawings for placement for Building Foundations and Building Floor Slab.
- E. Each layer of Subbase Course fill should be compacted to the following density:
 - 1. Below Building Foundations, Building Floor Slab, Structures and Rigid Pavements: A minimum of 95% of maximum dry density, as determined by ASTM D 1557.
 - 2. Below Flexible Pavements: A minimum of 92% of ASTM D1557 or 95% of ASTM D698.

3.15 BASE COURSE FILL

- A. Upon approved placement and compaction of Structural Fill and Subbase Course Fill, placement of Base Course Fill shall proceed.
- B. Place and compact Base Course material in layers to required elevations. Place in maximum 6-inch loose lifts.
- C. Place Base Course materials evenly on all sides of structures to required elevations, and uniformly along the full length of each structure.
- D. Surface of Base Course shall be smooth, even surface. Remove ridges and fill depressions as required to meet finish grades.
- E. Base Course Fill at Structures, Building Slabs and Building Foundations:
 - 1. Building Floor Slabs: Compacted depth as shown on the Drawings
 - 2. Structures: Compacted depth as shown on the Drawings.
 - 3. Building Foundations: Not required.
 - 4. Coordinate with Specification Section 033000 and Architectural and Structural Drawings.
- F. Base Course at Paving, Curbs and Walks:
 - 1. Asphalt Paving: Compacted depth as indicated on the drawings.
 - 2. Concrete Flatwork, Curbs & Walks: Compacted depth as indicated on the drawings.
- G. Place Base Course in maximum 6-inch thick loose lifts to bottom of structure, building slab, pavement, curb or walk. Base Course shall be moisture conditioned to within 2 percent of the optimum moisture.
- H. Each layer of Base Course fill should be compacted to the following density:
 - 1. Below Structures and Rigid Pavements: A minimum of 95% of maximum dry density, as determined by ASTM D 1557.
 - 2. Below Flexible Pavements: A minimum of 95% of the maximum dry density as determined by ASTM D 698.

3.16 LANDSCAPE FILL

- A. Coordinate placement of topsoil with drawings.

3.17 GRADING

- A. General: Uniformly grade areas to a smooth surface, free of irregular surface changes. Comply with compaction requirements and grade to cross sections, lines, and elevations indicated.

- 1. Provide a smooth transition between adjacent existing grades and new grades.
- 2. Cut out soft spots, fill low spots, and trim high spots to comply with required surface tolerances.

- B. Site Rough Grading: Slope grades to direct water away from buildings and to prevent ponding. Finish subgrades to required elevations within the following tolerances:

- 1. Turf or Unpaved Areas: Plus or minus 1 inch.
- 2. Walks: Plus or minus 1/2-inch.
- 3. Pavements: Plus or minus 1/2-inch.

- C. Site drainage should be directed away from structural areas, to avoid ponding of waters during storm events.

- D. Grading inside Building Lines: Finish subgrade to a tolerance of 1/4 inch when tested with a 10-foot straightedge.

3.18 FIELD QUALITY CONTROL

- A. Perform field inspection and testing under provisions of Division 1.

- B. Testing Agency: Owner will engage a qualified geotechnical engineering testing agency to perform tests and inspections.

- C. Allow testing agency to inspect and test subgrades and each fill or backfill layer. Proceed with subsequent earthwork only after test results for previously completed work comply with requirements.

- D. Footing Subgrade: At footing subgrades, at least one test of each soil stratum will be performed to verify design bearing capacities. Subsequent verification and approval of other footing subgrades may be based on a visual comparison of subgrade with tested subgrade when approved by Owner's Representative.

- E. Testing agency will perform compaction testing at the following locations and frequencies:

- 1. Pavement, Walks and Building Slab Areas: At subgrade and at each compacted fill and backfill layer, at least one test for every 5,000 SF (Building Slab) and every 10,000 SF (paved areas) but in no case fewer than three tests.
- 2. Foundation Wall Backfill: At each compacted backfill layer, at least one test for

- every 100 feet or less of wall length, but no fewer than two tests.
3. Trench Backfill: At each compacted initial and final backfill layer (maximum 8" lifts), at least one test for every 100 feet or less of trench length, but no fewer than two tests.
 4. Landscape Fill: at each compacted fill and backfill layer, at least one test for every 20,000 SF but in no case fewer than two tests.
 5. Geotechnical Test Pits & demolished utilities: one test at each compacted fill layer at each test pit or demolished seepage bed.
- F. When testing agency reports that subgrades, fills, or backfills have not achieved degree of compaction specified, scarify and moisten or aerate, or remove and replace soil materials to depth required; re-compact and retest until specified compaction is obtained.

3.19 PROTECTION

- A. Protecting Graded Areas: Protect newly graded areas from traffic, freezing, and erosion. Keep free of trash and debris.
- B. Repair and reestablish grades to specified tolerances where completed or partially completed surfaces become eroded, rutted, settled, or where they lose compaction due to subsequent construction operations or weather conditions.
 1. Scarify or remove and replace soil material to depth as directed by Owner's Representative; reshape and re-compact.
- C. Where settling occurs before Project correction period elapses, remove finished surfacing, backfill with additional soil material, compact, and reconstruct surfacing.
 1. Restore appearance, quality, and condition of finished surfacing to match adjacent work, and eliminate evidence of restoration to greatest extent possible.

3.20 DISPOSAL OF SURPLUS AND WASTE MATERIALS

- A. Remove surplus unsatisfactory soil and waste materials, including unsatisfactory soil, trash, and debris, and legally dispose of them off Owner's property.
- B. Refer to specification section 31 10 00 for disposal of unsuitable and excess fill material at Owner provided Dump Site.

END OF SECTION

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Hot-mix asphalt patching
 - 2. Hot-mix asphalt paving
 - 3. Pavement-marking paint
- B. Related Sections:
 - 1. Division 31 Section "Earth Moving" for aggregate subbase and base courses and for aggregate pavement shoulders.
 - 2. Division 07 Section "Joint Sealants" for joint sealants and fillers at paving terminations.
 - 3. The Asphalt Institute - Manual MS-4 - The Asphalt Handbook.
 - 4. The Asphalt Institute - Manual MS-13 - Asphalt Surface Treatments for Asphalt Penetration Macadam.
 - 5. Idaho Standards for Public Works Construction, Current Edition.
 - 6. AHJ Standards and Specifications.
 - 7. Geotechnical Engineering Report and Addenda as prepared by Materials Testing & Inspection, MTI File Number: T200068g.

1.2 DEFINITION

- A. Hot-Mix Asphalt Paving Terminology: Refer to ASTM D 8 for definitions of terms.
- B. AHJ: Authority Having Jurisdiction

1.3 SUBMITTALS

- A. Submit under provisions of Division 01 Specifications.
- B. Product Data: For each type of product indicated. Include technical data and tested physical and performance properties.
- C. Submit design mix under provisions of Division 01.
- D. Sieve analysis for all course and fine aggregate materials.
- E. Submit pavement marking product data under provisions of Division 01.
- F. Material Certificates: For each paving and striping material, from manufacturer.
- G. Material Test Reports: For each paving material.
- H. Operations & Maintenance Data: Submit Materials Testing reports for compaction testing of all asphalt paving.

1.4 QUALITY ASSURANCE

- A. Perform work in accordance with the Current Edition of the Idaho Standards for Public Works Construction.
- B. Mixing Plant: Conform to the Current Edition of the Idaho Standards for Public Works Construction and comply with ASTM D 3515.
- C. Obtain materials from same source throughout duration of project.

1.5 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.

1.6 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. Tack Coat: Minimum surface temperature of 60 deg F.
 - 2. Asphalt Single Course: Minimum surface temperature of 40 deg F and rising 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.
- C. As-Built Topographic Survey: Coordinate with Part 3 of this section.

1.7 WARRANTY

- A. Contractor shall warrant work as provided by the General and Supplementary Conditions and Division 01 Specifications.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Asphaltic Concrete: Asphalt mix design shall meet the requirements of the ISPWC, Section 810 for Class III Plant Mix.
- B. Base Course (crushed aggregate base): Refer to Specification Section 312000.
- C. Subbase Course (granular structural fill): Refer to Specification Section 312000.
- D. Structural Fill: Refer to Specification Section 312000.
- E. Asphalt-Aggregate Mixtures: 1/2-inch mix design according to ISPWC Section 803.
- F. Comply with requirements of AHJ for all asphalt work in the Right of Way.

2.2 ASPHALT MATERIALS

- A. Asphalt Cement and Bituminous Materials per ISPWC Section 805.
- B. The Contractor shall provide the Engineer with a Mix Design for approval prior to placement of Bituminous Paving Materials.
- C. Plantmix Bituminous Pavement shall be Type 3, unless otherwise specified or approved.
- D. Asphalt Tack Coat: per ISPWC Section 806.
- E. Asphalt Prime Coat: per ISPWC Section 807.
- F. Water: Potable.
- G. Comply with requirements of AHJ for all asphalt work in the Right of Way.

2.3 AUXILIARY MATERIALS

- A. Sand: AASHTO M 29, Grade Nos. 2 or 3.
- B. Joint Sealant: AASHTO M 324, Type II of III.
- C. Pavement-Marking Paint: Alkyd-resin type, lead and chromate free, ready mixed, complying with AASHTO M 248; colors complying with FS TT-P-1952.
 - 1. Color: Per the plans.
- D. Glass Beads: AASHTO M 247, Type 1. Roadway pavement markings only.

2.4 PREFORMED THERMOPLASTIC PAVEMENT MARKINGS

- A. Preformed sheets of thermoplastic meeting AASHTO M-249.
 - 1. Color shall be manufactured to conform to standard traffic marking color requirements, ASTM D 6628. Color: White.
 - 2. Skid resistance shall meet ASTM E 303, minimum initial BPN ≥ 45 .
 - 3. Thickness shall be 90 mil.
 - 4. Preformed thermoplastic should be stored indoors at a minimum temperature of 50 deg. F.
 - 5. Thermoplastic shall have glass beads integrated during the manufacturing process.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Verify that Base Course below proposed pavement areas is dry and in suitable condition to begin paving.
- B. Proceed with paving only after unsatisfactory conditions have been corrected.
- C. Verify that utilities, 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.

3.2 PATCHING

- A. Hot-Mix Asphalt Pavement: Saw cut perimeter of patch and excavate existing pavement section to sound base. Excavate rectangular or trapezoidal patches, extending 12 inches into adjacent sound pavement, unless otherwise indicated. Cut excavation faces vertically. Remove excavated material. Re-compact existing unbound-aggregate base course to form new subgrade.
- B. Tack Coat: Apply uniformly to vertical surfaces abutting or projecting into new, hot-mix asphalt paving at a rate of 0.10 gal/sq. yd.
 - 1. Allow tack coat to cure undisturbed before applying hot-mix asphalt paving.
 - 2. Avoid smearing or staining adjoining surfaces, appurtenances, and surroundings. Remove spillages and clean affected surfaces.
- C. Patching: Fill excavated pavements with hot-mix asphalt base mix for full thickness of patch and, while still hot, compact flush with adjacent surface.
- D. Comply with requirements of AHJ for all asphalt work in the Right of Way.

3.3 REPAIRS

- A. Leveling Course: Install and compact leveling course consisting of hot-mix asphalt

surface course to level sags and fill depressions deeper than 1 inch in existing pavements.

1. Install leveling wedges in compacted lifts not exceeding 3 inches thick.
- B. Crack and Joint Filling: Remove existing joint filler material from cracks or joints to a depth of 1/4 inch.
 1. Clean cracks and joints in existing hot-mix asphalt pavement.
 2. Use emulsified-asphalt slurry to seal cracks and joints less than 1/4 inch wide. Fill flush with surface of existing pavement and remove excess.
 3. Use hot-applied joint sealant to seal cracks and joints more than 1/4 inch wide. Fill flush with surface of existing pavement and remove excess.

3.4 SURFACE PREPARATION

- A. General: Immediately before placing asphalt materials, remove loose and deleterious material from substrate surfaces. Ensure that prepared crushed surfacing below proposed pavement areas is ready to receive paving.
- B. Tack Coat: Apply uniformly to surfaces of existing pavement at a rate of 0.10 gal/sq. yd.
 1. Allow tack coat to cure undisturbed before applying hot-mix asphalt paving.
 2. Avoid smearing or staining adjoining surfaces, appurtenances, and surroundings. Remove spillages and clean affected surfaces.
- C. Surface Course: The surface course lift shall be placed as near project substantial completion as possible.
 1. If Base course pavement exists, it shall be cleaned to remove all debris and dust.
 2. Visually inspect base course pavement for mechanical or chemical damage. All areas with chemical damage, i.e. dripped fuels, or mechanical damage shall be identified and marked with paint for review by the Architect. All areas determined to require patching shall be patched per 3.2 of this Section prior to placement of surface course.
 3. Apply tack coat to base course prior to placement of surface course at a rate of 0.15 gal/sq. yd.

3.5 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. Light Duty Asphalt: Place hot-mix asphalt in single lift to 2.5-Inch compacted thickness.
 2. Heavy Duty Asphalt: Place hot-mix asphalt in single lift to 3.0-Inch compacted thickness.
 3. Spread mix at minimum temperature as required by binder temperature/viscosity curve.
 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.
- 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.

3.6 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 cold 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.
 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.

3.7 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. Compaction: 91% - 96% with a minimum average of 92%. Joint density should be at least 90 percent of Rice density.
- 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.

3.8 INSTALLATION TOLERANCES

- A. Pavement Thickness: Compact each course to produce the thickness indicated within the following tolerances:
 - 1. Base Course Asphalt Lift: Plus or minus 1/4-inch.
 - 2. Surface Course Asphalt Lift: Plus 1/4-inch, no minus.
- B. Pavement Surface Smoothness: Comply with ISPWC Section 810. 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 Asphalt Lift: 1/4 inch.
 - 2. Surface Course Asphalt Lift: 1/8 inch.
 - 3. Crowned Surfaces: Test with crowned template centered and at right angle to crown. Maximum allowable variance from template is 1/4 inch.

3.9 PAVEMENT MARKING

- A. Do not apply pavement-marking paint until layout, colors, and placement have been verified with Architect.
- B. Comply with the AHJ standards for all markings in the Right of Way.
- C. Apply per ISPWC Section 1104.
- D. Protect newly applied pavement-marking paint until it has fully cured.
- E. Coordinate with drawings for fire lane curb painting requirements.
- F. Preformed Thermoplastic Pavement Markings:
 - 1. Ensure asphalt or concrete surface is free of moisture, grease, loose dirt or particulate matter, or other substances which may hinder the mechanical bond to the surface. The surface should be pre-heated to an adequate temperature, and after installation is complete, the thermoplastic should be allowed to cool sufficiently so as to not incur structural deformation, compression, movement, or dirt-pickup.
 - 2. The asphalt or concrete surface should be pre-heated to approximately 275 deg. F. The preformed thermoplastic should then be heated, after being set in place, to approximately 300 deg. F., or until the thermoplastic begins to conform to the surface underneath. Before installing read the manufacturer's writing installation instructions.
 - 3. Utilize "Torch Down" installation process per manufacturer's recommendations.

3.10 FIELD QUALITY CONTROL

- A. Testing Agency: Owner will engage a qualified testing agency to perform tests and inspections.
- B. Field inspection and testing will be performed under provisions of Division 1.
- C. Take samples and perform tests in accordance with The Asphalt Institute.
- D. Frequency of Tests: Density Tests: 1 per 2000 sq. ft.
- E. All paved surfaces shall be flooded with water in the presence of the Engineer to verify that all surfaces completely drain and no low depressed areas exist. A

minimum of 48 hours notice shall be given.

