



PROJECT MANUAL

FOR

CORONA FUNDAMENTAL INTERMEDIATE SCHOOL

MPR RENOVATION

1230 S. Main Street
Corona, CA 92882

DSA SUBMITTAL

DECEMBER 19, 2022

ARCHITECT'S PROJECT NUMBER: 22063.01

CSDA DESIGN GROUP, Inc.

610 E. FRANKLIN AVE,

EL SEGUNDO, CA 90245

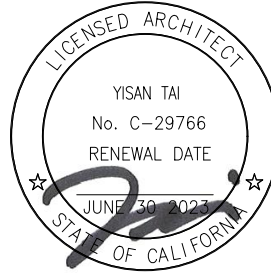
E-MAIL: YTAI@CSDADESIGNGROUP.COM

FAX: (310) 821-9201

PHONE: (310) 821-9200

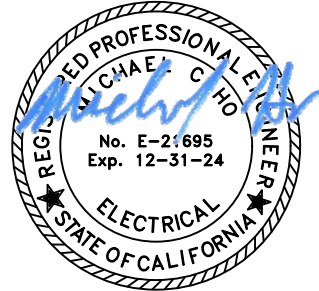
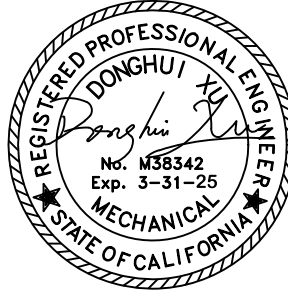
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Architect: CSDA DESIGN GROUP, INC.
899 N DOUGLAS ST, # 100
EL SEGUNDO, CA 90245
TEL: 310- 821-9200

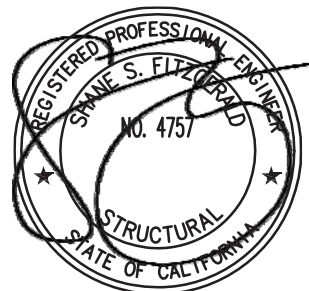


IDENTIFICATION STAMP
DIV. OF THE STATE ARCHITECT
APP: 04-121721 INC:
REVIEWED FOR
SS FLS ACS
DATE: 05/10/2023

Mechanical
Plumbing &
Electrical
Engineer: TX ENGINEERING CORP.
2866 BIRCH LANE
POMONA, CA 91767
TEL: 213-295-5532



Structural
Engineer: JOHN A. MARTIN & ASSOC.
950 SOUTH GRAND AVE, #400
LOS ANGELES, CA 90015
TEL: 310-464-8404



Civil
Engineer: VCA ENGINEERS, INC
2041 S. GARFIELD AVE, #210
ALHAMBRA, CA 91801
TEL: 323-729-6098



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PART 1 GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section includes requirements including but not limited to:
 1. Project information.
 2. Work covered by Contract Documents.
 3. Phased construction.
 4. Work by Owner.
 5. Work under separate contracts.
 6. Future Work.
 7. Purchase contracts.
 8. Owner furnished products.
 9. Owner furnished, Contractor installed products.
 10. Access to site.
 11. Coordination with occupants.
 12. Work restrictions.
 13. Specification and Drawing conventions.
 14. Miscellaneous provisions.

1.3 PROJECT INFORMATION

- A. Project Identification:
 1. Project Location: **Corona Fundamental Intermediate School**
1230 S. Main St
Corona, CA 92882
- B. Owner: **Corona Norco Unified School District**
 1. Owner's Representative: **Jacquelyn Roberts**
- C. Architect: **CSDA Design Group**
610 E. Franklin Ave.,
El Segundo, CA 90245
- D. Consultants: Additional design professionals have been retained who have prepared designated portions of the Contract Documents. Refer to "stamp" page this project manual.

1.4 WORK COVERED BY CONTRACT DOCUMENTS

- A. Renovation of the existing Multi-Purpose Room Building which includes the following:
 1. Repurposing of existing locker rooms into vocational classrooms
 2. Install projection systems in new rooms and MPR space
 3. Interior painting of renovated spaces
 4. Replacement of lighting in various renovated spaces
 5. Drinking fountain upgrade in MPR space

6. Installation of new wall-mounted lunch table storage units in MPR space
7. Path of travel (POT) upgrade to the MPR Building
8. Replace existing RTUs with new RTUS

1.5 WORK BY OWNER AND UNDER SEPARATE CONTRACTS

- A. The Owner reserves the right to let separate contract for work outside of the scope of this Contract. Cooperate fully with separate contractors so work on those contracts may be carried out smoothly, without interfering with or delaying Work under this Contract or other contracts. Coordinate the Work of this Contract with work performed under separate contracts.
- B. Owner Furnished Products (OFCI):
 1. The Owner will furnish products indicated. The Work includes receiving, unloading, handling, storing, protecting, and installing Owner furnished products and making building services connections when applicable:
 - a. Owner Furnished Products: Coordinate with Owner.

1.6 ACCESS TO SITE

- A. Use of Site:
 1. Limit use of Project site to Work in areas and areas within the Contract limits indicated. Do not disturb portions of site beyond areas in which the Work is indicated:
 - a. Limits: The Drawings indicate the limits of the construction operations.
 - b. Driveways, Walkways, and Entrances:
 - 1) Keep driveways, parking areas, student drop off and pick up points, loading areas, and entrances serving premises clear and available to Owner, Owner's employees, the students, and emergency vehicles at all times. Do not use these areas for parking or storage of materials:
 - a) Schedule deliveries to minimize use of driveways and entrances by construction operations.
 - b) Schedule deliveries to minimize space and time requirements for storage of materials and equipment onsite.
- B. Condition of Existing Building: Maintain portions of existing building affected by construction operations in weathertight condition throughout construction period. Repair damage caused by construction operations.
- C. COVID-19 Conditions: Contractors must conform, and ensure that all subcontractors and other Project personnel, including but not limited to; workers and site visitors, conform to all regulations, limitations, and requirements as put forth and recommended by Associated General Contractors of California (AGC), State of California Guidance on Outbreak of 2019 Novel Coronavirus (2019-nCoV) in Wuhan, China, and local Health Department agencies.

1.7 COORDINATION WITH OCCUPANTS

- A. Owner Limited Occupancy of Completed Areas of Construction:
 1. Owner reserves the right to occupy and to place and install equipment in completed portions of the Work, prior to Substantial Completion of the Work, provided occupancy does not interfere with completion of the Work. Such placement of equipment and limited occupancy shall not constitute acceptance of the total Work:
 - a. Architect will prepare a Certificate of Substantial Completion for each specific portion of the Work to be occupied prior to Owner acceptance of the completed Work.
 - b. Obtain a Certificate of Occupancy from authorities having jurisdiction before limited

- Owner occupancy.
- c. Before limited Owner occupancy, ensure mechanical and electrical systems are fully operational, and required tests and inspections and start up procedures are successfully completed. On occupancy, Owner will operate and maintain mechanical and electrical systems serving occupied portions of Work.
 - d. Upon occupancy, Owner will assume responsibility for maintenance and custodial service for occupied portions of Work.

1.8 WORK RESTRICTIONS

- A. Work Restrictions: Comply with restrictions on construction operations. Comply with limitations on use of public streets and with other requirements of authorities having jurisdiction.
- B. On Site Work Hours: Limit Work in the existing building to normal working hours, Monday through Friday, unless otherwise indicated. Coordinate with Owner when it is necessary to extend working hours or Work on weekends.
- C. Existing Utility Interruptions:
 - 1. Do not interrupt utilities serving facilities occupied by Owner or others unless permitted under the following conditions and after providing temporary utility services according to requirements indicated:
 - a. Notify Owner not less than two (2) weeks in advance of proposed utility interruptions.
 - b. Obtain Owner's written permission before proceeding with utility interruptions.
- D. Noise, Vibration, and Odors:
 - 1. Coordinate operations that result in high levels of noise and vibration, odors, or other disruption to Owner occupancy with Owner:
 - a. Notify Owner not less than two (2) weeks in advance of proposed disruptive operations.
 - b. Obtain Owner's written permission before proceeding with disruptive operations.
- E. Controlled Substances, Firearms, and Explosive Devices: Use of tobacco products, controlled substances, firearms, and explosive devices on the site is not permitted.
- F. Employee Identification: Provide identification tags for Contractor personnel working on site. Require personnel to use identification tags at all times.
- G. Employee Screening:
 - 1. Comply with Owner's requirements for drug and background screening of Contractor personnel working on site:
 - a. Maintain list of approved screened personnel with Owner's representative.

1.9 SPECIFICATION AND DRAWING CONVENTIONS

- A. Specification Content:
 - 1. The Specifications use certain conventions for the style of language and the intended meaning of certain terms, words, and phrases when used in particular situations. These conventions are as follows:
 - a. Imperative mood and streamlined language are generally used in the Specifications. The words "shall," "shall be," or "shall comply with," depending on the context, are implied where a colon (:) is used within a sentence or phrase.
 - b. Specification requirements are to be performed by Contractor unless specifically stated otherwise.

- B. Drawing Coordination:
1. Requirements for materials and products identified on Drawings are described in detail in the Specifications. One or more of the following are used on Drawings to identify materials and products:
 - a. Terminology: Materials and products are identified by the typical generic terms used in the individual Specifications Sections.
 - b. Abbreviations: Materials and products are identified by abbreviations.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION (NOT USED)

END OF SECTION 01 10 00

SECTION 01 25 00 SUBSTITUTION PROCEDURES AND FORM

PART 1 GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

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

1.3 DEFINITIONS

- A. Products: Items purchased for incorporation in the Work, regardless if specifically purchased for the Project or taken from Contractor's previously purchased stock. The term *product* is inclusive for material, equipment, assembly, system, and other terms of similar intent.
- B. Substitutions:
 - 1. Changes in products, materials, equipment, and methods of construction from those required by the Contract Documents and proposed by Contractor:
 - a. Substitutions for Cause: Changes proposed by Contractor that are required due to changed Project conditions, such as unavailability of product, regulatory changes, or unavailability of required warranty terms.
 - b. Substitutions for Convenience: Changes proposed by Contractor or Owner that are not required in order to meet other Project requirements but may offer advantage to Contractor or Owner.

1.4 SUBMITTALS

- A. Substitution Requests:
 - 1. Submit three (3) copies of each request for consideration. Identify product or fabrication or installation method to be replaced. Include Specification Section number and title and Drawing numbers and titles:
 - a. Substitution Request Form: Use facsimile of form provided in Project manual.
 - b. Documentation:
 - 1) Show compliance with requirements for substitutions and the following, as applicable:
 - a) Statement indicating why specified product or fabrication or installation cannot be provided, if applicable.
 - b) Coordination information, including a list of changes or revisions needed to other parts of the Work and to construction performed by Owner and separate contractors, which are necessary to accommodate proposed substitution.
 - c) Detailed comparison of significant qualities of proposed substitution with those of the Work specified. Include annotated copy of applicable Specification Section. Significant qualities may include attributes such as performance, weight, size, durability, visual effect, sustainable design characteristics, warranties, and specific features and requirements indicated. Indicate deviations, if any, from the Work specified.
 - d) Product Data, including drawings and descriptions of products and fabrication and installation procedures.
 - e) Samples, where applicable or requested.

- f) Certificates and qualification data, where applicable or requested.
 - g) List of similar installations for completed projects with project names and addresses and names and addresses of architects and owners.
 - h) Material test reports from a qualified testing agency indicating and interpreting test results for compliance with requirements indicated.
 - i) Research reports evidencing compliance with building code in effect for Project, from ICC-ES.
 - j) Detailed comparison of Contractor's Construction Schedule using proposed substitution with products specified for the Work, including effect on the overall Contract Time. If specified product or method of construction cannot be provided within the Contract Time, include letter from manufacturer, on manufacturer's letterhead, stating date of receipt of purchase order, lack of availability, or delays in delivery.
 - k) Cost information, including a proposal of change, if any, in the Contract Sum.
 - l) Contractor's certification that proposed substitution complies with requirements in the Contract Documents except as indicated in substitution request, is compatible with related materials, and is appropriate for applications indicated.
 - m) Contractor's waiver of rights to additional payment or time that may subsequently become necessary because of failure of proposed substitution to produce indicated results.
2. Architect's Action:
- a. If necessary, Architect will request additional information or documentation for evaluation within seven (7) days of receipt of a request for substitution. Architect will notify Contractor of acceptance or rejection of proposed substitution within 15 days of receipt of request, or seven (7) days of receipt of additional information or documentation, whichever is later:
 - 1) Forms of acceptance: Change Order, Construction Change Directive, or Architect's Supplemental Instructions for minor changes in the Work.
 - 2) Use product specified if Architect does not issue a decision on use of a proposed substitution within time allocated.

1.5 QUALITY ASSURANCE

- A. Compatibility of Substitutions: Investigate and document compatibility of proposed substitution with related products and materials. Engage a qualified testing agency to perform compatibility tests recommended by manufacturers.
- B. Coordination: Revise or adjust affected Work as necessary to integrate Work of the approved substitutions.