- F. Excessive rock pockets and/or cold joints (surface irregularities) are not acceptable and shall be corrected in a manner acceptable to the Engineer at no cost to the Owner.
- G. Replace and compact hot-mix asphalt where core tests were taken.
- H. Remove and replace or install additional hot-mix asphalt where test results or measurements indicate that it does not comply with specified requirements.
- I. Comply with requirements of AHJ for all asphalt work in the Right of Way.

3.11 PROTECTION

- A. Immediately after placement, protect pavement from mechanical and chemical damage until date of Substantial Completion.

3.12 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

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Site flatwork, sidewalks, curbs, gutters and mow strips.
2. Bases for light poles, furnishings, walls and signs.
3. Reinforcing.
4. Joint Filler and Joint Sealant
5. Miscellaneous items shown.

1.2 RELATED SECTIONS

- A. Division 31 Earth Moving
- B. Idaho Standards for Public Works Construction, Current Edition.
- C. Ada County Highway District Standard Construction Details and Specifications.
- D. Geotechnical Engineering Report and Addenda as prepared by Materials Testing & Inspection, MTI File Number: T200068g.

1.3 SUBMITTALS

- A. Submit under provisions of Division 01 Specifications.
- B. Product Data: For each type of product indicated.
- C. Sieve analysis for all course and fine aggregate materials.
- D. Shop Drawings:
 1. Provide contraction joint, isolation joint and pour sequence layout plan for review and approval.
 2. Indicate reinforcing steel sizes, spacing, locations and quantities for reinforcing steel, bending and cutting schedules, splicing, and supporting and spacing devices.
- E. Design Mixtures: For each concrete paving mixture. Include alternate design mixtures when characteristics of materials, Project conditions, weather, test results, or other circumstances warrant adjustments. Concrete testing data shall have been completed within 12 months of the submittal date.
- F. Qualification Data: Ready-mix concrete manufacturer and testing agency.

- G. Operations & Maintenance Data: Submit Materials Testing reports for sample and strength testing of all site concrete work.

1.4 QUALITY ASSURANCE

- A. Ready-Mix-Concrete Manufacturer Qualifications: A firm experienced in manufacturing ready-mixed concrete products and that complies with ASTM C 94/C 94M requirements for production facilities and equipment.
- B. ACI Publications: Comply with ACI 301 and ACI 316 unless otherwise indicated.

1.5 WARRANTY

- A. Contractor shall warrant work as provided by the General and Supplementary Conditions and Division 01 Specifications.

PART 2 - PRODUCTS

2.1 FORMS

- A. Form Materials: Plywood, metal, metal-framed plywood, or other approved panel-type materials to provide full-depth, continuous, straight, and smooth exposed surfaces.
 - 1. Use flexible or uniformly curved forms for curves with a radius of 100 feet or less. Do not use notched and bent forms.
- B. Form-Release Agent: Commercially formulated form-release agent that will not bond with, stain, or adversely affect concrete surfaces and that will not impair subsequent treatments of concrete surfaces.

2.2 STEEL REINFORCEMENT

- A. Recycled Content: Provide steel reinforcement with an average recycled content of steel so postconsumer recycled content plus one-half of preconsumer recycled content is not less than 25 percent.
- B. Plain-Steel Welded Wire Reinforcement: ASTM A 185/A 185M, flat sheet.
- C. Reinforcing Bars: ASTM A 615/A 615M, Grade 60; deformed.
- D. Epoxy-Coated Reinforcing Bars: ASTM A 775/A 775M or ASTM A 934/A 934M; with ASTM A 615/A 615M, Grade 60 deformed bars.
- E. Joint Dowel Bars: ASTM A 615/A 615M, Grade 60 plain-steel bars; zinc coated (galvanized) after fabrication according to ASTM A 767/A 767M, Class I coating. Cut bars true to length with ends square and free of burrs.

- F. Tie Bars: ASTM A 615/A 615M, Grade 60, deformed.
- G. Hook Bolts: ASTM A 307, Grade A, internally and externally threaded. Design hook-bolt joint assembly to hold coupling against paving form and in position during concreting operations, and to permit removal without damage to concrete or hook bolt.
- H. Bar Supports: Bolsters, chairs, spacers, and other devices for spacing, supporting, and fastening reinforcing bars, welded wire reinforcement, and dowels in place. Manufacture bar supports according to CRSI's "Manual of Standard Practice" from steel wire, plastic, or precast concrete of greater compressive strength than concrete specified, and as follows:
 - 1. Equip wire bar supports with sand plates or horizontal runners where base material will not support chair legs.
 - 2. For epoxy-coated reinforcement, use epoxy-coated or other dielectric-polymer-coated wire bar supports.
- I. Epoxy Repair Coating: Liquid, two-part, epoxy repair coating, compatible with epoxy coating on reinforcement.
- J. Zinc Repair Material: ASTM A 780.

2.3 CONCRETE MATERIALS

- A. Cementitious Material: Provide in accordance with ISPWC Division 700. Portland Cement Type I or II.
- B. Normal-Weight Aggregates: ASTM C 33, uniformly graded. Provide aggregates from a single source. Refer to ISPWC Section 703 for aggregate requirements.
 - 1. Maximum Coarse-Aggregate Size 3/4 inch nominal.
 - 2. Fine Aggregate: Free of materials with deleterious reactivity to alkali in cement.
 - 3. Use 1/2 inch maximum sized aggregate and high range water reducer in concrete at all round columns and exposed concrete wall to reduce bug holes and surface imperfections. Sack finishing will not be acceptable to cure surface problems.
- C. Water: Potable and complying with ASTM C 94/C 94M.
- D. Air-Entraining Admixture: ASTM C 260.
- E. Chemical Admixtures: Admixtures certified by manufacturer to be compatible with other admixtures and to contain not more than 0.1 percent water-soluble chloride ions by mass of cementitious material.
 - 1. Water-Reducing Admixture: ASTM C 494/C 494M, Type A.
 - 2. Retarding Admixture: ASTM C 494/C 494M, Type B.
 - 3. Water-Reducing and Retarding Admixture: ASTM C 494/C 494M, Type D.
 - 4. High-Range, Water-Reducing Admixture: ASTM C 494/C 494M, Type F.

5. High-Range, Water-Reducing and Retarding Admixture: ASTM C 494/C 494M, Type G.
6. Plasticizing and Retarding Admixture: ASTM C 1017/C 1017M, Type II.

F. Fiber Reinforcement Admixture: Fibermesh® 650 or approved equal.

1. Reference plan details for locations required.
2. Install per manufactures recommendations.

2.4 CURING MATERIALS

A. Curing Compound: ASTM C 309, Type 1, Class A, water based.

B. Pre-Approved Product: W.R. Meadows 1100-Clear.

2.5 JOINT MATERIALS

A. Joint Fillers:

1. 1/2 thick Fiber Joint Filler as manufactured by W.R. Meadows, or approved equal. Provide resilient and non-extruding type pre-molded bituminous-impregnated fiberboard complying with ASTM D1751.
2. Use with Snap-Cap as manufactured by W.R. Meadows, or approved equal where joint is to be sealed. Coordinate with Drawings for location.

B. Joint Sealant: provide at locations shown on drawings.

1. Tremco THC-901 – High Performance Multi-Component Polyurethane Sealant, or approved equal. Sealant shall meet or exceed the following specifications:
 - a. U.S. Federal Specification TT-S-00227E, Class A, Type I
 - b. ASTM C 920, Type M, Grade P, Class 25, Use T, M, & O
2. Tremco Universal Color Pak or pre-tinted in limestone. Color to match surrounding concrete flatwork.

2.6 CONCRETE MIXTURES

A. Prepare design mixtures, proportioned according to ACI 301, for each type and strength of normal-weight concrete, and as determined by either laboratory trial mixtures or field experience.

1. Use a qualified independent testing agency for preparing and reporting proposed concrete design mixtures for the trial batch method.
2. When automatic machine placement is used, determine design mixtures and obtain laboratory test results that meet or exceed requirements.

B. Proportion mixtures to provide normal-weight concrete with the following properties:

1. Compressive Strength (28 Days): 4000 psi with modulus of rupture of greater than 650 psi, generally complying with ITD requirements for Urban Concrete.
 2. Maximum Water-Cementitious Materials Ratio at Point of Placement: 0.45.
 3. Slump Limit: 3 inches, plus or minus 1 inch.
- C. Add air-entraining admixture at manufacturer's prescribed rate to result in normal-weight concrete at point of placement having an air content as follows:
1. Air Content: 6 percent plus or minus 1.5 percent for 3/4-inch nominal maximum aggregate size.
- D. Chemical Admixtures: Use admixtures according to manufacturer's written instructions.
1. Use water-reducing admixture in concrete as required for placement and workability.
 2. Use water-reducing and retarding admixture when required by high temperatures, low humidity, or other adverse placement conditions.
- E. Cementitious Materials: Limit percentage by weight of cementitious materials other than portland cement according to ACI 301 requirements as follows:
1. Fly Ash or Pozzolan: 25 percent.
 2. Ground Granulated Blast-Furnace Slag: 50 percent.
 3. Combined Fly Ash or Pozzolan, and Ground Granulated Blast-Furnace Slag: 50 percent, with fly ash or pozzolan not exceeding 25 percent.
- F. Fiber Reinforcement Admixture:
1. Reference plan details for locations required.
 2. Install per manufactures recommendations.

2.7 CONCRETE MIXING

- A. Ready-Mixed Concrete: Measure, batch, and mix concrete materials and concrete according to ASTM C 94/C 94M. Furnish batch certificates for each batch discharged and used in the Work.
1. When air temperature is between 85 and 90 deg F, reduce mixing and delivery time from 1-1/2 hours to 75 minutes; when air temperature is above 90 deg F, reduce mixing and delivery time to 60 minutes.

2.8 AUXILIRY MATERIALS

- A. Pavement-Marking Paint: Alkyd-resin type, lead and chromate free, ready mixed, complying with AASHTO M 248; colors complying with FS TT-P-1952.
1. Color: Per the plans.

- B. Glass Beads: AASHTO M 247, Type 1. Roadway pavement markings only.

2.9 JOINT MATERIALS – HEAVY DUTY CONCRETE FLATWORK

- A. Joint Fillers and Sealants:
 - 1. As shown on drawings and per ITD Standard Drawings and Specifications for Highway Construction plans.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine exposed base course surfaces for compliance with requirements for dimensional, grading, and elevation tolerances.
- B. Proof-roll prepared base course surface below concrete flatwork, curb and paving to identify soft pockets and areas of excess yielding.
 - 1. Completely proof-roll base course. Limit vehicle speed to 3 mph.
 - 2. Proof-roll with a pneumatic-tired and loaded, 10-wheel, tandem-axle dump truck weighing not less than 15 tons.
 - 3. Correct soft spots and areas of pumping or rutting exceeding depth of 1/2 inch according to requirements in Division 31 Section "Earth Moving."
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Remove loose material from compacted base course surface immediately before placing concrete.

3.3 EDGE FORMS AND SCREED CONSTRUCTION

- A. Set, brace, and secure edge forms, bulkheads, and intermediate screed guides to required lines, grades, and elevations. Install forms to allow continuous progress of work and so forms can remain in place at least 24 hours after concrete placement.
- B. Clean forms after each use and coat with form-release agent to ensure separation from concrete without damage.

3.4 STEEL REINFORCEMENT

- A. General: Comply with CRSI's "Manual of Standard Practice" for fabricating, placing, and supporting reinforcement.

- B. Refer to drawings for location of reinforcement at all utility structures.
- C. Coordinate with drawings for reinforcement at building doorways.
- D. Clean reinforcement of loose rust and mill scale, earth, ice, or other bond-reducing materials.
- E. Arrange, space, and securely tie bars and bar supports to hold reinforcement in position during concrete placement. Maintain minimum cover to reinforcement.
- F. Install welded wire reinforcement in lengths as long as practicable. Lap adjoining pieces at least one full mesh, and lace splices with wire. Offset laps of adjoining widths to prevent continuous laps in either direction.
- G. Zinc-Coated Reinforcement: Use galvanized-steel wire ties to fasten zinc-coated reinforcement. Repair cut and damaged zinc coatings with zinc repair material.
- H. Epoxy-Coated Reinforcement: Use epoxy-coated steel wire ties to fasten epoxy-coated reinforcement. Repair cut and damaged epoxy coatings with epoxy repair coating according to ASTM D 3963/D 3963M.

3.5 JOINTS

- A. General: Form construction, isolation, and contraction joints and tool edges true to line, with faces perpendicular to surface plane of concrete. Construct transverse joints at right angles to centerline unless otherwise indicated.
 - 1. When joining existing paving, place transverse joints to align with previously placed joints unless otherwise indicated.
- B. Construction Joints: Set construction joints at side and end terminations of paving and at locations where paving operations are stopped for more than one-half hour unless paving terminates at isolation joints.
 - 1. Continue steel reinforcement across construction joints unless otherwise indicated. Do not continue reinforcement through sides of paving strips unless otherwise indicated.
 - 2. Provide tie bars at sides of paving strips where indicated.
 - 3. Butt Joints: Use epoxy bonding adhesive at joint locations where fresh concrete is placed against hardened or partially hardened concrete surfaces.
 - 4. Keyed Joints: Provide preformed keyway-section forms or bulkhead forms with keys unless otherwise indicated. Embed keys at least 1-1/2 inches into concrete.
 - 5. Doweled Joints: Install dowel bars and support assemblies at joints where indicated. Lubricate or coat with asphalt one-half of dowel length to prevent concrete bonding to one side of joint.
 - 6. Construction joints within heavy duty concrete flatwork shall be constructed as isolation joints as detailed on plans. Contractor shall provide joint and pour sequence layout plan for review and approval.

- C. Isolation Joints: Form isolation joints of preformed joint-filler strips abutting concrete curbs, catch basins, manholes, inlets, structures, columns, other fixed objects, new concrete flatwork to old concrete flatwork, and where indicated.
1. Extend joint fillers full width and depth of joint. No plug or sliver of concrete should extend over, under, through, around, or between sections of the filler board.
 2. Terminate joint filler not less than 1/2 inch or more than 1 inch below finished surface if joint sealant is indicated. Utilize filler board cap at all sealed joints.
 3. Place top of joint filler flush with finished concrete surface if joint sealant is not indicated.
 4. Furnish joint fillers in one-piece lengths. Where more than one length is required, lace or clip joint-filler sections together.
 5. During concrete placement, protect top edge of joint filler with metal, plastic, or other temporary preformed cap. Remove protective cap after concrete has been placed on both sides of joint.
 6. Place joint sealant per Manufacturer's written specifications.
 - a. Surfaces must be sound, clean and dry. Apply to surface when temperatures are 40 deg. F or above.
 - b. Mix in accordance with written instructions on product packaging.
 - c. Ensure joint filler is installed properly.
 - d. Excess sealant and smears adjacent to the joint shall be carefully removed in accordance with written instructions.
 7. Isolation joints within heavy duty concrete flatwork shall be constructed as detailed on plans. Contractor shall provide joint layout and pour sequence layout plan for review and approval.
- D. Contraction Joints: Form weakened-plane contraction joints, sectioning concrete into areas as indicated. Construct contraction joints for a depth equal to at least one-third of the concrete thickness, as follows:
1. Grooved Joints: Saw joints at locations shown.
 2. Contraction Joints shall be constructed at the optimum time to prevent raveling (too early) and cracking (too late). Excessive raveling and chipping of joint edge will be cause for slab replacement.
 3. Jointed panels should be as close to square as possible.
 4. Contraction joints should be straight and continuous. Align joints of adjacent panels.
 5. Align joints in attached curbs with joints in pavement.
 6. Contraction joints within heavy duty concrete flatwork shall receive backer rod and sealant as detailed on plans. Contractor shall provide joint layout and pour sequence layout plan for review and approval.
- E. Edging: After initial floating, tool edges of paving, gutters, curbs, and joints in concrete with an edging tool to a 1/2-inch radius. Repeat tooling of edges after applying surface finishes. Eliminate edging-tool marks on concrete surfaces.
- F. Coordinate with Civil Drawings and Structural Drawings for Doweled Joints at building

doorways.