PART 2 PRODUCTS

2.1 SUBSTITUTIONS

- A. Substitutions: Substitutions are considered as changes to the Drawings and shall be submitted to DSA.
- B. Substitutions for Cause:
 - 1. Submit requests for substitution immediately on discovery of need for change, but not later than 30 days prior to time required for preparation and review of related submittals:
 - a. Conditions:
 - 1) Architect will consider Contractor's request for substitution when the following

conditions are satisfied. If the following conditions are not satisfied, Architect will return requests without action, except to record noncompliance with these requirements:

- a) Requested substitution is consistent with the Contract Documents and will produce indicated results.
- b) Substitution request is fully documented and properly submitted.
- c) Requested substitution will not adversely affect Contractor's Construction Schedule.
- d) Requested substitution has received necessary approvals of authorities having jurisdiction.
- e) Requested substitution is compatible with other portions of the Work.
- f) Requested substitution has been coordinated with other portions of the Work.
- g) Requested substitution provides specified warranty.
- h) If requested substitution involves more than one contractor, requested substitution has been coordinated with other portions of the Work, is uniform and consistent, is compatible with other products, and is acceptable to all contractors involved.

C. Substitutions for Convenience:

1. Architect will consider requests for substitution if received prior to the Award of the Contract. Requests received after that time may be considered or rejected at discretion of Architect:

a. Conditions:

- 1) Architect will consider Contractor's request for substitution when the following conditions are satisfied. If the following conditions are not satisfied, Architect will return requests without action, except to record noncompliance with these requirements:
 - a) Requested substitution offers Owner a substantial advantage in cost, time, energy conservation, or other considerations, after deducting additional responsibilities Owner must assume. Owner's additional responsibilities may include compensation to Architect for redesign and evaluation services, increased cost of other construction by Owner, and similar considerations.
 - b) Requested substitution does not require extensive revisions to the Contract Documents.
 - c) Requested substitution is consistent with the Contract Documents and will produce indicated results.
 - d) Substitution request is fully documented and properly submitted.
 - e) Requested substitution will not adversely affect Contractor's Construction Schedule.
 - f) Requested substitution has received necessary approvals of authorities having jurisdiction.
 - g) Requested substitution is compatible with other portions of the Work.
 - h) Requested substitution has been coordinated with other portions of the Work.
 - i) Requested substitution provides specified warranty.
 - j) If requested substitution involves more than one contractor, requested substitution has been coordinated with other portions of the Work, is uniform and consistent, is compatible with other products, and is acceptable to all contractors involved.

PART 3 EXECUTION (NOT USED)

REQUEST FOR SUBSTITUTION

Contract Award Date:

To:

Substitution Requested By:

Project Name and Number:

We submit for consideration the following product in lieu of the specified item for the above Project:

Drawing No.	Specification Section	Paragraph	Specified Item
-------------	-----------------------	-----------	----------------

_____	_____	_____	_____
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Proposed Substitution:

Request is made during ____ bidding ____ construction period.

Submit in accordance with Section 01 33 00: Submittal Procedures.

1. Technical data, cost, and time information relating to changes to Construction Documents required by proposed substitution.
2. Detailed comparison of proposed substitution and specified product including but not limited to warranty, significant variations, qualifications of manufacturers, and maintenance.
3. Complete technical data, detailed shop drawings, samples, installation procedures, warranty, and substantiating data marked to indicate equivalent quality and performance to that specified. Manufacturer sell sheets are not acceptable submittals.

Cause for Request:

Cost saving realized by Owner:

Does substitution affect adjacent Work, Construction Documents, cost, schedule, quality, and related submittals?

Yes ____ No ____ On separate sheet, explain affects to the Work, documents, schedule, and submittals.

Contractor is responsible for associated costs and additional time of the proposed substitution including costs incurred by the Architect for evaluation of substitution and changes to the documents. Describe costs for changes to design, including engineering and detailing costs caused by the requested substitution.

Warranty: Is the warranty for the requested substitution the same or different? Yes ____ No ____

Explain Differences:

Contractor Certification:

In making a request for substitution, Contractor certifies that:

1. The proposed substitution has been thoroughly researched and evaluated and determined as equivalent or superior to specified product or material, will fit into space provided, and is compatible with adjacent materials.
2. It will provide the same or better warranty for the proposed substitution at no additional cost to the Owner.
3. Cost data is complete and includes related costs under the Contract. Claims for additional costs related to the proposed substitution that may subsequently become apparent are waived.
4. It will assume the responsibility for delays and costs caused by the proposed substitution, if approved, are accepted by Contractor unless delays are and costs are specifically mentioned and approved in writing by the Owner and the Architect.
5. It will assume the liability for the performance of the substitution and its performance.
6. The installation of the proposed substitution is coordinated with the Work and with changes required for the Work.
7. It will reimburse the Owner and Architect for evaluation and redesign services associated with the substitution request and, when required, by approval by governing authorities.

Submitted by:

Signature of Contractor

Title

Firm

Telephone

Date

Signature shall be by the individual authorized to legally bind Contractor to the above terms. Failure to provide legally binding signature will result in retraction of approval.

FOR USE BY ARCHITECT:

FOR USE BY OWNER:

____ Accepted

____ Accepted as Noted

____ Accepted ____ Not Accepted

____ Not Accepted

____ Received Too Late

By: _____

By: _____

Date: _____

By: _____

Remarks: _____

Remarks: _____

END OF SECTION 01 25 00

SECTION 01 31 00 PROJECT MANAGEMENT AND COORDINATION

PART 1 GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes:
 - 1. Administrative provisions for coordinating construction operations on Project including, but not limited to, the following:
 - a. General coordination procedures.
 - b. Coordination drawings.
 - c. Pre-installation meetings.
- B. Each contractor shall participate in coordination requirements. Certain areas of responsibility are assigned to a specific contractor.
- C. Contractor shall make a reasonable attempt to interpret the Contract Documents before asking the Architect for assistance in interpretation. Requests for Information (RFI) will not be allowed from Contractor. Contractor shall arrange the necessary meeting in the field with appropriate Architect's field representative(s) to obtain clarification as needed on items that may need interpretation.

1.3 SUBMITTALS

- A. Subcontract List:
 - 1. Prepare a written summary identifying individuals or firms proposed for each portion of the Work, including those who are to furnish products or equipment fabricated to a special design. Include the following information in tabular form:
 - a. Name, address, and telephone number of entity performing subcontract or supplying products.
 - b. Number and title of related Specification Section(s) covered by subcontract.
 - c. Drawing number and detail references, as appropriate, covered by subcontract.
- B. Key Personnel Names:
 - 1. 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 the duties and responsibilities; list address, telephone numbers (home, office, and cellular), and email addresses. Provide names, addresses, and telephone numbers of individuals assigned as alternates in the absence of individuals assigned to Project:
 - a. Post copies of list in Project meeting room, in temporary field office, and by each temporary telephone. Keep list current at all times.

1.4 COORDINATION PROCEDURES

- A. Coordinate construction operations to ensure efficient and orderly installation of each part of the Work. Coordinate construction operations 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 items as required notices, reports, and list of attendees at meetings:
1. Prepare similar memoranda for Owner and separate contractors if coordination of the Work is required.
- C. Administrative Procedures:
1. Coordinate scheduling and timing of required administrative procedures with other construction activities to avoid conflicts and to ensure orderly progress of the Work. Administrative activities include, but are not limited to, the following:
 - a. Preparation of Contractor's Construction Schedule.
 - b. Preparation of the schedule of values.
 - c. Installation and removal of temporary facilities and controls.
 - d. Delivery and processing of submittals.
 - e. Progress meetings.
 - f. Pre-installation conferences.
 - g. Project closeout activities.
 - h. Startup and adjustment of systems.
 - i. Coordinating inspections and other jurisdictional requirements.
 - j. Coordinate OFCI equipment.
 - k. Action items and issue logs.
- D. Conservation:
1. 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:
 - a. Salvage materials and equipment involved in performance of, but not actually incorporated into, the Work. Refer to the Specifications Sections for disposition of salvaged materials that are designated as Owner's property.

1.5 COORDINATION DRAWINGS

- A. Coordination Drawings, General:
1. 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:
 - a. Content:
 - 1) 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 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:

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, ductwork, piping, 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.
 - e. Floor boxes.
8. Fire protection system - Show the following:
 - a. Locations of standpipes, mains piping, branch lines, pipe drops, sprinkler heads, and inspector test locations.
9. IDF/MDF rooms: Communications and low voltage (security, data, phone, etc.) audio.
10. 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 so inform Contractor, who shall make changes as directed and resubmit.
11. Coordination drawing prints: Prepare coordination drawing prints according to requirements in Section 01 33 00: Submittal Procedures.

- C. Coordination Digital Data Files:
 - 1. Prepare coordination digital data files according to the following requirements:
 - a. File preparation format: Same digital data software program, version, and operating system as original Drawings.
 - b. File submittal format: Submit or post coordination drawing files using same format as file preparation.
 - c. BIM file incorporation:
 - 1) Develop and incorporate coordination drawing files into Building Information Model established for Project:
 - a) Perform three-dimensional component conflict analysis as part of preparation of coordination drawings. Resolve component conflicts prior to submittal. Indicate where conflict resolution requires modification of design requirements by Architect.
 - d. Architect will furnish Contractor one set of digital data files of Drawings for use in preparing coordination digital data files:
 - 1) Architect makes no representations as to the accuracy or completeness of digital data files as they relate to Drawings.
 - 2) Digital data software program: Drawings are available in Revit.
 - 3) Contractor shall execute a data licensing agreement in the form of AIA Document C106.

1.6 PROJECT MEETINGS

- A. Schedule and conduct meetings and conferences at Project site unless otherwise indicated:
 - 1. Attendees: Inform participants and others involved, and individuals whose presence is required, of date and time of each meeting. Notify Owner and Architect of scheduled meeting dates and times.
 - 2. Agenda: Architect to prepare the meeting agenda and distribute the agenda to all invited attendees.
 - 3. Minutes: Entity responsible for conducting meeting will record significant discussions and agreements achieved. Distribute the meeting minutes to everyone concerned, including Owner and Architect, within three days of the meeting.
 - 4. Action items: An element of work, design, research, or other task to be completed before a specific date or time, such as before a subsequent meeting of involved parties.
 - 5. Issue logs: Documentation element of software project management and contains a list of ongoing and closed issues of the Project.
- B. Kick-off and Preconstruction Conference:
 - 1. Architect will schedule and conduct a preconstruction conference before starting construction, at a time convenient to Owner and Architect:
 - a. Conduct the conference to review responsibilities and personnel assignments.
 - b. Attendees: Authorized representatives of Owner, Architect, and their consultants; Contractor and its superintendent; major subcontractors; suppliers; and other concerned parties shall attend the conference. Participants at the conference shall be familiar with the Project and authorized to conclude matters relating to the Work.
 - c. Agenda: Discuss items of significance that affect progress.
 - d. Minutes: Entity responsible for conducting meeting will record and distribute meeting minutes.
 - e. Action items: An element of work, design, research, or other task to be completed before a specific date or time, such as before a subsequent meeting of involved parties.
- C. Pre-Installation Conferences:
 - 1. Conduct a pre-installation trade conference at site before each construction activity

that requires coordination with other construction trades:

- a. Attendees: Installer and representatives of manufacturers and fabricators involved in or affected by the installation and its coordination or integration with other materials and installations that have preceded or will follow, shall attend the meeting. Advise Architect and Engineer of Record of scheduled meeting dates.
- b. Agenda: Contractor to review progress of other construction activities and preparations for the particular activity under consideration.
- c. Contractor to record significant conference discussions, agreements, and disagreements, including required corrective measures and actions.
- d. Reporting: Contractor to distribute minutes of the meeting to each party present and to other parties requiring information.
- e. Do not proceed with installation if the conference cannot be successfully concluded. Initiate whatever actions are necessary to resolve impediments to performance of the Work and reconvene the conference at earliest feasible date.
- f. Action items: An element of work, design, research, or other task to be completed before a specific date or time, such as before a subsequent meeting of involved parties.

D. Project Closeout Conference:

1. Schedule and conduct a Project closeout conference, at a time convenient to Owner and Architect, but no later than 90 days prior to the scheduled date of Substantial Completion:
 - a. Conduct the conference to review requirements and responsibilities related to Substantial Completion.
 - b. Attendees: Authorized representatives of Owner, Architect, and their consultants; Contractor and its superintendent; major subcontractors; suppliers; and other concerned parties shall attend the meeting. Participants at the meeting shall be familiar with the Project and authorized to conclude matters relating to the Work.
 - c. Agenda: Discuss items of significance that could affect or delay Project closeout.
 - d. Minutes: Entity conducting meeting will record and distribute meeting minutes.
 - e. Action items: An element of work, design, research, or other task to be completed before a specific date or time, such as before a subsequent meeting of involved parties.