3.6 CONCRETE PLACEMENT

- A. Before placing concrete, inspect and complete formwork installation, steel reinforcement, and items to be embedded or cast-in.
- B. Remove snow, ice, or frost from subbase surface and steel reinforcement before placing concrete. Do not place concrete on frozen surfaces.
- C. Moisten subbase to provide a uniform dampened condition at time concrete is placed. Do not place concrete around manholes or other structures until they are at required finish elevation and alignment.
- D. Place reinforcing bars at locations shown on drawings.
- E. Comply with ACI 301 requirements for measuring, mixing, transporting, and placing concrete.
- F. Do not add water to concrete during delivery or at Project site. Do not add water to fresh concrete after testing.
- G. Deposit and spread concrete in a continuous operation between transverse joints.
- H. Consolidate concrete according to ACI 301 by mechanical vibrating equipment supplemented by hand spading, rodding, or tamping.
 - 1. Consolidate concrete along face of forms and adjacent to transverse joints with an internal vibrator. Keep vibrator away from joint assemblies, reinforcement, or side forms. Use only square-faced shovels for hand spreading and consolidation. Consolidate with care to prevent dislocating reinforcement, dowels, and joint devices.
- I. Screed paving surface with a straightedge and strike off.
- J. Commence initial floating using bull floats or darbies to impart an open-textured and uniform surface plane before excess moisture or bleed water appears on the surface. Do not further disturb concrete surfaces before beginning finishing operations or spreading surface treatments.
- K. Curbs and Gutters: Use design mixture for automatic machine placement. Produce curbs and gutters to required cross section, lines, grades, finish, and jointing.
- L. Slip-Form Paving: Use design mixture for automatic machine placement. Produce paving to required thickness, lines, grades, finish, and jointing.
 - 1. Compact subbase and prepare subgrade of sufficient width to prevent displacement of slip-form paving machine during operations.

M. Cold-Weather Placement: Protect concrete work from physical damage or reduced strength that could be caused by frost, freezing, or low temperatures. Comply with ACI 306.1 and the following:

1. When air temperature has fallen to or is expected to fall below 40 deg F, uniformly heat water and aggregates before mixing to obtain a concrete mixture temperature of not less than 50 deg F and not more than 80 deg F at point of placement.
2. Do not use frozen materials or materials containing ice or snow.
3. Do not use calcium chloride, salt, or other materials containing antifreeze agents or chemical accelerators unless otherwise specified and approved in design mixtures.

N. Hot-Weather Placement: Comply with ACI 301 and as follows when hot-weather conditions exist:

1. Cool ingredients before mixing to maintain concrete temperature below 90 deg F at time of placement. Chilled mixing water or chopped ice may be used to control temperature, provided water equivalent of ice is calculated in total amount of mixing water. Using liquid nitrogen to cool concrete is Contractor's option.
2. Cover steel reinforcement with water-soaked burlap so steel temperature will not exceed ambient air temperature immediately before embedding in concrete.
3. Fog-spray forms, steel reinforcement, and subgrade just before placing concrete. Keep subgrade moisture uniform without standing water, soft spots, or dry areas.

3.7 FLOAT FINISHING

A. General: Do not add water to concrete surfaces during finishing operations.

B. Float Finish: Begin the second floating operation when bleed-water sheen has disappeared and concrete surface has stiffened sufficiently to permit operations. Float surface with power-driven floats or by hand floating if area is small or inaccessible to power units. Finish surfaces to true planes. Cut down high spots and fill low spots. Refloat surface immediately to uniform granular texture.

1. Medium-to-Fine-Textured Broom Finish: Draw a soft-bristle broom across float-finished concrete surface perpendicular to line of traffic to provide a uniform, fine-line texture.

3.8 CONCRETE PROTECTION AND CURING

A. General: Protect freshly placed concrete from premature drying and excessive cold or hot temperatures.

B. Comply with ACI 306.1 for cold-weather protection.

C. Evaporation Retarder: Apply evaporation retarder to concrete surfaces if hot, dry, or windy conditions cause moisture loss approaching 0.2 lb/sq. ft. x h before and during

finishing operations. Apply according to manufacturer's written instructions after placing, screeding, and bull floating or darbying concrete but before float finishing.

- D. Begin curing after finishing concrete but not before free water has disappeared from concrete surface.
- E. Curing Methods: Cure concrete by moisture curing, moisture-retaining-cover curing, curing compound or a combination of these as follows:
 - 1. Moisture Curing: Keep surfaces continuously moist for not less than seven days with the following materials:
 - a. Water.
 - b. Continuous water-fog spray.
 - c. Absorptive cover, water saturated and kept continuously wet. Cover concrete surfaces and edges with 12-inch lap over adjacent absorptive covers.
 - 2. Moisture-Retaining-Cover Curing: Cover concrete surfaces with moisture-retaining cover, placed in widest practicable width, with sides and ends lapped at least 12 inches and sealed by waterproof tape or adhesive. Immediately repair any holes or tears occurring during installation or curing period using cover material and waterproof tape.
 - 3. Curing Compound: Apply uniformly in continuous operation by power spray or roller according to manufacturer's written instructions. Recoat areas that have been subjected to heavy rainfall within three hours after initial application. Maintain continuity of coating, and repair damage during curing period.

3.9 PAVING TOLERANCES

- A. Comply with tolerances in ACI 117 and as follows:
 - 1. ACI 117 establishes few paving tolerances; those in subparagraphs below are based on ACI 330.1. Revise to suit Project.
 - 2. Elevation: 1/4 inch flatwork
 - 3. Thickness: Plus 3/8 inch, minus 1/4 inch.
 - 4. Surface: Gap below 10-foot- long, unlevelled straightedge not to exceed 1/2 inch.
 - 5. Alignment of Tie-Bar End Relative to Line Perpendicular to Paving Edge: 1/2 inch per 12 inches of tie bar.
 - 6. Lateral Alignment and Spacing of Dowels: 1 inch.
 - 7. Vertical Alignment of Dowels: 1/4 inch.
 - 8. Alignment of Dowel-Bar End Relative to Line Perpendicular to Paving Edge: 1/4 inch per 12 inches of dowel.
 - 9. Joint Spacing: 3 inches.
 - 10. Contraction Joint Depth: Plus 1/4 inch, no minus.
 - 11. Joint Width: Plus 1/8 inch, no minus.

3.10 FIELD QUALITY CONTROL

- A. Testing Agency: Owner will engage a qualified testing agency to perform tests and inspections.
- B. Testing Services: Testing of composite samples of fresh concrete obtained according to ASTM C 172 shall be performed according to the following requirements:
 - 1. Testing Frequency: Obtain at least one composite sample for each 100 cu. yd. or fraction thereof of each concrete mixture placed each day.
 - a. When frequency of testing will provide fewer than five compressive-strength tests for each concrete mixture, testing shall be conducted from at least five randomly selected batches or from each batch if fewer than five are used.
 - 2. Slump: ASTM C 143/C 143M; one test at point of placement for each composite sample, but not less than one test for each day's pour of each concrete mixture. Perform additional tests when concrete consistency appears to change.
 - 3. Air Content: ASTM C 231, pressure method; one test for each composite sample, but not less than one test for each day's pour of each concrete mixture.
 - 4. Concrete Temperature: ASTM C 1064/C 1064M; one test hourly when air temperature is 40 deg F and below and when it is 80 deg F and above, and one test for each composite sample.
 - 5. Compression Test Specimens: ASTM C 31/C 31M; cast and laboratory cure one set of three standard cylinder specimens for each composite sample.
 - 6. Compressive-Strength Tests: ASTM C 39/C 39M; test one specimen at seven days and two specimens at 28 days.
 - a. A compressive-strength test shall be the average compressive strength from two specimens obtained from same composite sample and tested at 28 days.
- C. Strength of each concrete mixture will be satisfactory if average of any three consecutive compressive-strength tests equals or exceeds specified compressive strength and no compressive-strength test value falls below specified compressive strength by more than 500 psi.
- D. Test results shall be reported in writing to Architect, concrete manufacturer, and Contractor within 48 hours of testing. Reports of compressive-strength tests shall contain Project identification name and number, date of concrete placement, name of concrete testing and inspecting agency, location of concrete batch in Work, design compressive strength at 28 days, concrete mixture proportions and materials, compressive breaking strength, and type of break for both 7- and 28-day tests.
- E. Nondestructive Testing: Impact hammer, sonoscope, or other nondestructive device may be permitted by Architect but will not be used as sole basis for approval or rejection of concrete.
- F. Additional Tests: Testing and inspecting agency shall make additional tests of concrete when test results indicate that slump, air entrainment, compressive strengths, or other requirements have not been met, as directed by Architect.

- G. Concrete paving will be considered defective if it does not pass tests and inspections.
- H. Additional testing and inspecting, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.

3.11 REPAIRS AND PROTECTION

- A. Remove and replace concrete paving that is broken, damaged, or defective or that does not comply with requirements in this Section. Remove work in complete sections from joint to joint unless otherwise approved by Architect.
- B. Drill test cores, where directed by Architect, when necessary to determine magnitude of cracks or defective areas. Fill drilled core holes in satisfactory paving areas with portland cement concrete bonded to paving with epoxy adhesive.
- C. Protect concrete paving from damage. Exclude traffic from paving for at least 14 days after placement. When construction traffic is permitted, maintain paving as clean as possible by removing surface stains and spillage of materials as they occur.
- D. Maintain concrete paving free of stains, discoloration, dirt, and other foreign material. Sweep paving not more than two days before date scheduled for Substantial Completion inspections. Pressure washing or other method shall be used to remove stains and tire markings if necessary.
- E. All concrete paving shall be broom clean at date of Substantial Completion.

END OF SECTION

PART 1 – GENERAL

1.1 SUMMARY

- A. Fence framework, fabric, and accessories.
- B. Excavation for post bases; concrete foundation for posts.
- C. Gates and related hardware.
- D. Privacy Slats.

1.2 RELATED SECTIONS

- A. Division 32 – Concrete Paving: Concrete anchorage for posts.
- B. Division 01 Specifications.

1.3 REFERENCES

- A. ASTM A 116 - Standard Specification for Zinc-Coated (Galvanized) Steel Woven Wire Fence Fabric; 1995.
- B. ASTM A 123/A 123M - Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products; 2000.
- C. ASTM A 153/A 153M - Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware; 2000.
- D. ASTM A 392 - Standard Specification for Zinc-Coated Steel Chain-Link Fence Fabric; 1996.
- E. ASTM C 94/C 94M - Standard Specification for Ready-Mixed Concrete; 2000.
- F. ASTM F 567 - Standard Practice for Installation of Chain-Link Fence; 2000.
- G. ASTM 900 – Standards Specifications for Industrial and Commercial Swing Gates.
- H. ASTM F 1043 – Standard Specifications for Strength and Protective Coatings on Metal Industrial Chain Link Fence Framework.
- I. ASTM F 1083 - Standard Specification for Pipe, Steel, Hot-Dipped Zinc-Coated (Galvanized) Welded, for Fence Structures; 1997.
- J. CLFMI CLF 2445 - Product Manual; Chain Link Fence Manufacturers Institute; 1997.

1.4 SUBMITTALS

- A. Product Data: Provide data on fabric, posts, accessories, fittings and hardware.
- B. Shop Drawings: Spacing of components, post foundation dimensions, hardware anchorage, gate hardware and schedule of components.
- C. Manufacturer's Installation Instructions: Indicate installation requirements and recommended methods.

1.5 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company specializing in manufacturing products specified in this section, with not less than five (5) years of documented experience.
- B. Installer's Qualifications: Installer specializing in the installation of products and work specified in the section with not less than five (5) years of documented experience.

1.6 WARRANTY

- A. Contractor shall warrant work as provided by the General and Supplementary Conditions and Division 01 Specifications.

PART 2 – PRODUCTS

2.1 MATERIALS

- A. General: Substitutions or equivalent products shall be in accordance with Division 01 Specifications.
- B. 6-FT Fencing:
 - 1. Posts, Rails, and Frames: ASTM F 1083 Schedule 40 steel pipe, 25 ksi; OR ASTM F 1043 IC SS40 steel pipe, 50 ksi. Standard Hot Dipped Galvanized.
 - 2. Wire Fabric: 2-inch mesh, 9 gauge, ASTM A 392 zinc coated steel chain link fabric with 1.2 oz. per square foot.
 - 3. Selvage edges: **Fabric shall be Twist at top and bottom.**
 - 4. Concrete: Type specified in Division 32.
- C. Footings shall be sized as follows:

Fence Height	Footing Depth (from finished surface)	Footing Diameter
6-FT	30-inch	9-inch

2.2 COMPONENTS (finish to match post and fabric)

- A. Gate Posts (Hinge and Latch Posts): All post dimensions are outside diameter.
 - 1. 2.875 inch O.D. for gate leaf 6 feet and under.
 - 2. 4 inch O.D. for gate leaf 6 feet to 9 feet.
 - 3. 6.625 inch O.D. for gate leaf 10 feet to 20 feet.
- B. Gates:
 - 1. All gates shall be width noted on plans, height to match adjacent fencing.
- C. Terminal Posts: Corner/End/Pull - All post dimensions are outside diameter.
 - 1. 2.375 inch for 6' high.
- D. Line Post: All post dimensions are outside diameter.
 - 1. 1.9 inch for 6' height, max spacing 10' o.c.
- E. Brace Rail: 1.66 inch O.D., plain end, sleeve coupled, unless otherwise indicated on the drawing. Manufacturer's longest lengths.
- F. Top & Bottom Rail: 0.065 tubing at all fencing locations.
- G. Tie Wire: Aluminum alloy steel wire, 9-gauge or 11-gauge, galvanized steel, to match fabric core material.
- H. Post Brace Assembly: Install per manufacturer's recommendations
 - 1. Horizontal Brace: 1.66 inch diameter, length and fittings as required.
 - 2. Truss Rod: 0.375 inch diameter steel rod, length adjusted as required.
- I. Gate Frame: 1.625 inch O.D., steel pipe for welded fabrication. Provide corner reinforcing gusset plates to prevent twist when damaged. Gate frames in leaf 10' or greater shall have vertical member truss rods and 3/8" adjustable truss rods with turn buckles.

2.3 ACCESSORIES (finish to match post and fabric)

- A. Caps: Cast steel galvanized; sized to post diameter, set screw retainer, finish to match post.
- B. Fittings: Sleeves, bands, clips, rail ends, tension bars, fasteners and fittings; steel, finish to match post and fabric.
- C. Hardware for Single Swinging Gates: 180 degree hinges, 2 for gates up to 60 inches high, 3 for taller gates; fork latch with gravity drop and padlock hasp. Finish to match post and fabric. Hinge must allow for gate to swing as shown on the drawings.
- D. Hardware for Double Swinging Gates: Greater than 180 degree hinges, 2 for gates up to 60 inches high, 3 for taller gates. Finish to match post and fabric. Gate frame shall have Vertical member truss rods and 3/8" adjustable truss rods with turn buckles.
- E. Gate Latch for Double Swinging Gates and Pipe Gates: Fulcrum Double Gate Latch, Hoover or equal.

2.4 FINISHES

- A. Components (Other than Fabric): Galvanized in accordance with ASTM A 123/A 123M, at 2.0 oz/sq ft.
- B. Hardware: Hot-dip galvanized to weight required by ASTM A 153/A 153M.
- C. Accessories: Same finish as framing.