E. Progress Meetings:

1. Conduct progress meetings at weekly intervals:
 - a. Coordinate dates of meetings with preparation of payment requests.
 - b. Attendees: In addition to representatives of Owner and Architect, each contractor, subcontractor, supplier, and other entity concerned with current progress or involved in planning, coordination, or performance of future activities shall be represented at these meetings. All participants at the meeting shall be familiar with the Project and authorized to conclude matters relating to the Work.
 - c. Agenda:
 - 1) Review and correct or approve minutes of previous progress meeting.
Review other items of significance that could affect progress. Include topics for discussion as appropriate to status of the Project:
 - a) Contractor's Construction Schedule: Review progress since the last meeting. Determine whether each activity is on time, ahead of schedule, or behind schedule, in relation to Contractor's Construction Schedule. Determine how construction behind schedule will be expedited; secure commitments from parties involved to do so. Discuss whether schedule revisions are required to ensure that current and subsequent activities will be completed within the Contract Time.
 - d. Minutes:
 - 1) Entity responsible for conducting the meeting will record and distribute the meeting minutes to each party present and to parties requiring information:

- a) Schedule updating: Revise Contractor's Construction Schedule after each progress meeting where revisions to the schedule have been made or recognized. Issue revised schedule concurrently with the report of each meeting.
 - b) Six (6) week look-ahead schedules. This may be altered to three (3) week look-ahead as part of an action item when Architect/District request:
 - i. Action items: An element of work, design, research, or other task to be completed before a specific date or time, such as before a subsequent meeting of involved parties.
- F. Coordination Meetings:
1. Conduct coordination meetings at weekly intervals. Project coordination meetings are in addition to specific meetings held for other purposes, such as progress meetings and pre-installation conferences:
 - a. Attendees: In addition to representatives of Owner and Architect, each contractor, subcontractor, supplier, and other entity concerned with current progress or involved in planning, coordination, or performance of future activities shall be represented at these meetings. All participants at the meetings shall be familiar with the Project and authorized to conclude matters relating to the Work.
 - b. Agenda:
 - 1) Review and correct or approve minutes of the previous coordination meeting. Review other items of significance that could affect progress. Include topics for discussion as appropriate to status of the Project:
 - a) Combined Contractor's Construction Schedule: Review progress since the last coordination meeting. Determine whether each contract is on time, ahead of schedule, or behind schedule, in relation to combined Contractor's Construction Schedule. Determine how construction behind schedule will be expedited; secure commitments from parties involved to do so. Discuss whether schedule revisions are required to ensure that current and subsequent activities will be completed within the Contract Time.
 - b) Schedule updating: Revise combined Contractor's Construction Schedule after each coordination meeting where revisions to the schedule have been made or recognized. Issue revised schedule concurrently with report of each meeting.
 - c) Review present and future needs of each contractor present.
 - c. Reporting: Record meeting results and distribute copies to everyone in attendance and to others affected by decisions or actions resulting from each meeting.
 - d. Action items: An element of work, design, research, or other task to be completed before a specific date or time, such as before a subsequent meeting of involved parties.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION (NOT USED)

END OF SECTION 01 31 00

SECTION 01 32 00 CONSTRUCTION PROGRESS DOCUMENTATION

PART 1 GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section includes administrative and procedural requirements for documenting the progress of construction during performance of the Work, including the following:
 1. Startup construction schedule.
 2. Contractor's Construction Schedule.
 3. Construction schedule updating reports.
 4. Daily construction reports.
 5. Material location reports.
 6. Site condition reports.
 7. Special reports.

1.3 DEFINITIONS

- A. Activity:
 1. A discrete part of a project that can be identified for planning, scheduling, monitoring, and controlling the construction project. Activities included in a construction schedule consume time and resources:
 - a. Critical activity: An activity on the critical path that must start and finish on the planned early start and finish times.
 - b. Predecessor activity: An activity that precedes another activity in the network.
 - c. Successor activity: An activity that follows another activity in the network.
- B. Cost Loading: The allocation of the schedule of values for the completion of an activity as scheduled. The sum of costs for all activities must equal the total Contract Sum unless otherwise approved by Architect.
- C. CPM: Critical path method, which is a method of planning and scheduling a construction project where activities are arranged based on activity relationships. Network calculations determine when activities can be performed and the critical path of the project.
- D. Critical Path: The longest connected chain of interdependent activities through the network schedule that establishes the minimum overall Project duration and contains no float.
- E. Float:
 1. The measure of leeway in starting and completing an activity:
 - a. Float time is not for the exclusive use or benefit of either Owner or Contractor, but is a jointly owned, expiring Project resource available to both parties as needed to meet schedule milestones and Contract completion date.
 - b. Free float is the amount of time an activity can be delayed without adversely affecting the early start of the successor activity.
 - c. Total float is the measure of leeway in starting or completing an activity without adversely affecting the planned Project completion date.
- F. Look-ahead Schedule: Schedule indicating activities scheduled to occur or commence prior

to submittal of next schedule update.

- G. Milestones: Measurable, observable, and serve as progress markers (flags) but, by definition, are independent of time (have zero durations); therefore, no Work or consumption of resources is associated with them.
- H. Recovery Schedule: Submittal of a revised CPM schedule and a written plan.
- I. Resource Loading: The allocation of manpower and equipment necessary for completion of an activity as scheduled.

1.4 SUBMITTALS

- A. Submittal Format:
 - 1. Submit required submittals in the following format:
 - a. Working electronic copy of schedule file, where indicated.
 - b. PDF electronic file.
- B. Startup Diagram: Of size necessary to display entire network for entire construction period. Show logic relationship ties for all activities.
- C. Contractor's Construction Schedule:
 - 1. Initial schedule, of size required to display entire schedule for entire construction period:
 - a. Submit a working electronic copy of schedule labeled to comply with requirements for submittals. Include type of schedule (initial or updated) and date on label.
- D. CPM Reports:
 - 1. Concurrent with CPM schedule, submit each of the following reports. Format for each activity in reports shall contain activity number, activity description, cost and resource loading, original duration, remaining duration, early start date, early finish date, late start date, late finish date, and total float in calendar days:
 - a. Activity Report: List of activities sorted by activity number and then early start date, or actual start date if known.
 - b. Logic Report: List of preceding and succeeding activities for all activities, sorted in ascending order by activity number and then early start date, or actual start date if known.
 - c. Total Float Report: List of all activities sorted in ascending order of total float.
 - d. Earnings Report: Compilation of Contractor's total earnings from commencement of the Work until most recent Application for Payment.
- E. Construction Schedule Updating Reports: Submit with Applications for Payment.
- F. Daily Construction Reports: Submit at monthly intervals.
- G. Material Location Reports: Submit at monthly intervals.
- H. Site Condition Reports: Submit at time of discovery of differing conditions.
- I. Special Reports: Submit at time of unusual event.

1.5 QUALITY ASSURANCE

- A. Pre-Scheduling Conference:
 - 1. Conduct conference at site. Review methods and procedures related to the preliminary

construction schedule and Contractor's Construction Schedule, including, but not limited to, the following:

- a. Review software limitations and content and format for reports.
 - b. Verify availability of qualified personnel needed to develop and update schedule.
 - c. Discuss constraints, including phasing, Work stages, area separations, interim milestones, and partial Owner occupancy.
 - d. Review delivery dates for Owner furnished products.
 - e. Review schedule for work of Owner's separate contracts, if any.
 - f. Review submittal requirements and procedures.
 - g. Review time required for review of submittals and resubmittals.
 - h. Review requirements for tests and inspections by independent testing and inspecting agencies.
 - i. Review time required for Project closeout and Owner startup procedures.
 - j. Review and finalize list of construction activities to be included in schedule.
 - k. Review procedures for updating schedule.
- B. Coordination:
1. Coordinate Contractor's Construction Schedule with the schedule of values, list of subcontracts, submittal schedule, progress reports, payment requests, and other required schedules and reports:
 - a. Secure time commitments for performing critical elements of the Work from entities involved.
 - b. Coordinate each construction activity in the network with other activities and schedule them in proper sequence.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION

3.1 CONTRACTOR'S CONSTRUCTION SCHEDULE

- A. Time is of the essence to Owner. Commence Work immediately upon issuance of the Notice to Proceed. There is a critical need for the Work to be substantially complete within the time frame identified in the Agreement.
- B. Time Frame:
1. Extend schedule from date established for commencement of the Work to date of Substantial Completion and date of final completion:
 - a. Contract completion date shall not be changed by submission of schedule that shows an early completion date, unless specifically authorized by Change Order.
- C. Activities:
1. Treat each separate area or story as a separate numbered activity for each main element of the Work. Comply with the following:
 - a. Activity duration: Define activities in terms of number of days anticipated.
 - b. Procurement activities: Include procurement process activities for long lead items and major items requiring a cycle of more than 60 days as separate activities in schedule. Procurement cycle activities include, but are not limited to, submittals, approvals, purchasing, fabrication, and delivery.
 - c. Submittal review time: Include review and resubmittal times indicated in Section 01 33 00: Submittal Procedures in schedule. Coordinate submittal review times in Contractor's Construction Schedule with submittal schedule.
 - d. Startup and testing time: Include number of days anticipated for startup and testing.
 - e. Substantial Completion: Indicate completion of all conditions as in advance of date

- established for Substantial Completion and allow time for Architect's administrative procedures necessary for certification of Substantial Completion.
- f. Punch list and final completion: Include a maximum of 30 days for completion of punch list items and final completion.
 - g. Inspections required by Authorities Having Jurisdiction (AHJ).
- D. Constraints:
1. Include constraints and Work restrictions indicated in the Contract Documents and show how the sequence of the Work is affected:
 - a. Work restrictions:
 - 1) Show the effect of the following items on the schedule:
 - a) Coordination with existing construction.
 - b) Limitations of continued occupancies.
 - c) Uninterruptible services.
 - d) Partial occupancy before Substantial Completion.
 - e) Use of premises restrictions.
 - f) Provisions for future construction.
 - g) Seasonal variations.
 - h) Environmental control.
 - i) Rain days as indicated in Section 01 10 00: Summary.
 - b. Work stages:
 - 1) Indicate important stages of construction for each major portion of the Work, including, but not limited to, the following:
 - a) Submittals.
 - b) Mockups.
 - c) Fabrication.
 - d) Installation.
 - e) Tests and inspections.
 - f) Adjusting.
 - g) Curing.
- E. Cost Correlation: Superimpose a cost correlation timeline, indicating planned and actual costs. On the line, show planned and actual dollar volume of the Work performed as of planned and actual dates used for preparation of payment requests.
- F. Three (3) Week Look-Ahead Schedule:
1. Prepare schedule indicating activities scheduled to occur or commence prior to submittal of next schedule update. Summarize the following issues:
 - a. Unresolved issues.
 - b. Unanswered Requests for Information.
 - c. Rejected or unreturned submittals.
 - d. Notations on returned submittals.
 - e. Pending modifications affecting the Work and Contract Time.
 - f. Inspections by AHJ.
 - g. Trade pre-installation conference.
- G. Recovery Schedule: When periodic update indicates the Work is 14 or more calendar days behind the current approved schedule, submit a separate recovery schedule indicating means by which Contractor intends to regain compliance with the schedule. Indicate changes to working hours, working days, crew sizes, and equipment required to achieve compliance, and date by which recovery will be accomplished.
- H. Computer Scheduling Software: Prepare schedules using current version of a program that has been developed specifically to manage construction schedules.
- I. Contract Modifications: For each proposed Contract modification and concurrent with its

submission, prepare a time impact analysis to demonstrate the effect of the proposed change on the overall Project schedule.

- J. Schedule Updating:
 - 1. Concurrent with making revisions to the schedule, prepare tabulated reports showing the following:
 - a. Identification of activities that have changed.
 - b. Changes in early and late start dates.
 - c. Changes in early and late finish dates.
 - d. Changes in activity durations in workdays.
 - e. Changes in the critical path.
 - f. Changes in total float or slack time.
 - g. Changes in Contract Time.

3.2 REPORTS

- A. Daily Construction Reports:
 - 1. Prepare a daily construction report recording information concerning events at the site and submit each month to Architect:
 - a. List of subcontractors at the Project site.
 - b. List of separate contractors at the Project site.
 - c. Approximate count of personnel at the Project site.
 - d. Rental equipment at the Project site.
 - e. Material deliveries.
 - f. High and low temperatures and general weather conditions, including presence of rain or snow.
 - g. Accidents.
 - h. Meetings and significant decisions.
 - i. Unusual events (see special reports).
 - j. Stoppages, delays, shortages, and losses.
 - k. Meter readings and similar recordings.
 - l. Emergency procedures.
 - m. Orders and requests of AHJ.
 - n. Change Orders received and implemented.
 - o. Construction Change Directives received and implemented.
 - p. Services connected and disconnected.
 - q. Equipment or system tests and startups.
 - r. Partial completions and occupancies.
 - s. Substantial Completions authorized.
- B. Material Location Reports:
 - 1. At monthly intervals, prepare and submit a comprehensive list of materials delivered to and stored at site. List shall be cumulative, showing materials previously reported plus items recently delivered. Include with list a statement of progress on and delivery dates for materials or items of equipment fabricated or stored away from the Project site. Indicate the following categories for stored materials:
 - a. Material stored prior to previous report and remaining in storage.
 - b. Material stored prior to previous report and since removed from storage and installed.
 - c. Material stored following previous report and remaining in storage.
- C. Site Condition Reports: Immediately on discovery of a difference between site conditions and the Contract Documents, prepare and submit a detailed report and contact Architect's field representative. Include a detailed description of the differing conditions, together with recommendations for changing the Contract Documents to Architect's field representative.

- D. Special Reports:
 - 1. Submit special reports directly to Owner within 24 hours of an occurrence. Distribute copies of report to parties affected by the occurrence:
 - a. Reporting unusual events: When an event of an unusual and significant nature occurs at site, whether or not related directly to the Work, prepare and submit a special report. List chain of events, persons participating, and response by Contractor's personnel, evaluation of results or effects, and similar pertinent information. Advise Owner and Architect in advance when these events are known or predictable.

3.3 CONTRACTOR'S CONSTRUCTION SCHEDULE

- A. Contractor's Construction Schedule Updating:
 - 1. At monthly intervals, update schedule to reflect actual construction progress and activities. Issue schedule with a pencil copy of pay application:
 - a. Revise schedule immediately after each meeting or other activity where revisions have been recognized or made. Issue updated schedule concurrently with the report of each such meeting.
 - b. Include a report with updated schedule that indicates every change, including, but not limited to, changes in logic, durations, actual starts and finishes, and activity durations.
 - c. As the Work progresses, indicate final completion percentage for each activity.
- B. Distribution:
 - 1. Distribute copies of approved schedule to Architect, Owner, separate contractors, testing and inspecting agencies, and interested parties identified by Contractor with a need-to-know schedule responsibility:
 - a. Post copies in Project meeting rooms and temporary field offices.
 - b. When revisions are made, distribute updated schedules to the same parties and post in the same locations. Delete parties from distribution when they have completed their assigned portion of the Work and are no longer involved in performance of construction activities.

END OF SECTION 01 32 00

SECTION 01 33 00 SUBMITTAL PROCEDURES

PART 1 GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes:
 - 1. Requirements for the submittal schedule and administrative and procedural requirements for submitting shop drawings, product data, samples, and other submittals.
- B. Related Section:
 - 1. Section 01 25 00: Substitution Procedures and Form.

1.3 DEFINITIONS

- A. File Transfer Protocol (FTP): Communications protocol that enables transfer of files to and from another computer over a network and that serves as the basis for standard Internet protocols. An FTP site is a portion of a network located outside of network firewalls within which internal and external users are able to access files.
- B. Portable Document Format (PDF): An open standard file format used for representing documents in a device and display resolution independent fixed layout document format.
- C. Submittals: Written and graphic information and physical samples that require Architect's responsive action, or are for information and do not require Architect's action.

1.4 SUBMITTALS

- A. 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 construction schedule. Include submittals required during the first 30 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. Submit revised submittal schedule to reflect changes in current status and timing for submittals.

1.5 SUBMITTAL ADMINISTRATIVE REQUIREMENTS

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

- a. Upon request, Architect will furnish Contractor one set of digital data drawing files of the Contract Drawings for use in preparing shop drawings and Project record drawings:
 - 1) Architect makes no representations as to the accuracy or completeness of digital data drawing files as they relate to the Contract Drawings.
 - 2) Digital drawing software program: The Contract Drawings are available in Revit.
 - 3) Contractor shall execute a data licensing agreement in the form of AIA Document C106, Digital Data Licensing Agreement.
 - 4) The following digital data files will be furnished for each appropriate discipline:
 - a) Floor plans.
 - b) Reflected ceiling plans.

- B. Coordination:
 - 1. Coordinate preparation and processing of submittals with performance of construction activities:
 - a. Coordinate each submittal with fabrication, purchasing, testing, delivery, other submittals, and related activities that require sequential activity.
 - b. Submit submittal items required for each Specification Section concurrently unless partial submittals for portions of the Work are indicated on approved submittal schedule.
 - c. Submit action submittals and informational submittals required by the same Specification Section as separate packages under separate transmittals.
 - d. Coordinate transmittal of different types of submittals for related parts of the Work so processing will not be delayed because of need to review submittals concurrently for coordination:
 - 1) Architect reserves the right to withhold action on a submittal requiring coordination with other submittals until related submittals are received.

- C. Processing Time:
 - 1. Allow time for submittal review, including time for resubmittals. Time for review shall commence on Architect's receipt of submittal. No extension of the Contract Time will be authorized because of failure to transmit submittals enough in advance of the Work to permit processing, including resubmittals:
 - a. Initial review: Allow 15 days for initial review of each submittal. Allow additional time if coordination with subsequent submittals is required. Architect will advise Contractor when a submittal being processed must be delayed for coordination.
 - b. Intermediate review: If intermediate submittal is necessary, process in same manner as initial submittal.
 - c. Resubmittal review: Allow 15 days for review of each resubmittal.
 - d. Sequential review: Where sequential review of submittals by Architect's consultants, Owner, or other parties is indicated, allow 21 days for initial review of each submittal.
 - e. Concurrent consultant review: Where the Contract Documents indicate that submittals may be transmitted simultaneously to Architect and to Architect's consultants, allow 15 days for review of each submittal. Submittal will be returned to Architect before being returned to Contractor.

- D. Electronic Submittals:
 - 1. Identify and incorporate information in each electronic submittal file:
 - a. 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.
 - b. Name file with submittal number or other unique identifier, including revision identifier:

- 1) File name shall use Project identifier and Specification Section number followed by a decimal point and then a sequential number (e.g., SLOHSM-06 10 00.01). Resubmittals shall include an alphabetic suffix after another decimal point (e.g., SLOHSM-06 10 00.01.A).
 - c. Provide means for insertion to permanently record Contractor's review and approval markings and action taken by Architect.
 - d. Transmittal form for electronic submittals:
 - 1) Use software generated form from electronic project management software acceptable to Owner, containing the following information:
 - a) Project name.
 - b) Date.
 - c) Name and address of Architect.
 - d) Name of Construction Manager.
 - e) Name of Contractor.
 - f) Name of firm or entity that prepared submittal.
 - g) Names of Subcontractor, manufacturer, and supplier.
 - h) Category and type of submittal.
 - i) Submittal purpose and description.
 - j) Specification Section number and title.
 - k) Specification paragraph number or Drawing designation and generic name for each of multiple items.
 - l) Drawing number and detail references, as appropriate.
 - m) Location(s) where product is to be installed, as appropriate.
 - n) Related physical samples submitted directly.
 - o) Indication of full or partial submittal.
 - p) Transmittal number, numbered consecutively.
 - q) Submittal and transmittal distribution record.
 - r) Other necessary identification.
 - s) Remarks.
 - e. Metadata:
 - 1) Include the following information as keywords in the electronic submittal file metadata:
 - a) Project name.
 - b) Number and title of appropriate Specification Section.
 - c) Manufacturer name.
 - d) Product name.
- E. Options: Identify options requiring selection by Architect.
- F. Deviations and Additional Information: On an attached separate sheet, prepared on Contractor's letterhead, record relevant information, requests for data, revisions other than those requested by Architect on previous submittals, and deviations from requirements in the Contract Documents, including minor variations and limitations. Include same identification information as related submittal.
- G. Resubmittals:
 1. Make resubmittals in same form and number of copies as initial submittal:
 - a. Note date and content of previous submittal.
 - b. Note date and content of revision in label or title block and clearly indicate extent of revision.
 - c. Resubmit submittals until they are marked with approval notation from Architect's action stamp.
- H. Distribution: Furnish copies of final submittals to manufacturers, subcontractors, suppliers, fabricators, installers, authorities having jurisdiction, and others as necessary for performance of construction activities. Show distribution on transmittal forms.

SUBMITTAL PROCEDURES

- I. Use for Construction: Retain complete copies of submittals on the Project site. Use only final action submittals that are marked with approval notation from Architect's action stamp.

PART 2 PRODUCTS

2.1 SUBMITTAL PROCEDURES

- A. Submittal Procedure Requirements:
 1. Prepare and submit submittals required by individual Specification Sections:
 - a. Submit electronic submittals via email as PDF electronic files:
 - 1) Architect will return annotated file. Annotate and retain one copy of file as an electronic Project record document file.
 - b. Submittals: Submit three (3) paper copies of each submittal unless otherwise indicated. Architect will return two (2) copies.
 - c. Certificates and certifications submittals:
 - 1) Provide statement that includes signature of entity responsible for preparing certification. Certificates and certifications shall be signed by an officer or other individual authorized to sign documents on behalf of that entity:
 - a) Provide a digital signature with digital certificate on electronically submitted certificates and certifications where indicated.
 - b) Provide a notarized statement on original paper copy certificates and certifications where indicated.
- B. Product Data:
 1. Collect information into a single submittal for each element of construction and type of product or equipment:
 - a. If information must be specially prepared for submittal because standard published data are not suitable for use, submit as shop drawings, not as product data.
 - b. Mark each copy of each submittal to show which products and options are applicable.
 - c. Include the following information, as applicable:
 - 1) Manufacturer's catalog cuts.
 - 2) Manufacturer's product specifications.
 - 3) Standard color charts.
 - 4) Statement of compliance with specified referenced standards.
 - 5) Testing by recognized testing agency.
 - 6) Application of testing agency labels and seals.
 - 7) Notation of coordination requirements.
 - 8) Availability and delivery time information.
 - d. For equipment, include the following in addition to the above, as applicable:
 - 1) Wiring diagrams showing factory installed wiring.
 - 2) Printed performance curves.
 - 3) Operational range diagrams.
 - 4) Clearances required to other construction, if not indicated on accompanying shop drawings.
 - e. Submit product data before or concurrent with samples.
 - f. Submit product data in PDF electronic file.
- C. Shop Drawings:
 1. Prepare Project specific information, drawn accurately to scale. Do not base shop drawings on reproductions of the Contract Documents or standard printed data:
 - a. Preparation:
 - 1) Fully illustrate requirements in the Contract Documents. Include the following information, as applicable:
 - a) Identification of products.

- b) Schedules.
 - c) Compliance with specified standards.
 - d) Notation of coordination requirements.
 - e) Notation of dimensions established by field measurement.
 - f) Relationship and attachment to adjoining construction clearly indicated.
 - g) Seal and signature of professional Engineer if specified.
- b. Sheet size: Except for templates, patterns, and similar full-size drawings, submit shop drawings on sheets size indicated in Specification Section.
 - c. Submit shop drawings in PDF electronic file.

D. Samples:

1. Submit samples for review of kind, color, pattern, and texture for a check of characteristics with other elements and for a comparison of these characteristics between submittal and actual component as delivered and installed:
 - a. Transmit samples that contain multiple related components, such as accessories, together in one submittal package.
 - b. Identification:
 - 1) Attach label on unexposed side of samples that includes the following:
 - a) Generic description of sample.
 - b) Product name and name of manufacturer.
 - c) Sample source.
 - d) Number and title of applicable Specification Section.
 - e) Specification paragraph number and generic name of each item.
 - c. For projects where electronic submittals are required, provide corresponding electronic submittal of sample transmittal, digital image file illustrating sample characteristics, and identification information for record:
 - 1) Disposition: Maintain sets of approved samples at the Project site, available for quality-control comparisons throughout the course of construction activity. Sample sets may be used to determine final acceptance of construction associated with each set.
 - 2) Samples that may be incorporated into the Work are indicated in individual Specification Sections. Such samples must be in an undamaged condition at time of use.
 - 3) Samples not incorporated into the Work, or otherwise designated as Owner's property, are the property of Contractor.
 - d. Submit full size units or samples of size indicated, prepared from same material to be used for the Work, cured and finished in manner specified, and physically identical with material or product proposed for use, and that show full range of color and texture variations expected. Samples include, but are not limited to, the following:
 - 1) Partial sections of manufactured or fabricated components.
 - 2) Small cuts or containers of materials.
 - 3) Complete units of repetitively used materials.
 - 4) Swatches showing color, texture, and pattern.
 - 5) Color range sets.
 - 6) Components used for independent testing and inspection:
 - a) Number of samples - Submit three (3) sets of samples. Architect will retain two (2) sample sets; remainder will be returned:
 - i. Submit a single sample where assembly details, workmanship, fabrication techniques, connections, operation, and other similar characteristics are to be demonstrated.
 - ii. If variation in color, pattern, texture, or other characteristic is inherent in material or product represented by a sample, submit at least three (3) sets of paired units that show approximate limits of variations.