PART 3 – EXECUTION

3.1 INSTALLATION

- A. Verify finished grades are complete prior to installation.
- B. Install framework, fabric, accessories and gates in accordance with ASTM F 567.
- C. Place fabric on inside of posts and rails.
- D. Set intermediate posts plumb, in concrete footings with top of footing 2 inches above finish grade or as shown on the drawings. Slope top of concrete for water runoff.
- E. Line Post Footing per Part 2 of this Specification. Submit shop drawings for review.
- F. Corner, Gate and Terminal Post Footing Depth Below Finish Grade per Part 2 of this Specification. Submit shop drawings for review.
- G. Brace each gate and corner post to adjacent line post with horizontal center brace rail and diagonal truss rods. Install brace rail one bay from end and gateposts.
- H. Provide top rail through line post tops and splice with 6 inch long rail sleeves.
- I. Install center brace rail on corner gate leaves and on backstop fencing.
- J. Do not stretch fabric until concrete foundation has cured 7 days.
- K. Stretch fabric between terminal posts or at intervals of 500 feet maximum, whichever is less
- L. Position bottom of fabric 2 inches above finished grade or 1 inch above mow strip or concrete flatwork or wall cap.
- M. Fasten fabric to top rail, line posts, braces, mid rail and bottom rail with tie wire at maximum 15 inches on center. Bend ends to minimize hazard to persons or clothing.
- N. Attach fabric to end, corner, and gateposts with tension bars and tension bar clips.
- O. Do not attach the hinged side of gate to building wall; provide gateposts.
- P. Install gate with fabric to match fence. Install hardware, finish to match fence.
- Q. Adjust gate to operate smoothly, easily, and quietly, free from binding, wrap, excessive deflection, distortion, non-alignment, or malfunction throughout the entire operational range. Confirm that latches and locks engage accurately and securely without forcing or

binding. Lubricate hardware and other moving parts.

- R. Latch, catches, returns, locking clamp, etc. shall be track welded to the pipe and painted with two coats of "galviron" at weld.
- S. Coordinate with drawings for post footings adjacent to masonry walls.

3.2 ERECTION TOLERANCES

- A. Maximum Variation From Plumb: 1/4 inch.
- B. Maximum Offset From True Position: 1 inch.
- C. Components shall not infringe adjacent property lines.

END OF SECTION

The Land Group, Inc
100% Construction Set
March 17, 2023

TWIN FALLS TRAINING FACILITY
SECTION 32 3113
DECORATIVE METAL FENCES AND GATE

PART 1 – GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes

1. Pipe and fittings, valves, sprinkler heads, dripper line, accessories, and connections to water source.
2. Control system.

B. System Description

1. Electric solenoid controlled automatic underground irrigation system.

C. Related Sections

1. Division 26 Sections for Electrical Power Materials and Installations.
2. Division 31 Sections for Earthmoving
3. Division 32 Sections for Turf and Grasses and Plants

1.3 DEFINITIONS

- A. Pipe sizes used in this Section are nominal pipe size (NPS) in inches. Tube sizes are Standard size in inches.
- B. Pressure Piping Main Line: Piping downstream from supply piping to and including control valves. Piping is under irrigation system pressure. Piping in this category includes backflow preventers.
- C. Circuit Piping Lateral Lines: Piping downstream from control valves to irrigation system sprinklers. Piping is under pressure (less than pressure piping) during flow.
- D. Control Valve: Automatic (electrically operated) valve for control water flow to irrigation system zone.

1.4 SYSTEM PERFORMANCE REQUIREMENTS

- A. Location of Sprinklers and Devices: Design location is approximate. Make minor adjustments necessary to avoid plantings and obstructions such as signs and light standards.

- B. Minimum Water Coverage: Not less than:
 - 1. Turf Areas: 100 percent.
 - 2. Other Planting Areas: 100 percent.
- C. All flow velocities, within the entire irrigation system, shall not exceed 5 feet per second.

1.5 SUBMITTALS

- A. Product data including pressure rating, rated capacity, settings, and electrical data of selected models for the following:
 - 1. Valves, including general-duty, underground, automatic control, and quick-coupler types, isolation, valve boxes, and valve ID tags.
 - 2. Sprinklers
 - 3. Drip tubing
 - 4. Irrigation Controller, including controller wiring diagrams
 - 5. Wiring
 - 6. Irrigation system record drawings
 - 7. Pipe, Fittings, etc.
- B. Wiring diagrams for electrical controllers, valves, and devices. Valve numbers shall reflect station numbers within the controller and shall be noted on the as builts.
- C. Maintenance data for inclusion in "Operating and Maintenance Manual" specified in Division 1 Section "Contract Closeout" for the following:
 - 1. Seasonal activities of start-up, shut-down and winterization, including blow-out operation of sprinkler system with compressed air
 - a. Automatic control valves
 - b. Sprinklers
 - c. Controllers
 - d. Drip tubing
 - e. Irrigation system record drawings

1.6 QUALITY ASSURANCE

- A. Comply with requirements of utility supplying water for prevention of backflow and backsiphonage. Comply with appropriated water rights.
- B. Installer Qualifications: Engage an experienced Installer with a minimum of five years experience and who has completed irrigation systems similar in material, design, and extent to that indicated for Project that have resulted in construction with a record of successful in-service performance.
- C. Listing/Approval Stamp, Label, or Other Marking: On equipment, specialties, and accessories made to specified standards.
- D. Listing and Labeling: Equipment, specialties, and accessories that are listed and

labeled.

1. The Terms "Listed" and "Labeled": As defined in "National Electrical Code," Article 100.
 - a. Listing and Labeling Agency Qualifications: A "Nationally Recognized Testing Laboratory" (NRTL) as defined in OSHA Regulation 1910.7.

- E. Product Options: Irrigation system piping, specialties, and accessories are based on specific types, manufacturers, and models indicated. Components with equal performance characteristics produced by other manufacturers may be considered, provided deviations in dimensions, operation, and other characteristics do not change design concept or intended performance as judged by the Architect. The burden of proof of product equality is on the Contractor. All substitutions must be approved by the Architect in writing prior to installation per section 1.10.

1.7 PROJECT CONDITIONS

- A. Perform site survey, research public utility records, and verify existing utility locations. Verify that irrigation system piping may be installed in compliance with original design and referenced standards. Verify that domestic supply performs as specified.

1.8 SEQUENCING AND SCHEDULING

- A. Coordinate irrigation systems work with landscape work specified and in the drawings.

1.9 EXTRA MATERIALS

- A. Deliver extra materials to Owner. Furnish extra materials matching products installed as described below. Package them with protective covering for storage and label clearly describing contents.

1. Utilized drip fittings, drip drain valves – (12) each type and size
2. Spray Head – (1) box each type and size
3. Rotor Nozzle – (10) each size and type
4. Rotor Head – (1) box each type and size
5. Spray Nozzle – (10) each size and type
6. Remote Control Valve – (2) each type and size
7. Valve box w/ lid – (1) each type and size
8. Valve key – (1) each type

1.10 IRRIGATION RECORD DRAWINGS

- A. Record accurately, on one set of black and white prints of the site plan, all installed work including both pressure and non-pressure lines and pipe sizes.
- B. Upon completion of each increment of work, transfer all such information and dimensions to the print. The dimensions shall be recorded in a legible and workmanlike manner. Maintain as-built drawings on site at all times. Make all notes on drawing in pencil (no ball point pen). When the work has been completed, transfer all information from the field record print to a set of reproducible drawings.
- C. Dimension from two permanent points of reference (buildings, monuments, sidewalks, curbs, pavements, etc.). Locations shown on as-built drawings shall be kept day to day as the project is being installed. All dimension text noted on drawings shall be 1/8 inch in size (minimum).
- D. Show locations and depths of the following items:
 - 1. Point of connection
 - 2. Routing of drip irrigation lines
 - 3. Gate valves
 - 4. Control valves
 - 5. Routing of control wires
 - 6. Splice boxes
 - 7. Other related equipment noted on plan and legend

1.11 SUBSTITUTIONS

- A. Coordinate substitutions per Division 1.
- B. Substitutions to the specified equipment will be permitted with the express written approval of the Architect. Substitutions will be approved only when the substituted item is equivalent or better in quality and performance than the item originally specified. The final determination for "equivalents" rests with the Architect. Their decision shall be final and binding.

1.12 WARRANTY

- A. Warranty system against defects of installation and material for a period of 1 year after final completion of the irrigation system. Guarantee shall also cover repair or damage to any part of the premises resulting from leaks or other defects in material, equipment, and workmanship to the satisfaction of the Architect. Repairs, if required, shall be done promptly upon notification by the Owner, and, at no cost to the Owner.
- B. As part of the warranty, the Contractor shall be responsible for deactivating and

winterizing the system prior to the onset of the freezing season and for reactivating the system at the onset of the spring growing season; each event must be accomplished once during the warranty period. In the event the system is completed in a season when it will not be in use, the Contractor shall winterize the system upon completion of testing (and approval by the Architect) and reactivate the system in the spring. The Contractor shall SUBMIT a letter to the Architect certifying that the system was winterized and drained and indicate the date such action was accomplished. The Contractor shall be responsible for any damage resulting from failure to comply. Contractor shall instruct and demonstrate winterization and startup techniques for Owner.

PART 2 - PRODUCTS

2.1 SUMMARY

- A. All materials used throughout the system shall be new, unused, and in perfect condition. Refer to the irrigation materials legend, notes, detail drawings and these specifications for specific equipment to be used. Equipment or materials installed or furnished without prior approval of the Architect may be rejected and the Contractor required to remove such materials from the site at his own expense.
- B. Substitutions: Under provisions of Division 1 and 328400, paragraph 1.11.

2.2 PLASTIC PIPE AND ACCESSORIES

- A. Pipe
 - 1. Pipe walls shall be uniform, smooth, glossy, and free of interior or exterior extrusion marks; pre-belled or straight to receive solvent-weld couplings; 20 foot standard lengths.
 - 2. Pipe shall be marked with manufacturer's name, class of pipe, NSF seal, and date/shift of manufacturing run.
 - 3. PVC Pipe: ASTM D1785, D2241
- B. Fittings: PVC - ASTM D2464, D2466.
- C. Irrigation System Plastic Pipe
 - 1. Mainline: Schedule 40 PVC with SDR26 solvent weld fittings or Class 200 PVC with ductile iron joint restraints, size and type per plans.
 - 2. Laterals: Schedule 40 PVC with SDR26 solvent weld fittings, size per plans.
 - 3. Sleeving: ASTM D 1785, Class 200, polyvinyl chloride (PVC) plastic pipe; ASTM D 2466, Schedule 40, PVC plastic, socket-type fittings; and solvent-cemented joints.

4. Refer to Part 3 Article "Piping Applications" for identification of systems where pipe and tube materials specified below are used.

D. Pipe and Tube Fittings

1. Refer to Part 3 Article "Piping Applications" for identification of systems where pipe and tube fitting materials specified below are used.
2. Polyvinyl Chloride (PVC) Plastic Pipe Fittings: ASTM D 2464, Schedule 80, threaded.
3. Polyvinyl Chloride (PVC) Plastic Pipe Fittings: ASTM D 2467, Schedule 40, socket-type.
4. "Leemco" Push-on joint Ductile Iron Epoxy Coated Fittings: for all pipes 3" and larger.
5. Dielectric Fittings: Assembly or fitting with insulating material isolating joined dissimilar metals to prevent galvanic action and stop corrosion. These devices are a combination of copper alloy and ferrous metal; threaded- and solder-end types, matching piping system materials.
 - a. Dielectric Unions: Factory-fabricated, union assembly, designed for 250 psig (1725 kPa) minimum working pressure at 180 deg F (82 deg C). Include insulating material isolating dissimilar metals and ends with inside threads according to ASME B1.20.1.
 - b. Transition Fittings: Manufactured assembly or fitting, with pressure rating at least equal to that of system and with ends

2.3 JOINING MATERIALS

- A. Solvent Cement: ASTM F 656 primer and ASTM D 2564 solvent cement in color other than orange.

2.4 VALVES

- A. General: Valves are for general-duty and underground applications. Refer to "Valve Applications" Article for locations of various valve types specified in this Article. Refer to "Control Valves" Article for control valves and accessories.

2.5 CONTROL VALVES

- A. Description: Manufacturer's standard control valves for circuits, of type and size indicated on Drawing, and as follows:
 1. Angle Valves: As noted on the Drawings.
 2. Automatic Control Valves: Diaphragm-type, normally closed, with manual flow adjustment, and operated by 24-volt-a.c. solenoid.
 3. Drain Valve: As noted on the Drawings.
 4. Isolation Valves: As noted on Drawings.

- B. Control Valve Boxes and Cover: Thermo-plastic valve boxes with lockable, snap-top lids. Size as required for application or as noted on drawings, maximum one (1) valve per box. All boxes shall have green lids labeled "Irrigation" in English and Spanish.
 - 1. Drainage Backfill: Cleaned gravel or crushed stone, graded from 3 inches (75 mm) maximum to 3/4 inch (19 mm) minimum. Cover gravel with layer of filter fabric.
- C. Service Boxes for Key-Operated Control Valves: Size and type as shown on Drawings.
 - 1. Include valve key, 48 inches (915 mm) long with tee handle and key end to fit valve.
- D. Irrigation System Controls
 - 1. Controller: As noted on the Drawings. All control wires that are above ground shall be installed in rigid steel conduit. Electrical wiring shall be installed according to local code. Provide surge protectors install controllers.
 - 2. Controller Housing: Weatherproof, watertight, with lockable access door.
 - 3. Valves: Electric Solenoid type and size of control valves as noted on the Drawings, including required fittings and accessories.
 - 4. Wire: Per 2.8 Automatic Control System; G.
 - a. Provide grounding per manufacturer's specifications.

2.6 SPRINKLERS

- A. Description: Manufacturer's standard sprinklers designed to provide uniform coverage over entire area of spray shown on Drawings at available water pressure, as follows:
 - 1. Housings: Plastic, except where material is specified.
 - 2. Pop-Up, Spray: Fixed pattern, with screw-type flow adjustment and stainless-steel retraction spring.
 - 3. All sprinkler heads shall have purple non-potable water caps.

2.7 DRIP IRRIGATION

- A. Description: Manufacturer's standard drip irrigation designed to provide uniform coverage over the entire area shown on Drawings at available water pressure, as follows:
 - 1. Dripline: 1/2" diameter tubing with pressure compensating drip emitters spaced at 12" apart. Drip emitter shall include an integrated check valve capable of holding a minimum 4.5 feet of head. Drip emitters shall flow at 0.6 gallons per hour. Drip emitters shall prohibit root intrusion and shall be UV resistant. Type as shown on Drawing.
 - 2. Filtration: As called out on Drawings. Each dripper zone shall include filtration between remote control valve and dripline.
 - 3. Flushing Valve: Flush valve shall be installed at all points furthest from point of connection.

2.8 AUTOMATIC CONTROL SYSTEM

- A. Description: Low-voltage controller system, made for control of irrigation system automatic control valves. Controller operates on 120 volts a.c. building power system, provides 24 volts a.c. power to control valves, and includes stations for at least the number of control valves indicated. Size and type as shown on Drawing. Control system will work in conjunction with a central control system.
- B. Control Enclosures: Weatherproof enclosure with locking cover and 2 matching keys. Enclosure construction complies with NFPA 70 and NEMA 250, Type 4, and includes provision for grounding. All control wires that are above ground shall be installed in conduit. Electrical wiring shall be installed according to local code. Provide surge protectors in all controllers.
 - 1. AG 240 V Surge Arrester: Install in approved J-box next to controller. Install per manufacturer recommendations.
- C. Transformer: Internal-type, and suitable for converting 120 volts a.c. building power to 24 volts a.c. power.
- D. Controller Stations for Automatic Control Valves: Each station is variable from approximately 1 to 60 minutes. Include switch for manual or automatic operation of each station.
- E. Timing Device: Adjustable, 24-hour, 14-day clock to operate any time of day. Include provision for the following settings:
 - 1. Setting to skip operation any day in timer period.
 - 2. Setting for operation every other day.
 - 3. Settings for operation 2 or more times daily.
 - 4. Include manual or semi-automatic operation without disturbing preset automatic operation.
 - 5. Provide NI-CAD battery and trickle charger to automatically power the timing device during power outages.
- F. Surge Protection: As required per manufacturer's recommendations. Install at all required grounding per manufacturer's recommendations along two-wire path.
- G. Wiring:
 - 1. Two-wire control wire shall be Paige, UF-UL listed, color coded, tin coated copper conductor, direct burial, 14 AWG, 2 conductor, irrigation control cable with PVC insulation and impregnated polyethylene jacket.
 - 2. Run (2) 2-conductor cables to every valve decoder, sensor, and master valve.
 - 3. Provide 36-inch coil in each valve box and 18-inch loop at each direction change in
 - 4. trench. Do not loop two-wire path, path shall be installed in star pattern.
 - 5. Waterproof Wire Connectors: DBY/DBR-600 splice kit by 3M or approved equal by Architect before installation.
 - 6. Surge Protector: Per manufacturers standard drawings and specification.