E. Product Schedule:

1. As required in individual Specification Section, prepare a written summary indicating types of products required for the Work and their intended locations. Include the following information in tabular form:
 - a. Type of product. Include unique identifier for each product indicated in the Contract Documents or assigned by Contractor if none is indicated.
 - b. Manufacturer, product name, and model number if applicable.
 - c. Number and name of room or space.
 - d. Location within room or space.
 - e. Submit product schedule in PDF electronic file.

- F. Coordination Drawing Submittals: Comply with requirements specified in Section 01 31 00: Project Management and Coordination.

- G. Test and Inspection Reports and Schedule of Tests and Inspections Submittals: Comply with requirements specified in Section 01 45 23: Testing and Inspecting Services.

- H. Closeout Submittals required for Substantial Completion: Comply with requirements specified in Section 01 77 00: Closeout Procedures.

- I. Qualification Data: Prepare written information that demonstrates capabilities and experience of firm or person. Include lists of completed projects with project names and addresses, contact information of architects and owners, and other information specified.

- J. Welding Certificates: Prepare written certification that welding procedures and personnel comply with requirements in the Contract Documents. Submit record of Welding Procedure Specification and Procedure Qualification Record on AWS forms. Include names of firms and personnel certified.

- K. Installer Certificates: Submit written statements on manufacturer's letterhead certifying that the installer complies with requirements in the Contract Documents and, where required, is authorized by manufacturer for this specific Project.

- L. Manufacturer Certificates: Submit written statements on manufacturer's letterhead certifying that manufacturer complies with requirements in the Contract Documents. Include evidence of manufacturing experience where required.

- M. Product Certificates: Submit written statements on manufacturer's letterhead certifying that product complies with requirements in the Contract Documents.

- N. Material Certificates: Submit written statements on manufacturer's letterhead certifying that material complies with requirements in the Contract Documents.

- O. Material Test Reports: Submit reports written by a qualified testing agency, on testing agency's standard form, indicating and interpreting test results of material for compliance with requirements in the Contract Documents.

- P. Product Test Reports: Submit written reports indicating that current product produced by manufacturer complies with requirements in the Contract Documents. Base reports on evaluation of tests performed by manufacturer and witnessed by a qualified testing agency, or on comprehensive tests performed by a qualified testing agency.

- Q. Research Reports:
 1. Submit written evidence, from a model code organization acceptable to authorities having jurisdiction, that product complies with the building code in effect for the Project. Include the following information:

- a. Name of evaluation organization.
 - b. Date of evaluation.
 - c. Time period when report is in effect.
 - d. Product and manufacturers' names.
 - e. Description of product.
 - f. Test procedures and results.
 - g. Limitations of use.
- R. Pre-Construction Test Reports: Submit reports written by a qualified testing agency, on testing agency's standard form, indicating and interpreting results of tests performed before installation of product for compliance with performance requirements in the Contract Documents.
- S. Compatibility Test Reports: Submit reports written by a qualified testing agency, on testing agency's standard form, indicating and interpreting results of compatibility tests performed before installation of product. Include written recommendations for primers and substrate preparation needed for adhesion.
- T. Field Test Reports: Submit written reports indicating and interpreting results of field tests performed either during installation of product or after product is installed in its final location for compliance with requirements in the Contract Documents.
- U. Design Data: Prepare and submit written and graphic information, including, but not limited to, performance and design criteria, list of applicable codes and regulations, and calculations. Include list of assumptions and other performance and design criteria and a summary of loads. Include load diagrams if applicable. Provide name and version of software, if any, used for calculations. Include page numbers.

2.2 DELEGATED DESIGN SERVICES

- A. Performance and Design Criteria:
- 1. 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:
 - a. 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:
- 1. In addition to shop drawings, product data, and required submittals, submit digitally signed PDF electronic file and three (3) paper 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:
 - a. 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.

PART 3 EXECUTION

3.1 CONTRACTOR'S REVIEW

- A. Action and Informational Submittals: Review each submittal and check for coordination with other Work of the Contract and for compliance with the Contract Documents. Note corrections and field dimensions. Mark with approval stamp before submitting to Architect.
- B. Approval Stamp: Stamp each submittal with a uniform, approval stamp. Include Project

name and location, submittal number, Specification Section title and number, name of reviewer, date of Contractor's approval, and statement certifying that submittal has been reviewed, checked, and approved for compliance with the Contract Documents.

3.2 ARCHITECT'S ACTION

- A. Submittals: Architect will review each submittal, make marks to indicate corrections or revisions required, and return it. Architect will stamp each submittal with an action stamp and will mark stamp appropriately to indicate action.
- B. Partial submittals prepared for a portion of the Work will be reviewed when use of partial submittals has received prior approval from Architect.
- C. Incomplete submittals are not permitted, will be considered nonresponsive, and will be returned for resubmittal without review.
- D. Submittals not required by the Contract Documents will be returned by Architect without action.

END OF SECTION 01 33 00

SECTION 01 35 46 INDOOR AIR QUALITY PROCEDURES

PART 1 GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes:
 - 1. Construction procedures to promote adequate indoor air quality after construction.
 - 2. Testing indoor air quality after completion of construction.
- B. Reference Standards:
 - 1. ASHRAE Std 52.2 – Method of Testing General Ventilation Air-Cleaning Devices for Removal Efficiency by Particle Size.
 - 2. ASHRAE Std 62.1 – Ventilation For Acceptable Indoor Air Quality.
 - 3. ASHRAE Std 129 – Measuring Air-Change Effectiveness.
 - 4. ASTM E779 – Standard Test Method for Determining Air Leakage Rate by Fan Pressurization.
 - 5. SMACNA (OCC) – IAQ Guideline for Occupied Buildings Under Construction.
- C. Project Goals:
 - 1. Dust and airborne particulates:
 - a. Prevent deposition of dust and other particulates in HVAC ducts and equipment:
 - 1) Establish condition of existing ducts and equipment prior to start of alterations.
 - 2) Contractor shall bear the cost of cleaning required due to failure to protect ducts and equipment from construction dust.
 - 2. Airborne contaminants:
 - a. Procedures and products have been specified to minimize indoor air pollutants:
 - 1) Furnish products meeting the Specifications.
 - 2) Avoid construction practices that could result in contamination of installed products leading to indoor air pollution.
- D. Verification: HVAC system has been designed to achieve the minimum requirements for ventilation specified in ASHRAE 62.1, with verification provided by MEP Engineer of Record.

1.3 DEFINITIONS

- A. Adsorptive Materials: Gypsum board, acoustical ceiling tile and panels, carpet and carpet tile, fabrics fibrous insulation, and other similar products.
- B. Contaminants: Gases, vapors, regulated pollutants, airborne mold and mildew, and the like, as specified.
- C. Particulates: Dust, dirt, and other airborne solid matter.
- D. Wet Work: Concrete, plaster, coatings, and other products that emit water vapor or volatile organic compounds during installation, drying, or curing.

1.4 SUBMITTALS

- A. Submittals provided by Owner and/or the Commissioning Agent: To be reviewed by Contractor and submitted to Architect for processing.
- B. Indoor Air Quality Management Plan:
 - 1. Describe in detail measures to be taken to promote adequate indoor air quality upon completion; use SMACNA IAQ Guidelines for Occupied Buildings Under Construction as a guide (submit prior to pre-construction meeting):
 - a. Submit not less than 60 days before enclosure of building.
 - b. Identify potential sources of odor and dust.
 - c. Identify construction activities likely to produce odor or dust.
 - d. Identify areas of Project potentially affected, especially occupied areas.
 - e. Evaluate potential problems by severity and describe methods of control.
 - f. Describe construction ventilation to be provided, including type and duration of ventilation, use of permanent HVAC systems, types of filters, and schedule for replacement of filters.
 - g. Describe cleaning and dust control procedures.
 - h. Describe measures to be taken for protection of absorptive materials.
 - i. Outline requirement for filtration for air handling equipment used during construction to use media with a minimum of MERV 8 at each return grill if permanently installed air handlers are used during construction.
- C. Interior Finishes Installation Schedule: Identify each interior finish that either generates odors, moisture, or vapors, or is susceptible to adsorption of odors and vapors, and indicate air handling zone, sequence of application, and curing times.
- D. Duct and Terminal Unit Inspection Report.
- E. Air Contaminant Test Plan:
 - 1. Identify:
 - a. Testing agency qualifications.
 - b. Locations and scheduling of air sampling.
 - c. Test procedures, in detail.
 - d. Test instruments and apparatus.
 - e. Sampling methods.
- F. Air Contaminant Test Reports:
 - 1. Show:
 - a. Location where each sample was taken, and time.
 - b. Test values for each air sample; average the values of each set of three (3).
 - c. HVAC operating conditions.
 - d. Certification of test equipment calibration.
 - e. Other conditions or discrepancies that might have influenced results.
- G. Ventilation Effectiveness Test Plan:
 - 1. Identify:
 - a. Testing agency qualifications.
 - b. Description of test spaces, including locations or air sampling.
 - c. Test procedures, in detail; state whether tracer gas decay or step-up will be used.
 - d. Test instruments and apparatus; identify tracer gas to be used.
 - e. Sampling methods.
- H. Ventilation Effectiveness Test Reports:
 - 1. Include preliminary tests of instruments, apparatus, and test spaces.
 - 2. Calculation of ventilation effectiveness, E.

3. Location where each sample was taken, and time.
4. Test values for each air sample.
5. HVAC operating conditions.
6. Other information specified in ASHRAE 129.
7. Other conditions or discrepancies that might have influenced results.

PART 2 PRODUCTS

2.1 MATERIALS

- A. Low VOC Materials: See other Sections for specific requirements for materials with low VOC content.
- B. Auxiliary Air Filters: MERV of 8, minimum, when tested in accordance with ASHRAE 52.2.

PART 3 EXECUTION

3.1 CONSTRUCTION PROCEDURES

- A. Prevent the absorption of moisture and humidity by adsorptive materials:
 1. Sequence the delivery of such materials so that they are not present in the building until wet work is completed and dry.
 2. Deliver and store such materials in fully sealed moisture-impermeable packaging.
 3. Provide sufficient ventilation for drying within reasonable time frame.
- B. Begin construction ventilation when building is substantially enclosed.
- C. If extremely dusty or dirty, work must be conducted inside the building:
 1. Shut down HVAC systems for the duration.
 2. Remove dust and dirt completely before restarting systems.
- D. HVAC equipment and supply air ductwork may be used for ventilation during construction:
 1. Operate HVAC system on 100 percent outside air, with 1.5 air changes per hour, minimum.
 2. Ensure that air filters are correctly installed prior to starting use:
 - a. Replace filters when they lose efficiency (for corridor HVAC only).
 3. Do not use return air ductwork for ventilation.
 4. Seal return air inlets or otherwise positively isolate return air system to prevent recirculation of air:
 - a. Provide alternate return air pathways (for corridor HVAC only).
- E. Do not store construction materials or waste in mechanical or electrical rooms.
- F. Prior to use of return air ductwork without intake filters, clean up and remove dust and debris generated by construction activities:
 1. Inspect duct intakes, return air grilles, and terminal units for dust.
 2. Clean plenum spaces, including top sides of lay-in ceilings, outsides of ducts, tops of pipes, and conduit.
 3. Clean tops of doors and frames.
 4. Clean mechanical and electrical rooms, including tops of pipes, ducts, and conduit, equipment, and supports.
 5. Clean return plenums of air handling units.
 6. Remove intake filters last after cleaning is complete.

- G. Do not perform dusty or dirty work after starting use of return air ducts without intake filters.
- H. Use other relevant recommendations of SMACNA IAQ Guideline for Occupied Buildings Under Construction for avoiding unnecessary contamination due to construction procedures.

END OF SECTION 01 35 46

SECTION 01 40 00 QUALITY REQUIREMENTS

PART 1 GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section includes administrative and procedural requirements for quality assurance and quality control.
- B. Testing and inspecting services are required to verify compliance with requirements specified or indicated and paid by the District (or refer to Section 01 45 23: Testing and Inspecting Services). These services do not relieve Contractor of responsibility for compliance with the Contract Document requirements:
 - 1. Specific quality assurance and quality control requirements for individual construction activities are specified in the Sections that specify those activities. Requirements in those Sections may also cover production of standard products.
 - 2. Specified tests, inspections, and related actions do not limit Contractor's other quality assurance and quality control procedures that facilitate compliance with Contract Document requirements.
 - 3. Requirements for Contractor to provide quality assurance and quality control services required by Architect, Owner, or authorities having jurisdiction are not limited by provisions.
 - 4. Specific test and inspection requirements are not specified in this Section.