2.9 VALVE BOXES

- A. Carson Industries or approved equal with locking lid. Valve box size per drawings. 12" round box for all mainline ball valves, gate valves, and hose bibs. All boxes shall have green lids labeled "Irrigation" in English and Spanish.

2.10 IRRIGATION SYSTEM ACCESSORIES

- A. Valve ID Tags:
 - 1. Christy's: Stamped ID tag: 2 -1/4" x 2-3/4" yellow plastic tag with alpha-numeric labeling matching zone number on drawings.
- B. Valve Box Supports:
 - 1. Standard clay paving bricks without holes (8-inch x 4-inch x 2-inch).
- C. Non-Woven Geotextile Fabric:
 - 1. DeWitt 4.1 oz, 20-year woven polypropylene weed barrier or approved equal.
- D. Detectable Marking Tape:
 - 1. Christy's 4.5 MIL detectable marking tape, 3-inch width. Shall be purple and reads "IRRIGATION".

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Investigate and determine available water supply water pressure and flow characteristics.
- B. Insure that new pup station is providing necessary performance. Notify Landscape Architect of any deviations from design performance.

3.2 PREPARATION

- A. Set stakes to identify proposed sprinkler locations. Obtain Irrigation Designer's approval before excavation.

3.3 PAVING WORK

- A. Install piping in sleeves where crossing sidewalks, roadways and parking lots.
 - 2. Install piping sleeves by boring or jacking under existing paving, where possible.
 - 3. If it is necessary to cut pavement sections, pavement shall be replaced in cut areas per ISPWC standards and requirements.

3.4 PIPING APPLICATIONS

- A. Refer to Part 2 of this Section for detailed specifications for pipe and fittings products listed below. Use pipe, tube, fittings, and joining methods according to the following applications. Piping in pits and aboveground may be joined with flanges instead of joints indicated.
- B. Use pipe, tube, fittings, and joining methods according to the following applications.

- C. Pressure Piping Underground: Use the following:
 - 1. ASTM D 2241, SDR 26, Schedule 40, polyvinyl chloride (PVC) plastic pipe; ASTM D 2467, Schedule 40, PVC plastic, socket-type pipe fittings; and solvent-cemented joints, size per plans.
- D. Circuit Piping: Use the following:
 - 1. ASTM D 2241, SDR 26, Schedule 40, polyvinyl chloride (PVC) plastic pipe; ASTM D 2467, Schedule 40, PVC plastic, socket-type pipe fittings; and solvent-cemented joints, size per plans.
- E. Sleeves: ASTM D 2241, SDR 21 Class 200, polyvinyl chloride (PVC) plastic pipe; sleeve diameter shall be two sizes larger than pipe installed in sleeve with minimum sleeve size being 4". Extend sleeves 18" beyond walk or pavement edge.

3.5 JOINT CONSTRUCTION

- A. Threaded Joints: Thread pipes with tapered pipe threads according to ASME B1.20.1, apply tape or joint compound, and apply wrench to valve ends into which pipes are being threaded.
- B. Polyvinyl Chloride (PVC) Piping Solvent-Cemented Joints: Construct joints according to ASTM D 2672 and ASTM D 2855.
 - 1. Handling of Solvent Cements, Primers, and Cleaners: Comply with procedures in ASTM F 402 for safe handling when joining plastic pipe and fittings with solvent cements.
- C. Dissimilar Materials Piping Joints: Construct joints using adapters that are compatible with both piping materials, outside diameters, and system working pressure. Refer to "Piping Systems - Common Requirements" Article for joining dissimilar metal piping.

3.6 PIPING SYSTEMS - COMMON REQUIREMENTS

- A. General Locations and Arrangements: Drawings indicate general location and arrangement of piping systems. Indicated locations and arrangements were used to size pipe and calculate friction loss, and in other design considerations. Install piping as indicated, except where deviations to layout are approved on coordination drawings.
- B. Install components having pressure rating equal to or greater than system operating pressure.
- C. Install piping free of sags and bends. Deflections angles shall not exceed manufacturer's recommendations.
- D. Locate groups of pipes parallel to each other, spaced to permit valve servicing.
- E. Install fittings for changes in direction and branch connections.

- F. Piping Connections: Except as otherwise indicated make piping connections as specified below.
 - 1. Install unions, in piping 2 inches (DN 50) and smaller, adjacent to each valve and at final connection to each piece of equipment having 2-inch (DN 50) or smaller threaded pipe connection.
 - 2. Install dielectric fittings to connect piping of dissimilar metals.

3.7 PIPING INSTALLATION

- A. Install underground polyvinyl chloride (PVC) plastic pipe according to ASTM D 2774.
- B. Lay piping on solid subbase, uniformly sloped without humps or depressions.
 - 1. Install polyvinyl chloride (PVC) plastic pipe in dry weather when temperature is above 40 deg F (4 deg C). Allow joints to cure at least 24 hours at temperature above 40 deg F (4 deg C) before testing, unless otherwise recommended by manufacturer.
- C. Minimum Cover: Provide following minimum cover over top of buried piping:
 - 1. Pressure Piping: Per Drawings.
 - 2. Circuit Piping: Per Drawings.
 - 3. Sleeves: Per Drawings.
- D. Boring
 - 1. Locations: Boring shall be used to route pipe, wiring or both under concrete structures such as walks or curbs where trenching is impractical. Sleeves shall be installed in all bored holes.
 - 2. Method: Boring shall be accomplished with a drill, auger, water jet, or any other instrument approved by the Owner's Representative capable of producing a precise hole. Boring shall not disturb overlaying structures or cause settlement and damage to those structures. Repair or replace any pavement damaged during boring procedures.
- E. Install piping under sidewalks and paving in sleeves.
- F. Back-filling
 - 1. Inspection: The trenching shall not be backfilled until inspection and pressure testing has been completed and the pipe installation, including the grade, alignment and jointing has been found to be in compliance with the requirements of the plans and specifications.
 - 2. Around and Over Pipe:
 - a. Select backfill material consisting of sand, fine gravel or select earth, free of large lumps or rocks larger than 1/2 inch shall be used in backfilling around and over the installed pipe.
 - b. The select material shall be obtained from the excavation material removed from the trench and shall be processed by screening, sifting, or selective sorting, so as to produce the type of backfill herein specified. The Contractor may at his option and own expense provide an acceptable imported material.

- c. Backfill material shall be carefully deposited around and over the pipe in layers not more than 6 inches thick, loose measurement, wetted to optimum moisture content and uniformly compacted to at least 95 percent of the maximum density obtainable at optimum moisture content as determined by AASHTO T99 Method A or D (latest revision), until the pipe has a cover depth of at least 12 inches.

3. Remainder of Trench Backfill:

- a. The remaining depth of the trench shall be backfilled to existing finish grade, with excavation material removed from the trench, which shall be wetted or dried to near optimum moisture content.
- b. Contractor shall be required to repair any settling problems which occur in the trench locations for the duration of the warranty period.

G. Pipe fittings

1. All piping less than 3" diameter shall use Schedule 40 socket type fittings.

3.8 VALVE APPLICATIONS

- A. Drawings indicate valve types to be used.

3.9 VALVE INSTALLATION

- A. Valves: Install underground valves in valve boxes as shown on Drawings.
- B. Control Valves: Install in valve control valve boxes, arranged for easy adjustment and removal. Install union on downstream side. Maximum (1) valve per valve box.
- C. Place 6 inches minimum of gravel below control valves for drainage. Maintain 4 inches minimum between bottom of valves and top of gravel. Place filter fabric barrier between gravel and valves. Valve box shall be free of dirt and debris.

3.10 DRIP IRRIGATION INSTALLATION

- A. Drip line: To be installed per Drawings.
1. Install drip to ensure an optimum and equal amount of water is applied to ensure the health of all plant material.
 2. All tubing shall be staked down with soil staples at five foot interval maximum.
 3. Landscape mulch shall not be placed until inspection and approval of landscape architect.

3.11 AUTOMATIC CONTROL SYSTEM INSTALLATION

- A. Install controllers and controller enclosure according to manufacturer's written instructions and as indicated.
- B. Install control wiring in same trench with piping. Where wiring leaves from piping trenches, install wiring in conduits at 18-inch depth minimum.
- C. Install control wiring in accordance with Specifications.

- D. Install decoders per manufacturer's written instructions. Route control wire from decoder to valve through conduit as shown on drawings.
- E. Install all exposed wiring in rigid conduit as shown on the drawings.

3.12 TRENCHING

- A. Trench Size:
 - 1. Minimum Width: 4 inch pipe and larger – 12 inches.
 - 2. Minimum Width: 3 inch pipe and smaller – 9 inches.
- B. Trench to accommodate grade changes and slope to drains.
- C. Maintain trenches free of debris, material, or obstructions that may damage pipe.

3.13 IRRIGATION SYSTEM ACCESSORIES

- 1. Standard yellow I.D. tags submit product for approval prior to ordering.
- 2. Detectable Warning Tape shall be installed at mainline only and as noted on drawings.

3.14 CONNECTIONS

- A. Connect piping to devices, valves, control valves, specialties, and accessories.
- B. Connect water supplies to irrigation systems. Include reduced pressure back-flow preventers on potable water supplies.
- C. Electrical Connections: Connect to power source, controllers, and automatic control valves.

3.15 FIELD QUALITY CONTROL

- A. Testing: Perform test of piping and valves before back-filling trenches. Piping may be tested in sections to expedite work. Owners representative must be present for testing.
 - 1. Make all necessary provisions for thoroughly bleeding the line of air and debris.
 - 2. Before testing, fill the line with water for a period of at least 24 hours.
 - 3. After valves have been installed, test all live water lines for leaks at a pressure of 100 psi for a period of two hours, with all couplings exposed and with all pipe sections center-loaded.
 - 4. Furnish all necessary testing equipment and personnel.
 - 5. Correct all leaks and retest until acceptance by the Project Landscape Architect.
- B. Field inspection and testing will be performed under provisions of Division 1.
- C. Installer's Field Service
 - 1. Prepare and start systems under provisions of Division 1.
 - 2. Provide one complete spring start-up and a fall shutdown, including winterization to blow out entire system with compressed air.
- D. Adjust work under provisions of Division 1.

- E. Change and/or adjust head types for full water coverage as directed.
- F. Have all backflow preventers tested by appropriate agency.

3.16 CLEANING AND ADJUSTING

- A. Flush dirt and debris from piping before installing sprinklers and other devices.
- B. Adjust automatic control valves to provide flow rate of rated operating pressure required for each sprinkler circuit.
- C. Adjust settings of controllers and automatic control valves to insure proper watering of all landscaping.

3.17 COMMISSIONING

- A. Starting Procedures: Follow manufacturer's written procedures. If no procedures are prescribed by manufacturers, proceed as follows:
 - 1. Verify that specialty valves and their accessories have been installed correctly and operate correctly.
 - 2. Verify that specified tests of piping are complete.
 - 3. Check that all devices are correct type.
 - 4. Check that potable water supplies have correct type back-flow preventers.
 - 5. Energize circuits to electrical equipment and devices.
 - 6. Adjust operating controls.
- B. Operational Testing: Perform operational testing after hydrostatic testing is completed, backfill is in place, and irrigation is adjusted to final position.

3.18 DEMONSTRATION

- A. Provide irrigation system demonstration under provisions of Division 1.
- B. Demonstrate to Owner: that system meets coverage requirements and that automatic control functions properly. Train Owner on BaseManager software.
- C. Demonstrate to Owner's maintenance personnel operation of equipment, drip line and components, specialties, and accessories. Review operating and maintenance information including start up and winterization procedures.
- D. Provide 7 days written notice in advance of demonstration.

END OF SECTION

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Soil preparation, amendment and fertilization.
2. Granular soil conditioner.
3. Weed abatement.
4. Finish grading.
5. Turf sodding.
6. Sod establishment.
7. Turf maintenance.
8. Clean-up.

B. Definitions

1. Weeds: Include Dandelion, Jimsonweed, Quackgrass, Horsetail, Morning Glory Rush Grass, Mustard, Lambsquarter, Chickweed, Cress, Crabgrass, Canadian Thistle, Nutgrass, Poison Oak, Blackberry, Tansy Ragwort, Bermuda Grass, Johnson Grass, Poison Ivy, Nut Sedge, Nimble Will, Bindweed, Bent Grass, Wild Garlic, Perennial Sorrel, Brome Grass, Black Henbane, Buffalobur, Common Crupina, Dalmatian Toadflax, Diffuse Knapweed, Dyer's Woad, Eurasian Watermilfoil, Field Bindweed, Hoary Cress, joined Goatgrass, Leafy Spurge, Matgrass, Meadow Hawkweed, Meadow Knapweed, Milium, Musk Thistle, Orange Hawkweed, Perennial Pepperweed, Perennial Sowthistle, Poison Hemlock, Puncturevine, Purple Loosestrife, Russian Knapweed, Scotch Broom, Scotch Thistle, Silverleaf Nightshade, Skeletonleaf Bursage, Spotted Knapweed, Syrian Beancaper, Toothed Spurge, Yellow Starthistle, Yellow Toadflax.
2. Finish Grade: Elevation of finished surface of planting soil.
3. Planting Soil: Imported topsoil, manufactured topsoil, or surface soil modified to become topsoil; mixed with soil amendments.
4. Topsoil: Material per Specification Section 31 20 00.
5. Subgrade: Surface or elevation of subsoil remaining after completing excavation, or top surface of a fill or backfill immediately beneath planting soil.

C. Related Sections include the following:

1. Division 01 Specifications.
2. Specification Section 31 10 00 "Site Clearing."
3. Specification Section 31 20 00 "Earth Moving."
4. Specification Section 32 84 00 "Planting Irrigation."

1.2 REFERENCES

- A. FS O-F-241 - Fertilizers, Mixed, Commercial.

1.3 SUBMITTALS

- A. Product Data: For each type of product indicated.
 - 1. Soil Amendment Fertilizer.
 - 2. Granular Soil Conditioner.
 - 3. Turf Starter Fertilizer.
 - 4. Turf Maintenance Fertilizer.
 - 5. Weed Control Herbicide.
- B. Submit sod certification for grass species and location of sod source.
- C. Submit compost testing data to confirm product meets specified parameters.
- D. Sod Establishment Irrigation Schedule.
- E. Turf Maintenance Irrigation Schedule.

1.4 QUALITY ASSURANCE

- A. Sod:
 - 1. Minimum age of 12 months, with root development that will support its own weight without tearing, when suspended vertically by holding the upper two corners.
 - 2. Qualifications: Sod Producer shall be company specializing in sod production and harvesting with minimum five years of experience.
- B. Regulatory Requirements:
 - 1. Comply with regulatory agencies for fertilizer and herbicide composition.
- C. Installer Qualifications (Firm): In order to qualify for the landscape installation work on this project, the following information must be submitted with the Bid Submittal.
 - 1. A signed statement of experience certifying a minimum of five (5) years in business and describing in detail, experience in the installation of a minimum of three (3) projects of similar nature and scope.
- D. Installer Qualifications (Individual): In order to qualify for the landscape installation work on this project, the following information must be submitted with the Bid Submittal.
 - 1. Landscape Installation/Maintenance Supervisor/Manager: This person shall have a minimum of three (3) years' experience in handling/maintaining the specified materials, and in sizes specified, in installations/maintenance of similar scope.

1.5 DELIVERY, STORAGE AND HANDLING

- A. Deliver, store, protect and handle products to site under provisions of Division 01.
- B. Packaged materials: Deliver packaged materials in original, unopened containers showing weight, certified analysis, name and address of manufacturer, and indication of compliance with State and Federal laws, as applicable.
- C. Sod:
 - 1. Deliver sod on pallets, in rolls. Protect exposed roots from dehydration.
 - 2. Do not deliver more sod than can be laid within 24 hours.
 - 3. Deliver fertilizer in waterproof bags showing weight, chemical analysis, and name of manufacturer.
- D. Bulk Materials:
 - 1. Do not dump or store bulk materials near structures, utilities, walkways and pavements, or on existing turf areas or plants.
 - 2. Provide erosion-control measures to prevent erosion or displacement of bulk materials; discharge of soil-bearing water runoff, and airborne dust reaching adjacent properties, water conveyance systems, or walkways.
 - 3. Accompany each delivery of bulk materials with appropriate certificates.

1.6 PROJECT/SITE CONDITIONS

- A. Do not install plant life when ambient temperatures may drop below 45 deg F or rise above 90 deg F.

1.7 SEQUENCING AND SCHEDULING

- A. Coordinate work under provisions of Division 01.
- B. Coordinate sod placement work with irrigation system work specified and in the Drawings.
- C. Coordinate timing of weed abatement in sodded areas.

1.8 WARRANTY

- A. Contractor shall warrant work as provided by the General and Supplementary Conditions and Division 01 Specifications.

PART 2 - PRODUCTS

2.1 PRODUCTS and MATERIALS

- A. Substitutions or equivalent products shall be in accordance with Division 01 Specifications.

- B. Topsoil: Compacted depth per Specifications Section 31 20 00. Place at all sod areas. Topsoil depth shall exceed specified depth if necessary to fill area to design finish grade.
1. General Turf Area: 12-inches.
- C. Granular Soil Conditioner: Turface MVP calcined, non-swelling illite and silica clay, or approved equal.
1. Submit product data and sample for approval prior to ordering.
 2. PROFILE Products, LLC, 800.207.6457 or www.turface.com.
- D. Turf Sod: ASPA Certified Field grown grade; cultivated grass sod; type indicated below; with strong fibrous root system, free of stones, burned or bare spots; containing no more than 5 weeds per 1000 sf. Sod shall be from an established regionally local grower.
1. Sod shall be per plans and below:
 - a. 80/20 Kentucky Bluegrass/Perennial Ryegrass blend, submit for approval prior to ordering.
 - b. Montane Mix™ by Magic Valley Turfgrass, submit for approval prior to ordering.
- E. Soil Amendment: Compost.
1. Compost shall be measured by the cubic yard at the point of loading.
 2. Compost shall be a well decomposed, stable, weedfree organic matter source. It shall be derived from agricultural, food, or industrial residuals; biosolids (treated sewage sludge); yard trimmings or source-separated or mixed solid waste. The product shall contain no substances toxic to plants, will possess no objectionable odors and shall not resemble the raw material from which it was derived.
 3. Compost shall meet the following parameters:
 - a. pH - Acceptable Range: 6.0 - 8.4 (1:5 by weight).
 - b. Soluble Salts - Acceptable Range: 0-7 mmhos/cm (1:5 by weight).
 - c. Maturity Indicators:
 - 1) Ammonia N / Nitrate N Ratio - < 4.
 - 2) Carbon to Nitrogen Ratio < 12.
 - d. Particle size: 98 percent pass through 1/2-inch screen.
 - e. Physical contaminants (inert matter): less than 1 percent
 - f. Submit lab testing indicating compliance with the parameters above. Lab testing shall also provide the following information: Bulk Density; percent Inorganics; percent Moisture; Particle Size Distribution, Primary and Secondary Nutrients; Trace Elements; Organic Matter Expressed in Percentage and Pounds per CY.
- F. Soil Amendment: Pre-Plant Fertilizer.

1. NPK Fertilizer: Wilbur-Ellis Perfection 16-20-0.
 2. Humic Acid: Live Earth Humate Soil Conditioner.
- G. Soil Amendment: Turf Starter Fertilizer.
1. NPK Fertilizer: Wilbur-Ellis Perfection Mix #29 15-15-15 with minors.
- H. Turf maintenance Fertilizer:
1. NPK Fertilizer: Wilbur-Ellis Perfection 16-16-16 (50 percent of nitrogen from Duration 90).
- I. Water: Clean, fresh and free of substances or matter which could inhibit vigorous growth of grass.
- J. Pre-Emergent Herbicide: Tupersan Herbicide Wettable Powder, Tenacity, or approved equal.
- K. Weed Control Herbicide:
1. Selective Broadleaf Weed Control: 2,4-D Amine Weed Killer.
 2. Broad Spectrum Herbicide: Roundup Pro.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Verify that prepared topsoil is ready to receive the work of this Section.
- B. Beginning of installation means acceptance of existing site conditions.
- C. All planting areas shall be weed free at the time of sod installation.

3.2 SOIL AMENDMENTS

- A. Granular Soil Conditioner - All Turf Areas:
1. Coordinate placement and installation with topsoil placement. After approximate finished grades have been established, soil shall be conditioned in the following manner.
 2. Place conditioner at 2,500 lbs. / 1000 SF. Location is shown on the Drawings.
 3. Blend soil conditioner into the topsoil layer (6-inch depth) with a mechanical tiller for an even homogenous mixture of soil and conditioner. Tilling operation shall be performed twice with the second run at a 45-degree angle to the first run. Tilling must be performed with a reverse-tilling machine, Rotadiron, Blec-a-Vator, or equal. Do not exceed specified tilling depth.
 4. Coordinate placement and blending of Granular Soil Conditioner with topsoil amendments of this Section.
 5. Placement and blending of Granular Soil Conditioner shall occur prior to Weed Abatement operations.

- B. Soil Amendments: After approximate finished grades have been established soil shall be conditioned and fertilized in the following manner. Soil amendments shall, at the following rate, be uniformly spread and cultivated thoroughly by means of mechanical tiller into the top soil layer; minimum 4 inch depth and maximum 6 inch depth.
1. Application Rates:
 - a. Soil Amendment: Compost - 1 CY per 1000 SF.
 - b. Soil Amendment: Humic Acid - 15 lbs per 1000 SF.
 - c. Soil Amendment: NPK 16-20-0 - 3 lbs per 1000 SF.
 2. Coordinate placement and tilling of Soil Amendments with Granular Soil Conditioner operations.
 3. Placement and blending of Soil Amendments shall occur prior to Weed Abatement operations.
- C. Placement and tilling of soil amendments listed in this Section must be completed prior to sod placement. Contractor shall photo document installation of all soil amendments and mechanical tilling and provide to the architect for review and approval. Contractor shall provide product receipts for all products specified in this Section for review and approval prior to granting of substantial completion. Receipts shall list job name, contractor name, date and detailed product and quantity information.

3.3 FINISH GRADING

- A. Upon completion of soil amendment operations, finish grading operations shall begin.
- B. Coordinate with Section 31 20 00 "Earth Moving."
- C. Grade topsoil to smooth, even surface with loose, uniformly fine texture. Remove ridges and fill depressions, as required to meet finish grades. Finish grade of topsoil related to adjacent site elements shall be:
1. Sod Areas: 1-inch below top of adjacent pavement, valve box, vault, etc.
 2. Planter Bed Areas: 3-inches below top of adjacent pavement, valve box, vault, etc.
- D. Remove all roots, weeds, rocks and foreign material on the surface. Coordinate with Section 328400 for removal of debris brought to the surface during trenching operations.
- E. Prior to placement of sod, topsoil shall be water settled through application of .5-inch of precipitation through the irrigation system. Coordinate with Section 32 84 00. All areas of settlement shall be top dressed with approved topsoil material to provide a smooth, even surface. Any settlement of soils after placement of sod shall be corrected by the contractor at no cost to the owner. Do not allow erosion or rilling of topsoil.

F. Tolerance: Top of Topsoil - Plus .5-inch, no minus.

3.4 WEED ABATEMENT

- A. All areas to be sodded shall have weed abatement operations performed after placement of granular soil conditioner, soil amendments and Finish Grading and prior to sodding operations.
- B. Upon completion of Finish Grading, the contractor shall confirm all areas are visibly weed free. Contractor shall spray all exposed weeds with Roundup. Comply with mixing instructions on product label.
- C. Irrigate all landscape areas to apply 1-inch of precipitation over a 3 day period. At conclusion of this watering period, discontinue watering for seven (7) days.
- D. After the seven day period inspect the site. Apply application of Roundup to all visible weeds. Apply in strict conformance with manufacturer's product label. Do not water for at least five (5) days, remove all exposed weeds from the site that would interfere with sodding operations.
- E. Weed Abatement operations shall be sequenced to be complete a minimum of seven (7) days and a maximum of fourteen (14) days prior to sodding operations. It is acceptable to phase weed abatement areas to match phased installation of sodding operations.

3.5 SOD PLACEMENT

- A. General:
 - 1. Topsoil placement, granular soil conditioner placement, soil amendments placement and tilling, compaction and finish grading shall be completed and approved by the landscape architect prior to sod placement.
 - 2. Do not place sod when ground is too wet or too dry.
 - 3. Temperature shall be between 45 F and 90 F for a 24 hour period.
 - 4. Wind shall be less than 20 mph.
- B. Turf Sod Placement:
 - 1. Moisten prepared surface immediately prior to laying sod.
 - 2. Lay sod immediately after delivery to site to prevent deterioration.
 - 3. Lay sod tight with no open joints visible, and no overlapping; stagger end joints 12 inches minimum. Do not stretch or overlap sod pieces.
 - 4. Lay smooth. Align with adjoining grass areas.
 - 5. Place top elevation of sod 1/2- inch below adjoining edging paving, curbs and sidewalks.
 - 6. On 3:1 or greater slopes, lay sod perpendicular to slope and secure every row with wooden pegs at maximum 2 feet on center. Drive pegs flush with soil portion of sod.

- C. Soil Amendments Turf Starter: Final operation after sod placement, and prior to irrigation, apply to the sod surface. Water into sod with irrigation system.
 - 1. Application Rates: Turf Starter - Mix #29 15-15-15: 3 lbs per 1000 SF.
- D. Placement of Turf Starter fertilizer listed in this Section must be completed immediately after sod placement. Contractor shall photo document installation of turf starter fertilizer and provide to the Architect for review and approval. Contractor shall provide product receipts for all products specified in this Section for review and approval by the landscape architect prior to granting of Substantial Completion.
- E. Water sodded areas immediately after installation of turf starter fertilizer.
- F. After initial irrigation of sod, allow soil to dry sufficiently for rolling. Roll sodded areas to ensure good bond between sod and soil and to remove minor depressions and irregularities. Roller not to exceed 100 lbs.

3.6 SOD ESTABLISHMENT

- A. General: Starting immediately after sod placement, sod establishment will begin. Irrigation, mowing, weed control and fertilization shall be the responsibility of the contractor as defined herein. Protect sodded area with signs to prevent traffic throughout the establishment period.
- B. The establishment period shall have a duration of thirty (30) days.
- C. Irrigation:
 - 1. Contractor shall submit for approval a proposed "Sod Establishment Irrigation Schedule". This schedule shall include Zone designation, days per week, cycles per day and cycle run time. Include targeted daily and weekly precipitation rates for each zone based on current climatic conditions.
 - 2. Water shall be applied to moisten the soil to approximately 2-inch depth but avoid overwatering and creating areas of standing water or under watering and creating areas of dry soil.
 - 3. Contractor shall monitor irrigation daily to identify areas receiving too much or too little precipitation.
 - 4. Slopes shall be monitored for erosion and corrective action taken immediately.
 - 5. Once the sod has been mown three times, approximately 3 weeks, the frequency of irrigation shall be reduced and run times increased to provide water deeper into the soil.
- D. Mowing:
 - 1. Mowing shall begin when the grass blades reach a height of approximately 2.5-inches.
 - 2. All cutting equipment shall be sharp and mowers shall be adjusted precisely to the proper mowing height.
 - 3. Mowing heights during the establishment period shall be 1.75-inch to 2-inch.

4. Mowing shall occur every 7 days or more often if growth dictates. At no point shall the height of the turf grass be more than 2.5-inches.
 5. Grass clippings shall be collected and removed from the site.
 6. Coordinate irrigation schedule with mowing schedule. At no time shall mowing occur if soil is wet and rutting may occur.
- E. Weed Control: Control growth of weeds throughout establishment period.
- F. Upon completion of the establishment period the Turf Maintenance period shall begin.

3.7 TURF MAINTENANCE

- A. Maintenance shall be according to the following standards. All areas shall be mown, weeded and cultivated at intervals of not more than seven (7) days. Watering, trash and debris removal, mowing, rolling, edging, trimming, fertilization, spraying and pest control, as required, shall be included in the maintenance period. Cleaning of street gutters and sidewalks shall be included. The Contractor shall be responsible for maintaining adequate protection of the area. Damaged areas shall be repaired at the Contractor's expense. The Contractor shall resod all spots or areas within the lawn where normal turf growth is not evident.
- B. The Turf Maintenance Period shall have a minimum duration of sixty (60) days and continue until the date of Substantial Completion.
- C. Irrigation:
1. Contractor shall submit for approval a proposed "Turf Maintenance Irrigation Schedule." This schedule shall include Zone designation, days per week, cycles per day and cycle run time. Include targeted daily and weekly precipitation rates for each zone based on current climatic conditions.
 2. Water shall be applied to moisten the soil appropriately for the current, seasonal climatic conditions. Avoid overwatering and creating areas of standing water or under watering and creating areas of dry soil.
 3. Irrigation shall be monitored weekly to identify areas receiving too much or too little precipitation.
 4. Slopes shall be monitored for erosion and corrective action taken immediately.
- D. Mowing:
1. Mowing shall occur at intervals of not more than seven (7) days or more often if growth dictates.
 2. All cutting equipment shall be sharp and mowers shall be adjusted precisely to the proper mowing height.
 3. Mowing heights during the maintenance period shall be 2.25-inch; at no point shall the height of the turf grass be more than 3-inches.
 4. Grass clippings shall be collected and removed from the site.

5. Coordinate irrigation schedule with mowing schedule. At no time shall mowing occur if soil is wet and rutting may occur.
 6. Edges shall be trimmed as needed for neat appearance.
- E. Weed Control:
1. Control growth of weeds throughout maintenance period. Inspect turf areas every seven (7) days for weed growth.
 2. Utilize 2,4-D broadleaf weed killer to control weeds in all turf areas.
- F. Fertilization:
1. Turf Maintenance Fertilizer (16-16-16) shall be applied at a rate of 3 lbs per 1000 SF, approximately sixty (60) days following placement of sod.
- G. Continuously maintain the entire Project area during the progress of work until the date of Substantial Completion.

3.8 FIELD QUALITY CONTROL

- A. Perform field inspections under provisions of Division 01 Specifications.
- B. Coordinate field inspections with Specification Sections 32 84 00 and 32 93 00.
- C. Contractor Performed Inspections: The contractor shall perform the following applicable inspections and provide written confirmation of completed and successful installation to the Architect.
1. Soil Amendments: Provide required photographs and product receipts demonstrating successful placement and tilling of specified soil amendments.
 2. Sod - Turf Starter Fertilizer: Provide required photographs and product receipts demonstrating successful placement of Turf Starter Fertilizer.
 3. Turf Maintenance - Maintenance Fertilizer: Provide required photographs and product receipts demonstrating successful placement of Turf Maintenance Fertilizer.