1.3 DEFINITIONS

- A. Experienced: When used with an entity or individual, experienced means having successfully completed a minimum of five (5) years' documented experience with projects similar in nature, size, and extent; being familiar with special requirements indicated; and having complied with requirements of authorities having jurisdiction.
- B. Field Quality Control Testing: Tests and inspections performed onsite for installation of the Work and for completed Work.
- C. Installer/Applicator/Erector:
 - 1. Contractor or another entity engaged by Contractor as an employee, Subcontractor, or Sub-subcontractor, to perform particular construction operations, including installation, erection, application, and similar operations:
 - a. Use of trade specific terminology in referring to a trade or entity does not require that certain construction activities be performed by accredited or unionized individuals, or that requirements specified apply exclusively to specific trade(s).
- D. Mockups:
 - 1. Full size physical assemblies that are constructed onsite. Mockups are constructed to verify selections made under sample submittals; to demonstrate aesthetic effects and, where indicated, qualities of materials and execution; to review coordination, testing, or operation; to show interface between dissimilar materials; and to demonstrate compliance with specified installation tolerances. Mockups are not samples. Unless otherwise indicated, approved mockups establish the standard by which the Work will

be judged:

- a. Laboratory mockups: Full size physical assemblies constructed at testing facility to verify performance characteristics.
 - b. Integrated exterior mockups: Mockups of exterior envelope erected separately from the building but on the Project site, consisting of multiple products, assemblies, and subassemblies.
 - c. Room mockups: Mockups of typical interior spaces complete with wall, floor, and ceiling finishes, doors, windows, millwork, casework, specialties, furnishings and equipment, and lighting.
- E. Pre-Construction Testing: Tests and inspections performed specifically for the Project before products and materials are incorporated into the Work, to verify performance or compliance with specified criteria.
- F. Product Testing: Tests and inspections that are performed by an NRTL, an NVLAP, or a testing agency qualified to conduct product testing and acceptable to authorities having jurisdiction, to establish product performance and compliance with specified requirements.
- G. Quality Assurance Services: Activities, actions, and procedures performed before and during execution of the Work to guard against defects and deficiencies and substantiate that proposed construction will comply with requirements.
- H. Quality Control Services: Tests, inspections, procedures, and related actions during and after execution of the Work to evaluate that actual products incorporated into the Work and completed construction comply with requirements. Services do not include Contract enforcement activities performed by Architect.
- I. Source Quality Control Testing: Tests and inspections that are performed at the source, e.g., plant, mill, factory, or shop.
- J. Testing Agency: An entity engaged to perform specific tests, inspections, or both. Testing laboratory shall mean the same as testing agency.

1.4 CONFLICTING REQUIREMENTS

- A. Referenced Standards: If compliance with two (2) or more standards is specified and the standards establish different or conflicting requirements for minimum quantities or quality levels, comply with the most stringent requirement. Refer conflicting requirements that are different, but apparently equal, to Architect for a decision before proceeding.
- B. Minimum Quantity or Quality Levels: The quantity or quality level shown or specified shall be the minimum provided or performed. The actual installation may comply exactly with the minimum quantity or quality specified, or it may exceed the minimum within reasonable limits. To comply with these requirements, indicated numeric values are minimum or maximum, as appropriate, for the context of requirements. Refer uncertainties to Architect for a decision before proceeding.

1.5 SUBMITTALS

- A. Shop Drawings:
1. Submit Plans, Sections, and elevations, indicating materials and size of mockup construction:
 - a. Indicate manufacturer and model number of individual components.
 - b. Provide axonometric drawings for conditions difficult to illustrate in two dimensions.

- B. Contractor's Statement of Responsibility:
 - 1. When required by authorities having jurisdiction, submit copy of written statement of responsibility sent to authorities having jurisdiction before starting work on the following systems:
 - a. Seismic force resisting system, designated seismic system, or component listed in the designated seismic system quality assurance plan prepared by Architect.
 - b. Main wind force resisting system or wind resisting component listed in the wind force resisting system quality assurance plan prepared by Architect.

- C. Schedule of Tests and Inspections:
 - 1. Prepare in tabular form and include the following:
 - a. Specification Section number and title.
 - b. Entity responsible for performing tests and inspections.
 - c. Description of test and inspection.
 - d. Identification of applicable standards.
 - e. Identification of test and inspection methods.
 - f. Number of tests and inspections required.
 - g. Time schedule or time span for tests and inspections.
 - h. Requirements for obtaining samples.
 - i. Unique characteristics of each quality control service.

1.6 REPORTS AND DOCUMENTS

- A. Test and Inspection Reports:
 - 1. Prepare and submit certified written reports specified. Include the following:
 - a. Date of issue.
 - b. Project title and number.
 - c. Name, address, and telephone number of testing agency.
 - d. Dates and locations of samples and tests or inspections.
 - e. Names of individuals making tests and inspections.
 - f. Description of the Work and test and inspection method.
 - g. Identification of product and Specification Section.
 - h. Complete test or inspection data.
 - i. Test and inspection results and an interpretation of test results.
 - j. Record of temperature and weather conditions at time of sample taking and testing and inspecting.
 - k. Comments or professional opinion on whether tested or inspected Work complies with the Contract Document requirements.
 - l. Name and signature of laboratory inspector.
 - m. Recommendations on retesting and reinspecting.

- B. Manufacturer's Technical Representative's Field Reports:
 - 1. Prepare written information documenting manufacturer's technical representative's tests and inspections specified in other Sections. Include the following:
 - a. Name, address, and telephone number of technical representative making report.
 - b. Statement on condition of substrates and their acceptability for installation of product.
 - c. Statement that products at site comply with requirements.
 - d. Summary of installation procedures being followed, whether they comply with requirements and, if not, what corrective action was taken.
 - e. Results of operational and other tests and a statement of whether observed performance complies with requirements.
 - f. Statement whether conditions, products, and installation will affect warranty.
 - g. Other required items indicated in individual Specification Sections.

- C. Factory Authorized Service Representative's Reports:

1. Prepare written information documenting manufacturer's factory authorized service representative's tests and inspections specified in other Sections. Include the following:
 - a. Name, address, and telephone number of factory authorized service representative making report.
 - b. Statement that equipment complies with requirements.
 - c. Results of operational and other tests and a statement of whether observed performance complies with requirements.
 - d. Statement whether conditions, products, and installation will affect warranty.
 - e. Other required items indicated in individual Specification Sections.

- D. Permits, Licenses, and Certificates: For Owner's records, submit copies of permits, licenses, certifications, inspection reports, releases, jurisdictional settlements, notices, receipts for fee payments, judgments, correspondence, records, and similar documents, established for compliance with standards and regulations bearing on performance of the Work.

- E. Trade Pre-Installation Conferences: Meeting minutes to be Contractor provided.

1.7 QUALITY ASSURANCE

- A. Qualifications establish the minimum qualification levels required; refer to individual Specification Sections for additional requirements.

- B. Manufacturer Qualifications: A firm experienced in manufacturing products or systems similar to those indicated and sufficient production capacity to produce required units.

- C. Fabricator Qualifications: A firm experienced in producing products similar to those indicated and with record of successful in-service performance, as well as sufficient production capacity to produce required units.

- D. Installer Qualifications: A firm or individual experienced in installing, erecting, or assembling work similar in material, design, and extent to that indicated for this Project, whose work has resulted in construction with a record of successful in-service performance.

- E. Professional Engineer Qualifications: A professional engineer who is legally qualified to practice in the State of California and is experienced in providing engineering services of the kind indicated. Engineering services are defined as those performed for installations of the system, assembly, or product that are similar in material, design, and extent to those indicated.

- F. Specialists:
 1. Certain Specification Sections require that specific construction activities shall be performed by entities who are recognized experts in those operations. Specialists shall satisfy qualification requirements indicated and shall be engaged for the activities indicated:
 - a. Requirements of authorities having jurisdiction supersede requirements for specialists.

- G. Testing Agency Qualifications:
 1. A NRTL, a NVLAP, or an independent agency with the experience and capability to conduct testing and inspecting indicated, documented according to ASTM E329; with additional qualifications specified in individual Sections; and, where required by authorities having jurisdiction, that is acceptable to authorities:
 - a. NRTL: A nationally recognized testing laboratory according to 29 CFR 1910.7.
 - b. NVLAP: A testing agency accredited according to NIST's National Voluntary Laboratory Accreditation Program.

- H. Manufacturer's Technical Representative Qualifications: An authorized representative of the manufacturer who is trained and approved by the manufacturer to observe and inspect installation of the manufacturer's products.
- I. Factory Authorized Service Representative Qualifications: An authorized representative of the manufacturer who is trained and approved by the manufacturer to inspect installation of the manufacturer's products.
- J. Pre-Construction Testing:
 - 1. Where testing agency is indicated to perform pre-construction testing for compliance with specified requirements for performance and test methods, comply with the following:
 - a. Contractor responsibilities include the following:
 - 1) Provide test specimens representative of proposed products and construction.
 - 2) Submit specimens with sufficient time for testing and analyzing results to prevent delaying the Work.
 - 3) Provide sizes and configurations of test assemblies, mockups, and laboratory mockups to adequately demonstrate capability of products to comply with performance requirements.
 - 4) Build site assembled test assemblies and mockups using installers who will perform same tasks for the Project.
 - 5) Build laboratory mockups at testing facility using personnel, products, and methods of construction indicated for the completed Work.
 - 6) When testing is complete, remove test specimens, assemblies, mockups, and laboratory mockups; do not reuse products on the Project.
 - 2. Testing agency responsibilities: Submit certified written report of each test, inspection, and similar quality assurance service to Architect, with copy to Contractor. Interpret tests and inspections and state in each report whether tested and inspected Work complies with or deviates from the Contract Documents.
- K. Mockups:
 - 1. Before installing portions of the Work requiring mockups, build mockups for each form of construction and finish required to comply with the following requirements, using materials indicated for the completed Work:
 - a. Build mockups in location and of size indicated, or if not indicated, as directed by Architect.
 - b. Notify Architect a minimum of seven (7) days in advance of dates and times when mockups will be constructed.
 - c. Employ supervisory personnel who will oversee mockup construction. Employ workers that will be employed during the construction.
 - d. Demonstrate the proposed range of aesthetic effects and workmanship.
 - e. Obtain Architect's approval of mockups before starting Work, fabrication, or construction. Allow seven (7) days for initial review and each re-review of each mockup.
 - f. Maintain mockups during construction in an undisturbed condition as a standard for judging the completed Work.
 - g. Demolish and remove mockups when directed unless otherwise indicated.
- L. Integrated Exterior Mockups: Mockup of the exterior envelope erected separately from the building but on the Project site, consisting of multiple products, assemblies, and subassemblies. Mockup, if not specifically shown on the Drawings, shall be minimum eight feet by eight feet (8'x8'). Mockup shall include all major façade elements and at least one (1) window a minimum of two feet by two feet (2'x2') in size. Prior to constructing mockup, verify requirements with Architect. Pre-installation conferences for trades involved in integrated exterior mockup shall be held after mockup is completed.

- M. Laboratory Mockups: Comply with requirements of pre-construction testing and those specified in individual Specification Sections.
- N. Trade Pre-Installation Conferences: Meeting minutes to be Contractor provided.

1.8 QUALITY CONTROL

- A. Owner Responsibilities:
 - 1. Where quality control services are indicated as Owner's responsibility, Owner will engage a qualified testing agency to perform the services:
 - a. Owner will furnish Contractor with names, addresses, and telephone numbers of testing agencies engaged and a description of types of testing and inspecting they are engaged to perform.
 - b. Costs for retesting and re-inspecting construction that replaces or is necessitated by Work that failed to comply with the Contract Documents will be charged to Contractor, and the Contract Sum will be adjusted by Change Order.
- B. Contractor Responsibilities:
 - 1. Tests and inspections not explicitly assigned to Owner are Contractor's responsibility. Perform additional quality control activities required to verify that the Work complies with requirements, whether specified or not:
 - a. Unless otherwise indicated, provide quality control services specified and those required by authorities having jurisdiction. Perform quality control services required of Contractor by authorities having jurisdiction, whether specified or not.
 - b. Where services are indicated as Contractor's responsibility, engage a qualified testing agency to perform the quality control services. Contractor shall not employ same entity engaged by Owner, unless agreed to in writing by Owner.
 - c. Notify testing agencies at least 24 hours in advance of time when Work that requires testing or inspecting will be performed.
 - d. Where quality control services are indicated as Contractor's responsibility, submit a certified written report, in duplicate, of each quality control service.
 - e. Testing and inspecting requested by Contractor and not required by the Contract Documents are Contractor's responsibility.
 - f. Submit additional copies of each written report directly to authorities having jurisdiction when they so direct.
 - g. Provide documentation for construction safety as required by CBC Chapter 33 and CFC Chapter 33. Show representation for construction safeguards through the life of the Project.
- C. Manufacturer's Field Services: Where indicated, engage a factory authorized service representative to inspect field assembled components and equipment installation, including service connections. Report results in writing as specified in Section 01 33 00: Submittal Procedures.
- D. Manufacturer's Technical Services: Where indicated, engage a manufacturer's technical representative to observe and inspect the Work. Manufacturer's technical representative's services include participation in pre-installation conferences, examination of substrates and conditions, verification of materials, observation of installer activities, inspection of completed portions of the Work, and submittal of written reports.
- E. Retesting/Re-Inspecting: Regardless of whether original tests or inspections were Contractor's responsibility, provide quality control services, including retesting and re-inspecting, for construction that replaced Work that failed to comply with the Contract Documents.
- F. Testing Agency Responsibilities:

1. Cooperate with Architect and Contractor in performance of duties. Provide qualified personnel to perform required tests and inspections:
 - a. Notify Architect and Contractor promptly of irregularities or deficiencies observed in the Work during performance of its services.
 - b. Determine the location from which test samples will be taken and in which in-situ tests are conducted.
 - c. Conduct and interpret tests and inspections and state in each report whether tested and inspected Work complies with or deviates from requirements.
 - d. Submit a certified written report, in duplicate, of each test, inspection, and similar quality control service through Contractor.
 - e. Do not release, revoke, alter, or increase the Contract Document requirements or approve or accept any portion of the Work.
 - f. Do not perform any duties of Contractor.