3.9 CLEANING

- A. After all sodding operations have been completed; remove all trash, excess soil or rubbish from the property. All scars, ruts or other marks in the ground caused by this work shall be repaired and the ground left in a neat and orderly condition throughout the site. Contractor shall pick up all trash resulting from this work no less frequently than each day before leaving the site. All trash shall be removed completely from the site. The Contractor shall leave the site area broom-clean and shall wash down all paved areas within the Contract area, leaving the premises in a clean condition acceptable to the Architect and Construction Manager.

3.10 PROTECTION

- A. Protect sodded areas with warning signs until date of Substantial Completion.

END OF SECTION

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Tree and shrub planting pits.
2. New trees and shrubs and accessories.
3. Soil amendments and fertilizer.
4. Landscape rock mulch and landscape boulders.
5. Tree and shrub establishment.
6. Tree and shrub maintenance.
7. Shredded Wood Mulch.

B. Definitions:

1. Weeds: Include Dandelion, Jimsonweed, Quackgrass, Horsetail, Morning Glory, Rush Grass, Mustard, Lambsquarter, Chickweed, Cress, Crabgrass, Canadian Thistle, Nutgrass, Poison Oak, Blackberry, Tansy Ragwort, Bermuda Grass, Johnson Grass, Poison Ivy, Nut Sedge, Nimble Will, Bindweed, Bent Grass, Wild Garlic, Perennial Sorrel, Brome Grass, Black Henbane, Buffalobur, Common Crupina, Dalmatian Toadflax, Diffuse Knapweed, Dyer's Woad, Eurasian Watermilfoil, Field Bindweed, Hoary Cress, Joined Goatgrass, Leafy Spurge, Matgrass, Meadow Hawkweed, Meadow Knapweed, Milium, Musk Thistle, Orange Hawkweed, Perennial Pepperweed, Perennial Sowthistle, Poison Hemlock, Puncturevine, Purple Loosestrife, Russian Knapweed, Scotch Broom, Scotch Thistle, Silverleaf Nightshade, Skeletonleaf Bursage, Spotted Knapweed, Syrian Beancaper, Toothed Spurge, Yellow Starthistle, Yellow Toadflax.
2. Plants: Living trees, plants, and ground cover as specified in this Section and indicated on Drawings, and described in ANSI Z60.1.

1.2 REFERENCES

- A. ANSI Z60.1 - Nursery Stock.
- B. NAA (National Arborist Association) - Pruning Standards for Shade Trees.
- C. FSO-F-241 - Fertilizers, Mixed, Commercial.

1.3 SUBMITTALS

- A. Provide submittals per Division 01 Specifications.
- B. Submit list of plant life sources and confirmed availability.
- C. Landscape Rock Mulch: 1-in Black and Tan: 1-gallon bag with sample name and product material.

- D. Landscape Bark Mulch: Shredded Bark Mulch: 1-gallon bag with sample name and product material for each type and size of mulch.
- E. Product Data: Provide Manufacturer's (catalog) product information.
 - 1. Tree Stakes.
 - 2. Tree Ties.
 - 3. Soil Amendments and Fertilizer.
 - 4. Maintenance Fertilizer.
 - 5. Pre-emergent herbicide.
- F. Tree and Shrub Establishment Irrigation Schedule.
- G. Tree and Shrub Maintenance Irrigation Schedule.

1.4 QUALITY ASSURANCE

- A. Nursery Qualifications: Company specializing in growing and cultivating the plants with three years' experience.
- B. Installer Qualifications: Company specializing in installing and planting the plants with three years' experience.
- C. Maintenance Services: Performed by Installer.
- D. Regulatory Requirements:
 - 1. Comply with regulatory agencies for fertilizer and herbicide composition.
 - 2. Plant Materials: Certified by state department of agriculture; Described by ANSI Z60.1; free of disease or hazardous insects.
- E. Quality:
 - 1. Plants shall be 100 percent sound, healthy, vigorous, and free from plant disease, insect pests or their eggs, noxious weeds, and have healthy, normal root systems. Container stock shall be well established and free of excessive root-bound conditions.
 - 2. Do not prune plants or top trees prior to delivery.
 - 3. Plant materials shall be subject to approval by Architect as to size, health, quality and character. Architect reserves the right to inspect trees and shrubs either at place of growth or at site for compliance with requirements.
 - 4. Bare root trees are not acceptable.

F. Measurements:

1. Measure height and spread of specimen plant materials with branches in their normal position as indicated on Drawings or Plant List.
2. Measure caliper of trees 6 inches above surface of ground.
3. Where caliper or other dimensions of plant materials are omitted from Plant List, plant materials shall be normal stock for type listed.
4. Plant materials larger than those specified may be supplied with approval of Architect
 - a. If complying in all other respects.
 - b. If at no additional cost to Owner.
 - c. If sizes of roots or balls are increased proportionately.
5. Shape and Form - Plant materials shall be symmetrical or typical for variety and species and conform to measurements specified in Plant List.
6. Provide plant materials from a licensed nursery.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Deliver, store, protect and handle products to site under provisions of Division 1.
- B. Deliver fertilizer in waterproof bags showing weight, chemical analysis, and name of manufacturer.
- C. Protect and maintain plant life until planted.
- D. Deliver plant life materials immediately prior to placement. Keep plants moist.

1.6 PROJECT/SITE CONDITIONS

- A. Do not install plant life when ambient temperatures may drop below 40 deg F or rise above 90 deg F.
- B. Do not install plant life when wind velocity exceeds 20 mph.

1.7 SEQUENCING AND SCHEDULING

- A. Coordinate work under provisions of Division 01 Specifications.
- B. Install plant life after and coordinate with installation of underground irrigation system piping and watering heads specified in Section 32 84 00.
- C. Coordinate plant installation work with irrigation work specified and in the Drawings.
- D. Coordinate tree installation with seeding and sodding installation per 32 92 00.

1.8 WARRANTY

- A. Contractor shall warrant work as provided by the General and Supplementary Conditions and Division 01 Specifications.

PART 2 - PRODUCTS

2.1 PRODUCTS AND MATERIALS

- A. Substitutions or equivalent products shall be in accordance with Division 01 Specifications.
- B. Topsoil: Material per Specifications Section 31 20 00.
 - 1. Depth and volume as required for tree pits as noted in this section and on the Drawings. Provide necessary volume to ensure planter areas are filled to specified finish grade.
- C. Trees, Shrubs, Plants and Ground Cover: Species and size identifiable in plant schedule on the Drawings, grown in climatic conditions similar to those in locality of the Work.
- D. Soil Amendment Materials:
 - 1. Granular Soil Conditioner: Turface MVP calcined, non-swelling illite and silica clay, or approved equal.
 - a. Submit product data and sample for approval prior to ordering.
 - b. PROFILE Products, LLC, 800.207.6457 or www.turface.com
 - 2. Fertilizer:
 - a. Commercial Grade Compost: Refer to Section 32 92 00.
 - b. Humic Acid: Live Earth Humate Soil Conditioner.
 - c. Planting Tablet Fertilizer: 21 gram - Agriform.
 - 3. Water: Clean, fresh, and free of substances or matter which could inhibit vigorous growth of plants.
- E. Maintenance Fertilizer: Live Earth Tree and Shrub 5-10-10.
- F. Pre-Emergent Herbicide: Tupersan Herbicide Wettable Powder, Tenacity, or approved equal.
- G. Weed Control Herbicide:
 - 1. Selective Broadleaf Weed Control: 2,4-D Amine Weed Killer.
 - 2. Broad Spectrum Herbicide: Roundup Pro.

2.2 ACCESSORIES

- A. Stakes: As noted on the Drawings.

- B. Tree Ties: Durable rubber ties designed for staking of trees. Length as required per manufacturer's specifications. Submit manufacturer's catalog cut sheet for approval prior to ordering.
- C. Landscape Bark Mulch:
1. 3-inch minimum depth of approximately 1-inch length shredded bark wood chips derived from hardwood or softwood tree species.
 2. Wood mulch shall not contain any trash, debris, rocks or other material harmful to plant growth.
 3. Submit 1-gallon bag sample and name and contract information of source for approval prior to ordering.
- D. Landscape Rock Mulch:
1. 3-inch minimum depth of approximately 1-inch black and tan rock mulch. Mulch shall be free of fines and rock less than $\frac{3}{4}$ -inch in size.
 2. Submit 1-gallon bag sample and name and contract information of source for approval prior to ordering.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Verify that prepared topsoil is ready to receive work.
- B. Verify that required underground utilities are available, in proper location, and ready for use.
- C. All planters shall be completely filled with topsoil to within 3-inch / 12-inch of adjacent curb, walk, etc. Topsoil elevation shall be adjusted per landscape mulch type, see Drawings.

3.2 SOIL PREPERATION

- A. Prior to placement of plants, topsoil shall be water settled through application of .5-inch of precipitation through the irrigation system. Coordinate with Section 32 84 00 and 32 92 00. All areas of settlement shall be top dressed with approved topsoil material to provide a smooth, even surface. Any settlement of soils after placement of plants shall be corrected by the Contractor at no cost to the Owner.
- B. Tree Pit Backfill Planting Mix: Blend topsoil and soil amendments and fertilizer for tree pit backfill at the following rates. Blend amendments thoroughly with soil backfill. Coordinate with Drawings for size of planting pit. Blend topsoil and amendments with native soil at bottom and edge of pit.
1. Tree Pits shall be: 5 feet by 5 feet by 1.5 feet.
 2. Application Rates:
 - a. Granular Soil conditioner: 50 lbs per Tree Pit.

- b. Humic Acid: 10 lbs per Tree Pit.
 - c. Commercial grade compost - 5 cubic feet per Tree Pit.
 - d. Planting Tablet Fertilizer - 4 tablets per Tree Pit.
- C. Shrub Pit Backfill Planting Mix: Blend topsoil and soil amendments and fertilizer for shrub pit backfill at the following rates. Blend amendments thoroughly with soil backfill. Coordinate with Drawings for size of planting pit. Blend topsoil and amendments with native soil at bottom and edge of pit.
- 1. Shrub Pits shall be: 2.5 feet by 2.5 feet by 1 foot.
 - 2. Application Rates:
 - a. Granular Soil conditioner: 10 lbs per Shrub Pit.
 - b. Humic Acid: 2 lbs per Shrub Pit.
 - c. Commercial grade compost - 1 cubic foot per Shrub Pit.
 - d. Planting Tablet Fertilizer - 2 tablets per Shrub Pit.
- D. Placement and blending of soil amendments listed in this section shall be photo documented by the contractor. Document installation of all soil amendment application and blending and provide to the Landscape Architect for review and approval. Contractor shall provide product receipts for all products specified in this section for review and approval by the Landscape Architect. Product receipts shall list date of delivery, delivery address and location, project name, quantity delivered and product delivered.
- E. Representative plant material must be delivered to the site for review and approval by the Landscape Architect prior to installation. Any plant material placed without prior approval is subject to removal at no cost to the Owner.

3.3 EXECUTION

- A. Place boulders for best appearance for review and final orientation by Landscape Architect. Coordinate with Drawings for placement depth into soil. Coordinate with installation of irrigation system and plant material.
- B. Place plants for best appearance for review and final orientation by Landscape Architect.
- C. Set plants vertical.
- D. After placement cut all string, wires, etc. and remove string, wire and burlap from top and sides of root ball before backfilling.
- E. Set plants in pits or beds, partly filled with prepared plant soil mix. Backfill soil mixture in 6 inch layers. Maintain plant materials in vertical position. Add fertilizer tablets in plant pit (at 2/3 full) as per manufacturer's recommendations.
- F. Saturate soil with water when the pit or bed is half full of topsoil and again when full.

G. Installation of Accessories:

1. Apply pre-emergent herbicide to planting areas after completion of planting. Planting areas shall be free of existing weed growth prior to application of herbicide. Apply herbicide in accordance with Manufacturer's recommendations.
2. Place shredded bark wood mulch at area shown on drawing. We down during placement to achieve moderate compaction. Rake Smooth.
3. Place landscape rock mulch over landscape planting bed areas. See Drawings for location and depth.

3.4 TREE AND SHRUB ESTABLISHMENT

A. General: Starting immediately after tree and shrub placement, establishment will begin and continue through the grow-in period. Irrigation and weed control shall be the responsibility of the Contractor as defined herein. Protect planter areas with signs to prevent traffic throughout the establishment period.

B. The establishment period shall have a duration of thirty (30) days.

C. Irrigation:

1. Contractor shall submit for approval a proposed "Tree and Shrub Establishment Irrigation Schedule." This schedule shall include Zone designation, days per week, cycles per day and cycle run time. Include targeted daily and weekly precipitation rates for each zone based on current climatic conditions.
2. Water shall be applied to moisten the root ball and the soil adjacent to the root ball. Avoid overwatering and creating areas of standing water.
3. Irrigation shall be monitored daily to identify areas receiving too much or too little precipitation.
4. Trees in Turf Areas: If sod/seed irrigation is not adequate to provide for trees, hand watering shall occur to moisten the root ball and soil adjacent to the root ball.

D. Weed Control:

1. Control growth of weeds throughout establishment period. Hand pull weeds weekly.
2. Chemical herbicide shall not be used in shrub areas during the establishment period.

E. Upon completion of the establishment period the maintenance period shall begin.

3.5 TREE AND SHRUB MAINTENANCE

A. Maintenance shall be according to the following standards. All areas shall be weeded and cultivated at intervals of not more than seven (7) days. Watering, trash and debris removal, fertilization, spraying and pest control, as required, shall be included in the maintenance period. Cleaning of street gutters and sidewalks shall be included. The Contractor shall be responsible for maintaining adequate

protection of the area. Damaged areas shall be repaired at the Contractor's expense.

- B. The maintenance period shall have a minimum duration of sixty (60) days and continue until the date of Substantial Completion.
- C. Irrigation:
 - 1. Contractor shall submit for approval a proposed "Tree and Shrub Maintenance Irrigation Schedule." This schedule shall include Zone designation, days per week, cycles per day and cycle run time. Include targeted daily and weekly precipitation rates for each zone based on current, seasonal climatic conditions.
 - 2. Water shall be applied to moisten the soil appropriately for the current, seasonal climatic conditions. Avoid overwatering and creating areas of standing water.
 - 3. Irrigation shall be monitored weekly to identify areas receiving too much or too little precipitation.
 - 4. Trees in Turf Areas: If sod/seed irrigation is not adequate to provide for trees, hand watering shall occur to moisten the root ball and soil adjacent to the root ball.
- D. Weed Control:
 - 1. Control growth of weeds throughout maintenance period. Inspect turf areas every seven (7) days for weed growth.
 - 2. Utilize weed killer and hand pulling to control weeds in all planter and turf areas.
- E. Fertilization:
 - 1. One application of Maintenance Fertilizer shall be applied during the maintenance period. Application shall occur approximately sixty (60) days after installation of plant material and prior to the date of Substantial Completion.
 - 2. Maintenance fertilizer shall be applied at the following rate per manufacturer's written instructions for root feeding:
 - a. Dilute 40:1 with water prior to use.
 - b. Trees: Apply 5 gallons of diluted product per inch of trunk diameter.
 - c. Shrubs: Apply 3 gallons of diluted product per shrub.
 - 3. Apply Liquid Humic Acid / water mixture to root ball and area directly adjacent to root ball.
- F. Insect and Disease Control: Maintain a reasonable level of control with approved materials.
- G. Plant material replacement: Replace dead, dying and missing plants with plants of a size, condition and variety to match plans and as acceptable to the Architect at Contractor's expense under the provisions Division 01 Specifications.

- H. Continuously maintain the entire project area during the progress of work until the date of Substantial Completion.

3.6 FIELD QUALITY CONTROL

- A. Perform field inspections under provisions of Division 01 Specifications.
- B. Coordinate field inspections with Specification Section 32 84 00 and 32 92 00.
- C. Contractor Performed Inspections: The contractor shall perform the following inspections and provide written confirmation of completed and successful installation to the Architect.
1. Tree Pit Backfill Planting Mix and Tree Placement: Provide required photographs and product receipts demonstrating successful placement and blending of specified soil amendments including the placement of trees and the backfill of the tree planting pit.
 2. Shrub Pit Backfill Planting Mix and Shrub Placement: Provide required photographs and product receipts demonstrating successful placement and blending of specified soil amendments including the placement of shrubs and the backfill of the shrub planting pit.
 3. Tree and Shrub Maintenance - Fertilization: Provide required photographs and product receipts demonstrating successful placement of specified maintenance fertilizer.
- D. Landscape Architect Performed Inspections:
1. Trees and Shrubs - Material and Installation: The Contractor shall schedule one site visit with the Landscape Architect to inspect representative plant material and the installation of trees and shrubs.

3.7 CLEANING

- A. After all planting, establishment and maintenance operations have been completed; remove all trash, excess soil or rubbish from the property. All scars, ruts or other marks in the ground caused by this work shall be repaired and the ground left in a neat and orderly condition throughout the site. Contractor shall pick up all trash resulting from this work no less frequently than each day before leaving the site. All trash shall be removed completely from the site. The Contractor shall leave the site area broom-clean and shall wash down all paved areas within the Contract area, leaving the premises in a clean condition acceptable to the Architect and Construction Manager.

3.8 PROTECTION

- A. Protect planter areas with warning signs until date of Substantial Completion.

END OF SECTION

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes

1. Water distribution piping and related components outside the building for water service, fire service and irrigation service.
2. Utility-furnished products include water meters that will be furnished to the site, ready for installation.

1.2 RELATED SECTIONS

- A. Division 01 Sections.
- B. Division 31 Section "Earth Moving" utility trench excavation, bedding and backfill.
- C. Idaho Standards for Public Works Construction, Current Edition.

1.3 SUBMITTALS

- A. Submit under provisions of Division 01.
- B. Product Data: for each type of product indicated.
- C. Shop Drawings
 1. Indicate general installation, components, dimensions, coverage, clearances, and methods of installation.
- D. Field Reports: Field quality-control test reports, pressure test reports and disinfection reports.
- E. Operations & Maintenance Data: Submit manufacturer's written Operations & Maintenance data for all components & accessories.

1.4 QUALITY ASSURANCE

A. Regulatory Requirements

1. Comply with requirements of utility company supplying water. Include tapping of water mains and backflow prevention.
2. Comply with AHJ Standards for potable-water-service piping, including materials, installation, testing and disinfection.
3. Piping materials shall bear label, stamp, or other markings of the specified testing agency.

4. Comply with ASTM F 645 for selection, design and installation of thermoplastic water piping.
5. Comply with FMG's "Approval Guide" or UL's "Fire Protection Equipment Directory" for fire-service-main products.
6. NFPA Compliance: Comply with NFPA 24 for materials, installations, tests, flushing, and valve and hydrant supervision for fire-service-main piping for fire suppression.
7. Comply with local plumbing codes.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Deliver, store, protect and handle products to site under provisions of Division 01.

1.6 COORDINATION

- A. Coordinate connection to water main with utility company.

1.7 WARRANTY

- A. Contractor shall warrant work as provided by the General and Supplementary Conditions and Division 01 Specifications.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Substitutions or equivalent products shall be in accordance with Division 01 Specifications.

2.2 PIPES AND PIPE FITTINGS

- A. Per the Drawings, AHJ Supplemental Specifications to the ISPWC, and the ISPWC.

2.3 PIPING SPECIALTIES

- A. Per the Drawings, AHJ Supplemental Specifications to the ISPWC, and the ISPWC.

2.4 GATE VALVES

- A. Per the Drawings, AHJ Supplemental Specifications to the ISPWC, and the ISPWC.

2.5 GATE VALVE ACCESSORIES AND SPECIALTIES

- A. Per the Drawings, AHJ Supplemental Specifications to the ISPWC, and the ISPWC.

2.6 WATER METERS & METER BOXES/VAULTS

- A. Per the Drawings, AHJ Supplemental Specifications to the ISPWC, and the ISPWC.

2.7 FIRE HYDRANTS

- A. Per the Drawings, AHJ Supplemental Specifications to the ISPWC, and the ISPWC.
- B. Color: Red.

2.8 FIRE DEPARTMENT CONNECIONS

- A. Per the Drawings, AHJ Supplemental Specifications to the ISPWC, and the ISPWC.

2.9 TRENCH FILL MATERIALS

- A. Bedding: per specification section 312000.
- B. Trench backfill: per specification section 312000.

2.10 ACCESSORIES

- A. Thrust Blocks: Per the Drawings and ISPWC.
- B. Anchorages: Provide anchorages for tees wyes, crosses, plugs, caps, bends, valves, and hydrants. After installation, apply full coat of asphalt or other acceptable corrosion-retarding material to surfaces of ferrous anchorages.
 - 1. Rods: Steel, ASTM A 575.
 - 2. Rod Couplings: Malleable-iron, ASTM A 197.
 - 3. Thrust Blocks: Concrete, 2,500 psi.
- C. No.12 Direct Burial Locator wire with Dri-splice connectors shall be installed with waterlines. Wire shall extend to surface at all valve boxes/meters and be fastened to the top of the pipe at maximum 10' intervals.
- D. Warning Tape: Install per specification section 312000.

3.1 EXECUTION

- A. Per the Drawings, AHJ Supplemental Specifications to the ISPWC, and the ISPWC.
- B. Route pipe in straight lines.
- C. Install pipe to allow for expansion and contraction without stressing pipe or joints.
- D. Install access fitting to permit disinfection of water system.
- E. Form and place concrete for thrust blocks at each change of direction of pipe main.
- F. Establish elevations of buried piping to ensure not less than 4'-0" of cover and not more than 5'-0" unless otherwise approved in writing by the AHJ.
- G. Set valves on solid bearing. Locate valve a minimum of 12" away from hydrant.
- H. Center and plumb valve box over valve. Set box cover flush with finished grade.

3.2 DISINFECTION AND TESTING

- A. Per the Drawings, AHJ Supplemental Specifications to the ISPWC, and the ISPWC.

END OF SECTION

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Sanitary sewerage piping, fittings and accessories.

1.2 RELATED SECTIONS

A. Division 01 Sections.

B. Division 31 Section "Earth Moving" utility trench excavation, bedding and backfill.

C. Idaho Standards for Public Works Construction, Current Edition.

1.3 SUBMITTALS

A. Submit under provisions of Division 01.

B. Product Data: Provide data indicating pipe, manholes, fittings, accessories, and fill material.

C. Project Record Documents

1. Submit documents under provisions of Division 01.
2. Conform to requirements of ISPWC.
3. Record location of pipe runs, connections, cleanouts and invert elevations.
4. Identify and describe unexpected variations to subsoil conditions or discovery of uncharted utilities.

D. Field Reports: Field quality-control and testing reports.

E. Operations & Maintenance Data: Submit manufacturer's written Operations & Maintenance data for all components & accessories.

1.4 QUALITY ASSURANCE

A. Regulatory Requirements

1. Conform to requirements of ISPWC.

B. Utility trench compaction

1. Per Division 31 Earth Moving.

1.5 PROJECT/SITE CONDITIONS

- A. Verify that field measurements and elevations are as indicated.

1.6 SEQUENCING AND SCHEDULING

- A. Coordinate work under provisions of Division 01.
- B. Coordinate the Work with termination of sanitary sewer connection outside building, and trenching.

1.7 WARRANTY

- A. Contractor shall warrant work as provided by the General and Supplementary Conditions and Division 01 Specifications.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Substitutions or equivalent products shall be in accordance with Division 01 Specifications.

2.2 MATERIALS

- A. Per the Drawings, AHJ Supplemental Specifications to the ISPWC, and the ISPWC.

2.3 COMPONENTS

- A. Per the Drawings, AHJ Supplemental Specifications to the ISPWC, and the ISPWC.

2.4 ACCESSORIES

- A. Per the Drawings, AHJ Supplemental Specifications to the ISPWC, and the ISPWC.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Verify that trench cut is ready to receive work and excavations, dimensions, and elevations are as indicated on drawings.

3.2 PREPARATION

- A. Hand trim excavations to required elevations. Correct over excavation with structural fill.
- B. Remove large stones or other hard matter which could damage pipe or impede consistent backfilling or compaction.

3.3 EXECUTION

- A. Per the Drawings, AHJ Supplemental Specifications to the ISPWC, and the ISPWC.
- B. Bedding
 - 1. Excavate pipe trench in accordance with Section 312000 for work of this Section.
 - 2. Place bedding material in accordance with Section 312000 at trench bottom, level materials in continuous layer not exceeding 4 inches compacted depth.
 - 3. Maintain optimum moisture content of bedding material to attain required compaction density.
- C. Pipe
 - 1. Install pipe, fittings, and accessories in accordance with ASTM D 2321, manufacturer's instructions. Seal joints watertight.
 - 2. Pipe installation and backfill shall be consistent with the drawings and the ISPWC.
 - 3. Lay pipe to slope at gradients noted on drawings; with maximum variation from true slope of 1/16 inch in 10 feet.
 - 4. Install bedding to minimum compacted thickness of 6" above pipe, 4" below pipe and 12" at sides of pipe.
 - 5. Refer to Section 312000 for trenching and detectable warning tape requirements. Do not displace or damage pipe when compacting.
 - 6. Connect to building sanitary sewer outlet and collection system.

3.4 TESTING

- A. Prior to final acceptance, after all utilities are in and prior to paving, the following testing shall perform testing in the presence of the Engineer.
- B. Visual Inspection.
 - 1. Per AHJ and ISPWC.
- C. Air Pressure Testing.
 - 1. Per AHJ and ISPWC.
- D. Pipe Cleaning.
 - 1. Per AHJ and ISPWC.

- E. Deflection Tests for Flexible Pipe.
 - 1. Per AHJ and ISPWC.
- F. Closed Circuit Television (CCTV) Inspection.
 - 1. Per AHJ and ISPWC.
 - 2. Test all mains and service lines.

3.5 PROTECTION

- A. Protect finished installation under provisions of Division 01.
- B. Protect pipe and aggregate cover from damage or displacement until backfilling operation is in progress.

END OF SECTION

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Storm drainage piping, fittings, and accessories.
2. Clean-outs.

1.2 SUBMITTALS

A. Submit under provisions of Division 01

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

C. Field quality-control reports.

D. Project Record Documents

1. Submit documents under provisions of Division 01.
2. Accurately record location of pipe runs, connections, catch basins, cleanouts, and invert elevations each day.
3. Identify and describe unexpected variations to subsoil conditions or discovery of uncharted utilities each day.

E. Operations & Maintenance Data: Submit manufacturer's written Operations & Maintenance data for all components & accessories.

1.3 QUALITY ASSURANCE

A. Regulatory Requirements:

1. Conform to requirements of agency having jurisdiction.
2. Piping materials shall bear label, stamp, or other markings of the specified testing agency.

1.4 WARRANTY

A. Contractor shall warrant work as provided by the General and Supplementary Conditions and Division 01 Specifications.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Substitutions or equivalent products shall be in accordance with Division 01 Specifications.

2.2 MATERIALS

- A. Per the Drawings, and the ISPWC.

2.3 CLEANOUTS

- A. Per drawings and details.

2.4 ACCESSORIES

- A. Warning Tape: Install per specification section 312000.

PART 3 - EXECUTION

3.1 EARTHWORK

- A. Excavation, trenching, and backfilling are specified in Division 31 Section "Earth Moving."

3.2 PIPING INSTALLATION

- A. General Locations and Arrangements: Drawing plans and details indicate general location and arrangement of underground storm drainage piping. Location and arrangement of piping layout take into account design considerations. Install piping as indicated, to extent practical. Where specific installation is not indicated, follow piping manufacturer's written instructions.
- B. Install piping beginning at low point, true to grades and alignment indicated with unbroken continuity of invert. Place bell ends of piping facing upstream. Install gaskets, seals, sleeves, and couplings according to manufacturer's written instructions for use of lubricants, cements, and other installation requirements.
- C. Install proper size increasers, reducers, and couplings where different sizes or materials of pipes and fittings are connected. Reducing size of piping in direction of flow is prohibited.
- D. When installing pipe under streets or other obstructions that cannot be disturbed, use pipe-jacking process of microtunneling.
- E. Install gravity-flow, nonpressure drainage piping according to the following:

1. Install piping pitched down in direction of flow.
2. Install corrugated steel piping according to ASTM A 798/A 798M.
3. Install PVC sewer piping according to ASTM D 2321 and ASTM F 1668.

3.3 CLEANOUT INSTALLATION

- A. Install cleanouts and riser extensions from sewer pipes to cleanouts at grade. Install piping so cleanouts open in direction of flow in drainage pipe.
 1. Construct cleanout as specified on drawings.

3.4 CONCRETE PLACEMENT

- A. Place cast-in-place concrete according to ACI 318.

3.5 CONNECTIONS

- A. Connect non-pressure, gravity-flow drainage piping to building storm drains.

3.6 IDENTIFICATION

- A. Materials and their installation are specified in Division 31 Section "Earth Moving." Arrange for installation of green warning tape directly over piping and at outside edge of underground structures.

3.7 FIELD QUALITY CONTROL

- A. Inspect interior of piping to determine whether line displacement or other damage has occurred. Inspect after approximately 24 inches of backfill is in place, and again at completion of Project.
 1. Submit separate reports for each system inspection.
 2. Defects requiring correction include the following:
 - a. Alignment: Less than full diameter of inside of pipe is visible between structures.
 - b. Deflection: Flexible piping with deflection that prevents passage of ball or cylinder of size not less than 92.5 percent of piping diameter.
 - c. Damage: Crushed, broken, cracked, or otherwise damaged piping.
 - d. Infiltration: Water leakage into piping.
 - e. Exfiltration: Water leakage from or around piping.
 - f. Replace defective piping using new materials, and repeat inspections until defects are within allowances specified.
 - g. Re-inspect and repeat procedure until results are satisfactory.

- B. Test new piping systems, and parts of existing systems that have been altered, extended, or repaired, for leaks and defects.
 - 1. Do not enclose, cover, or put into service before inspection and approval.
 - 2. Test completed piping systems according to requirements of authorities having jurisdiction.
 - 3. Schedule tests and inspections by authorities having jurisdiction with at least 24 hours' advance notice.
 - 4. Submit separate report for each test.
 - 5. Gravity-Flow Storm Drainage Piping: Test according to requirements of authorities having jurisdiction, UNI-B-6, and the following:
 - 6. Exception: Piping with soiltight joints unless required by authorities having jurisdiction.
 - a. Option: Test plastic piping according to ASTM F 1417.
 - b. Option: Test concrete piping according to ASTM C 924.
- C. Leaks and loss in test pressure constitute defects that must be repaired.
- D. Replace leaking piping using new materials, and repeat testing until leakage is within allowances specified.
- E. Refer to Division 31 Section "Earth Moving" for trenching compaction.

3.8 CLEANING

- A. Clear interior of piping and structures of dirt and other superfluous material as work progresses.
- B. Flush piping to remove collected debris. Debris shall not enter infiltration facilities.
- C. Place plugs in ends of uncompleted pipe at end of day or whenever work stops.
- D. After substantial completion, remove temporary filter fabric from catch basin frames.

3.9 PROTECTION

- A. Protect finished installation under provisions of Division 01.

END OF SECTION