- G. Associated Services:
 1. Cooperate with agencies performing required tests, inspections, and similar quality control services, and provide reasonable auxiliary services as requested. Notify agency sufficiently in advance of operations to permit assignment of personnel. Provide the following:
 - a. Access to the Work.
 - b. Incidental labor and facilities necessary to facilitate tests and inspections.
 - c. Adequate quantities of representative samples of materials that require testing and inspecting. Assist agency in obtaining samples.
 - d. Facilities for storage and field curing of test samples.
 - e. Delivery of samples to testing agencies.
 - f. Preliminary design mix proposed for use for material mixes that require control by testing agency.
 - g. Security and protection for samples and for testing and inspecting equipment at the Project site.

- H. Coordination:
 1. Coordinate sequence of activities to accommodate required quality assurance and quality control services with a minimum of delay and to avoid necessity of removing and replacing construction to accommodate testing and inspecting:
 - a. Schedule times for tests, inspections, obtaining samples, and similar activities.

- I. Schedule of Tests and Inspections:
 1. Prepare a schedule of tests, inspections, and similar quality control services required by the Contract Documents. Coordinate and submit concurrently with Contractor's Construction Schedule. Update as the Work progresses:
 - a. Distribution: Distribute schedule to Owner, Architect, testing agencies, and each party involved in performance of portions of the Work where tests and inspections are required.

1.9 SPECIAL TESTS AND INSPECTIONS

- A. Special Tests and Inspections:
 1. Owner will engage a qualified testing agency or special inspector to conduct special tests and inspections, as required by authorities having jurisdiction, as the responsibility of Owner, and as indicated in individual Specification Sections:
 - a. Verifying that manufacturer maintains detailed fabrication and quality control procedures, and reviews the completeness and adequacy of those procedures to perform the Work.
 - b. Notifying Architect and Contractor promptly of irregularities and deficiencies observed in the Work during performance of its services.
 - c. Submitting a certified written report of each test, inspection, and similar quality

control service to Architect with copy to Contractor and to authorities having jurisdiction.

- d. Submitting a final report of special tests and inspections at Substantial Completion, which includes a list of unresolved deficiencies.
- e. Interpreting tests and inspections and stating in each report whether tested and inspected Work complies with or deviates from the Contract Documents.
- f. Retesting and re-inspecting corrected Work.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION

3.1 TEST AND INSPECTION LOG

- A. Test and Inspection Log:
 1. Prepare a record of tests and inspections. Include the following:
 - a. Date test or inspection was conducted.
 - b. Description of the Work tested or inspected.
 - c. Date test or inspection results were transmitted to Architect.
 - d. Identification of testing agency or special inspector conducting test or inspection.
- B. Maintain log at site. Post changes and revisions as they occur. Provide access to test and inspection log for Architect's reference during normal working hours.

3.2 REPAIR AND PROTECTION

- A. 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.
- B. Protect construction exposed by or for quality control service activities.
- C. Repair and protection are Contractor's responsibility, regardless of the assignment of responsibility for quality control services.

END OF SECTION 01 40 00

SECTION 01 45 23 TESTING AND INSPECTING SERVICES

PART 1 GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section includes requirements and qualifications including but not limited to:
 - 1. Professional testing and laboratory services.
 - 2. Accessories necessary for the completion of testing and laboratory services.
- B. Testing and inspecting services are required to verify compliance with requirements specified or indicated. These services do not relieve Contractor of responsibility for compliance with the Contract Document requirements:
 - 1. Specific quality assurance and quality control requirements for individual construction activities are specified in the Sections that specify those activities. Requirements in those Sections may also cover production of standard products.
 - 2. Specified tests, inspections, and related actions do not limit Contractor's other quality assurance and quality control procedures that facilitate compliance with Contract Document requirements.
 - 3. Requirements for Contractor to provide quality assurance and quality control services required by Architect, Owner, or authorities having jurisdiction are not limited by provisions.
 - 4. Specific test and inspection requirements are not specified in this Section.
- C. A Qualified Independent Testing Laboratory and/or Geotechnical Engineering Service Selected and Paid by Owner:
 - 1. Owner will pay for the initial laboratory services of materials that comply with the requirements of the Contract Documents. Contractor shall pay for testing and retesting of materials that do not comply with the requirements of the Contract Documents.
- D. Inspecting agency shall perform inspections and tests in accordance with the rules and regulations of the building code, local authorities, specifications of ASTM, and the Contract Documents.
- E. Materials and workmanship found not in compliance with required standards or performance obligations shall be removed and replaced. Replacement and subsequent testing shall be at Contractor's expense.
- F. Where terms "Inspector" and "Laboratory" are used, it is meant and in reference to an officially designated and accredited inspector of the testing laboratory or geotechnical service engaged by Owner.
- G. Laboratory inspections shall not relieve Contractor or fabricator of his responsibility to furnish materials and workmanship in accordance with the Contract Documents.
- H. Contractor or fabricator shall cooperate with the testing laboratory in matters pertaining to the Work.
- I. Contractor to address deficiency and failed reports.

1.3 SUBMITTALS

- A. Schedule of Tests and Inspections:
 - 1. Prepare a schedule of tests, inspections, and similar quality control services required by the Contract Documents. Coordinate and submit concurrently with Contractor's Construction Schedule. Update as the Work progresses:
 - a. Prepare in tabular form and include the following:
 - 1) Specification Section number and title.
 - 2) Entity responsible for performing test and inspection.
 - 3) Description of test and inspection.
 - 4) Identification of applicable standards.
 - 5) Identification of test and inspection methods.
 - 6) Number of tests and inspections required.
 - 7) Time schedule or time span for tests and inspections.
 - 8) Requirements for obtaining samples.
 - 9) Unique characteristics of each quality control service.
- B. Test and Inspection Reports:
 - 1. Prepare and submit certified written reports specified. Include the following:
 - a. Date of issue.
 - b. Project title and number.
 - c. Name, address, and telephone number of testing agency.
 - d. Dates and locations of samples and tests or inspections.
 - e. Names of individuals making tests and inspections.
 - f. Description of the Work and test and inspection method.
 - g. Identification of product and Specification Section.
 - h. Complete test or inspection data.
 - i. Test and inspection results and an interpretation of test results.
 - j. Record of temperature and weather conditions at time of sample taking and testing and inspecting.
 - k. Comments or professional opinion on whether tested or inspected Work complies with the Contract Document requirements.
 - l. Name and signature of laboratory inspector.
 - m. Recommendations on retesting and re-inspecting.
- C. Submit copies of reports of each inspection and test:
 - 1. Owner, program or project manager, Architect, and each engineer or outside consultants regarding their particular phase of the Project: One (1) copy each.
 - 2. Construction Manager (CM) and Contractor: Two (2) copies each.
- D. In addition to furnishing a written report, notify the CM and Contractor verbally of uncorrected conditions or failures to comply with requirements of the Contract Documents, and immediately fax and email corresponding report to Architect and the engineer.
- E. At completion of each trade or branch of Work requiring inspecting and testing, submit a final certificate attesting to satisfactory completion of Work.
- F. Report full compliance with requirements of the Contract Documents.
- G. Submit copies of test results sealed by a registered engineer to municipal authorities having jurisdiction, as required.

1.4 QUALITY ASSURANCE

- A. Testing Agency Qualifications:

1. The 2019 California Administrative Code (Title 24, Part 1) describes the general administrative requirements for the Project under the jurisdiction of the Division of the State Architect (DSA). These provisions require that a structural test for construction projects under DSA jurisdiction be performed by testing laboratories acceptable to DSA. DSA administers the Laboratory Evaluation and Acceptance Program to evaluate laboratories for structural testing and special inspection services. A NRTL, a NVLAP, or an independent agency with the experience and capability to conduct testing and inspecting indicated, documented according to ASTM E329 and ASTM E534, and with additional qualifications specified in individual Sections:
 - a. NRTL: A Nationally Recognized Testing Laboratory according to 29 CFR 1910.7.
 - b. NVLAP: A testing agency accredited according to NIST's National Voluntary Laboratory Accreditation Program.
 - c. Laboratory Evaluation and Acceptance program to evaluate laboratories acceptable to DSA.
 - d. Testing agencies shall be insured against errors and omissions by a professional liability insurance policy having a minimum limit of liability of \$500,000.00.
- B. Inspection and testing services for the testing agency shall be under the direction of a California Registered Engineer, charged with engineering managerial responsibility, and having a minimum of five (5) years' engineering experience in inspection and testing of construction materials.
- C. Concrete Inspectors: Inspecting personnel monitoring concrete work shall be ACI certified inspectors.
- D. Structural Steel:
 1. Primary inspectors performing structural steel inspection shall be currently certified AWS Certified Welding Inspectors (CWI), in accordance with the provisions of AWS QCI, *Standard and Guide for Qualification and Certification of Welding Inspectors*:
 - a. Inspector may be supported by assistant inspectors who perform specific inspection functions under the direct supervision of the primary inspector. Assistant inspectors shall be currently certified AWS Certified Associate Welding Inspectors (CAWI). Work of assistant inspectors shall be monitored daily by the inspector.
- E. Testing Equipment: Equipment shall be calibrated at intervals not exceeding 12 months by devices of accuracy traceable to the National Bureau of Standards.
- F. Referenced Standards: Latest adopted edition of standards referenced apply to the Work. In the event of conflict between the Contract Documents and referenced standards, the Contract Documents shall govern. In case of conflict between Contract Documents and the California Building Code, the more stringent shall govern.
- G. Owner Responsibilities:
 1. Where quality control services are indicated as Owner's responsibility, Owner will engage a qualified testing agency to perform the services:
 - a. Owner will furnish Contractor with names, addresses, and telephone numbers of testing agencies engaged and a description of types of testing and inspecting they are engaged to perform.
 - b. Costs for retesting and re-inspecting construction that replaces or is necessitated by Work that failed to comply with the Contract Documents will be charged to Contractor, and the Contract Sum will be adjusted by Change Order.
- H. Contractor Responsibilities:
 1. Tests and inspections not explicitly assigned to Owner are Contractor's responsibility. Perform additional quality control activities required to verify that the Work complies with requirements, whether specified or not:

- a. Refer to individual Specification Sections for specific requirements.
- b. Unless otherwise indicated, provide quality control services specified and those required by authorities having jurisdiction. Perform quality control services required of Contractor by authorities having jurisdiction, whether specified or not.
- c. Where services are indicated as Contractor's responsibility, engage a qualified testing agency to perform the quality control services. Contractor shall not employ same entity engaged by Owner, unless agreed to in writing by Owner.
- d. Notify testing agencies at least 24 hours in advance of time when Work that requires testing or inspecting will be performed.
- e. Where quality control services are indicated as Contractor's responsibility, submit a certified written report, in duplicate, of each quality control service.
- f. Testing and inspecting requested by Contractor and not required by the Contract Documents are Contractor's responsibility.
- g. Submit additional copies of each written report directly to authorities having jurisdiction when they so direct.
- h. Associated responsibilities and services - Cooperate with agencies performing required tests, inspections, and similar quality control services, and provide reasonable auxiliary services as requested. Notify agency sufficiently in advance of operations to permit assignment of personnel:
 - 1) Provide the following:
 - a) Provide access to the Work.
 - b) Deliver of samples to testing laboratory, without cost to Owner, in adequate quantities of representative samples of materials that require testing and inspecting. Assist agency in obtaining samples.
 - c) Advise laboratory and Architect sufficiently in advance of construction operations to allow laboratory to complete required inspections or tests and to assign personnel for field inspection and testing as specified.
 - d) Provide facilities for storage and curing of concrete test samples on site for the first 24 hours and for subsequent field curing required by ASTM C31.
 - e) Incidental labor, facilities, and equipment necessary to assist laboratory personnel in obtaining and handling samples at the site.
 - f) Preliminary design mix proposed for use for material mixes that require control by testing agency.
 - g) Provide concrete mix designs in accordance with ACI 301 made by an independent testing laboratory or qualified concrete supplier. Where mix designs by an independent testing laboratory are required, select and pay for laboratory.
 - h) Obtain required inspections or approvals of the building official. Inspection requests and notifications required by building code are responsibility of Contractor.
 - i) Provide current welder certificates for each welder employed.
 - j) Provide fabrication and erection inspection and testing of welds in accordance with AWS D1.1, Chapter 6.
 - k) Use prequalification of welding procedures in executing the Work.
 - l) Security and protection for samples and for testing and inspecting equipment at the Project site.
 - i. Retesting/re-inspecting: Regardless of payment responsibility of the original tests or inspections, provide quality control services, including retesting and re-inspecting, for construction that replaced Work failing to comply with the Contract Documents, code requirements, or what is required from DSA.

I. Testing Agency Responsibilities:

- 1. Cooperate with Architect and Contractor in performance of duties. Provide qualified personnel to perform required tests and inspections:
 - a. Notify Architect and Contractor promptly of irregularities or deficiencies observed in

- the Work during performance of its services.
 - b. Determine the location from which test samples will be taken and in which in-situ tests are conducted.
 - c. Conduct and interpret tests and inspections and state in each report whether tested and inspected Work complies with or deviates from requirements.
 - d. Submit a certified written report, in duplicate, of each test, inspection, and similar quality control service through Contractor.
 - e. Do not release, revoke, alter, or increase the Contract Document requirements or approve or accept any portion of the Work.
 - f. Do not perform any duties of Contractor.

- J. Authority and Duties of Laboratory Personnel:
 - 1. A representative of the testing laboratory, who has reviewed and is familiar with the Project and Specifications, shall participate in pre-construction conferences. The representative shall coordinate material testing and inspection requirements with Contractor and its subcontractors consistent with the planned construction schedule. The laboratory representative shall attend conferences required or requested to address quality control issues.
 - 2. Laboratory personnel shall inspect and test materials, assemblies, specimens, and Work performed, including design mixes, methods and techniques, and report the progress to Architect.
 - 3. If material or Work fails to meet requirements of the Contract Documents, the laboratory inspector shall notify the CM, Architect, engineers, supplier, or Subcontractor providing or preparing the materials or Work being tested of such failure.
 - 4. Laboratory personnel shall not perform the work of Contractor or act as foremen or superintendents. Work will be inspected as it progresses, but failure to detect defective Work or materials shall not prevent later rejection when a defect is discovered.
 - 5. Laboratory personnel are not authorized to revoke, alter, relax, enlarge, or release the requirements of the Contract Documents or approve or accept portions of Work, except where approval is specifically specified in the Specifications.
 - 6. Comply with building code requirements for special inspections.

- K. Testing Laboratory Guidelines and Procedures:
 - 1. Technicians scheduled to perform specific testing services must be qualified to review and perform other services that overlap, i.e. earthwork, foundation inspections, rebar inspection, and concrete when scheduled concurrently at the site.
 - 2. Technician time for services performed will be reimbursed at a regular time rate. Compensation at the overtime rate will be considered for hours over eight (8) hours spent at the site on a single day, field testing services performed on a Saturday or Sunday, and field services performed on a recognized holiday.
 - 3. There shall be a three (3) hour minimum for each scheduled testing service. Vehicle charges will be included on a \$25.00 per trip basis.
 - 4. Cylinder pick up will be controlled by the technician performing test on a scheduled pick up day. If there are no testing services scheduled, the cylinder pick up fee is \$40.00 on week days and \$50.00 on weekends and holidays with no technician or vehicle charge.
 - 5. Contractor shall bear the responsibility of scheduling the testing services. Contractor and the testing laboratory shall assume full responsibility to coordinate the testing services. Cancellations or failed test shall be reimbursable to the Owner by the responsible party for the cancellations or failure of a test or service.

- L. Coordination:
 - 1. Coordinate sequence of activities to accommodate required quality assurance and quality control services with a minimum of delay and to avoid necessity of removing and replacing construction to accommodate testing and inspecting:
 - a. Schedule times for tests, inspections, obtaining samples, and similar activities.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION

3.1 TEST AND INSPECTION LOG

- A. Test and Inspection Log:
 - 1. Prepare a record of tests and inspections. Include the following:
 - a. Date test or inspection was conducted.
 - b. Description of the Work tested or inspected.
 - c. Date test or inspection results were transmitted to Architect.
 - d. Identification of testing agency or special inspector conducting test or inspection.
 - e. Deficiency log.
- B. Maintain log at site. Post changes and revisions as they occur. Provide access to test and inspection log for Architect's reference during normal working hours.

3.2 TESTING AND INSPECTION SERVICES

- A. Testing services shall include, but not be limited to those specified below or which are necessary or required during course of construction to ascertain Specification compliance and which may be deemed necessary by Architect, the engineer, or Owner to ensure the quality of the Work.
- B. Owner reserves the right to add to or delete any or all inspection and testing specified, excluding testing required by the applicable building codes.
- C. If conflicts arise between Drawings and Specifications, notify Architect immediately. The most stringent requirements shall dictate procedure.

3.3 TESTING OF EARTHWORK

- A. Testing Services (as specified or required):
 - 1. References (as applicable for tests required):
 - a. American Society for Testing and Materials (ASTM):
 - 1) D698 - Test Method for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lb/ft³ (600 kN-m/m³).
 - 2) D2922 - Standard Test Method for Density of Soil and Soil-Aggregate In Place By Nuclear Methods (Shallow Depth).
 - 3) D4318 - Standard Test Method for Liquid Limit, Plastic Limit, and Plasticity Index of Soils.
 - b. American Association of State Highway and Transportation Officials (AASHTO):
 - 1) T89 - Determining the Liquid Limit of Soils.
 - 2) T90 - Determining the Plastic Limit and Plasticity Index of Soils.
 - 3) T99 - Moisture-Density Relations of Soils Using a 2.5 kg (5.5 lb) Rammer and a 305-mm (12-in) Drop.
 - 4) T238 - Density of Soil and Soil Aggregates In Place By Nuclear Methods (Shallow Depth).
 - 2. Perform sieve analysis to develop grain size distribution curves for materials to be used for subgrade, fill under slab on grade, and backfills.
 - 3. Establish the moisture density relation of soils to be used as fill using the method best suited to the type of fill material.
 - 4. Determine moisture content of all fill materials before placement and advise Contractor when it is or is not suitable to achieve required compaction.
 - 5. Determine Liquid Limit in accordance with ASTM D4318 or AASHTO T89, Plastic Limit

in accordance with ASTM D4318, and Plasticity Index in accordance with ASTM D4318 of all fill material,

6. Perform one (1) in place density test for each 2,500 square feet (280 square yards) of existing subgrade material.
7. Perform Moisture-Density curve in accordance with ASTM D698 or AASHTO T99 for one type of fill material. If the original choice of material does not meet the Specifications, Contractor shall pay for additional testing.
8. Perform in place density tests of each lift of compacted fill at locations adequate to evaluate the degree of compaction of all fill areas. Conduct one test for each 2,500 square feet (280 square yards) of each lift of compacted fill.
9. Perform testing at a frequency of one (1) in-place density and moisture test for each 75 lineal feet or less of utility trench, with a minimum of three (3) tests per lift

B. Reports:

1. Submit reports with the following information:
 - a. Type and condition of soil at footing bottoms.
 - b. Level of water table in the excavated areas.
 - c. Grain size distribution of fill materials (average of three [3] tests).
 - d. Moisture density test results.
 - e. In place density test results with moisture content and relative density of each layer of compacted fill. Include with in place density test results, a plan showing location of each test.
 - f. Notify Architect by telephone within one (1) hour of the discovery of the following conditions and follow up telephone notification with written report:
 - 1) Materials used or degree of soil compaction not meeting specified requirements.
 - 2) Frost and freeze protection requirements for excavation bottoms not being complied with.
 - 3) Water in excavations not being removed prior to Work being performed in excavation.

3.4 INSPECTION OF PIPED SITE UTILITIES

- A. Laboratory representative shall observe and report on the following:
1. Proper alignment and grade of trenches.
 2. Pipe bedding and supports.
 3. Pipe, joints, jointing material, and thrust blocks prior to installation of pipe.
 4. Installation of pipe and joints.
 5. Testing of piped utilities performed by Contractor.

3.5 PAVING

- A. Testing Services:
1. Perform field tests for moisture density properties:
 - a. Provide field testing of the subgrade as specified.
 - b. Paving sub-base: Provide one (1) field test for every 5,000 square feet of area of crushed limestone or caliche sub-base.
 - c. Lime treated subgrade: Provide one (1) field test for every 5,000 square feet of area of lime treated subgrade for content of lime and subgrade compaction.
 - d. Cement soil stabilization: Provide one (1) field test for every 5,000 square feet of area of cement stabilized subgrade for content of cement and subgrade compaction.

3.6 PIER DRILLING OPERATION

- A. A representative of a qualified geotechnical laboratory shall provide services specified.

- B. Laboratory representative shall make continuous inspections to determine that proper bearing stratum is obtained and utilized for bearing and that shafts are properly clean and dry before placing concrete.
- C. Laboratory shall furnish complete pier log showing the diameter, top and bottom elevations of each pier, casing required or not required, actual penetration into bearing stratum, elevation of top of bearing stratum, volume of concrete used, and deviations from specified tolerances.
- D. Laboratory representative shall make continuous inspections of drilled pier construction to check the following:
 - 1. Verify soundness of bearing stratum and desired penetration.
 - 2. Verify pier dimensions and reinforcing used.
 - 3. Monitor condition of hole and removal of water and loose material from bottom.
 - 4. Monitor placement of concrete and use of tremie or pumps.
 - 5. Monitor the extraction of casing, if used.
- E. Request probe holes when deemed necessary to confirm safe bearing capacity.

3.7 CONCRETE REINFORCING STEEL AND EMBEDDED METAL ASSEMBLIES

- A. Inspect concrete reinforcing steel prior to placing concrete for compliance with Contract Documents and approved shop drawings. Noncompliance with Contract Documents and approved shop drawings shall be immediately brought to the attention of Contractor for correction and, if left uncorrected, reported to Architect.
- B. Laboratory representative shall observe and report on the following:
 - 1. Number and size of bars.
 - 2. Bending and lengths of bars.
 - 3. Splicing.
 - 4. Clearance to forms, including chair heights.
 - 5. Clearance to sides and bottom of trench if soil formed.
 - 6. Clearance between bars or spacing.
 - 7. Rust, form oil, and other contamination.
 - 8. Grade of steel.
 - 9. Securing, tying, and chairing of bars.
 - 10. Excessive congestion of reinforcing steel.
 - 11. Installation of anchor bolts and placement of concrete around such bolts.
 - 12. Fabrication and installation of embedded metal assemblies, including visual inspection of all welds.
 - 13. Visually inspect studs and deformed bar anchors on embedded assemblies for compliance with Contract Documents. Check number, spacing, and weld quality. If, after welding, visual inspection reveals that a sound weld or a full 360-degree fillet has not been obtained for a particular stud or bar, such stud or bar shall be struck with a hammer and bent 15 degrees off perpendicular and then bent back into position. Anchors failing this test shall be replaced.
- C. Provide a qualified, experienced inspector to inspect reinforcing steel. Inspector shall have a minimum of three (3) years of experience inspecting reinforcing steel in projects of similar size.

3.8 CONCRETE INSPECTION AND TESTING

- A. Receive and evaluate proposed concrete mix designs submitted by Contractor. If mix designs comply with Drawings and Specifications, the laboratory shall submit a letter to the

Architect certifying compliance. Mix designs not complying with Drawings and Specifications shall be returned by the laboratory as being unacceptable. Check the proposed mixes for proportions, water cement ratio, and slump in accordance with ACI 613 and 318.

- B. Comply with ACI 311 *Guide For Concrete Inspection* and ACI *Manual of Concrete Inspection*.
- C. Sample and test concrete placed at the site in accordance with ASTM C172. Each sample shall be obtained from a different batch of concrete on a random basis.
- D. Test concrete:
 - 1. Mold and cure five (5) specimens from each sample:
 - a. For each 50 cubic yards or fraction thereof of structural building concrete.
 - b. For each 100 cubic yards or fraction thereof of nonstructural concrete and site Work paving and sidewalks.
 - c. Laboratory cure two (2) cylinders in accordance with ASTM C192.
 - d. Field cure remaining cylinders in accordance with ASTM C31.
 - 2. Two (2) specimens shall be tested at seven (7) days for information, two (2) shall be tested at 28 days for acceptance.
 - 3. Store one (1) cylinder for testing at 56 days in the event the 28-day strength tests do not meet strength requirements.
- E. Deviations from the requirements of ASTM specifications shall be recorded in the test report. Test concrete specimens in accordance with ASTM C39.
- F. Specimens for pumped concrete shall be taken at the discharge end of pumping equipment.
- G. Supervise curing and protection provided for test specimens in field and transportation from the field to laboratory. Test cylinders shall be stored in the field for 24 hours and then carefully transported to laboratory and cured in accordance with ASTM C31.
- H. Make one (1) strength test (four [4] cylinders) of each mix design of concrete placed in any one (1) day.
- I. Make one (1) slump test for each set of cylinders following procedural requirements of ASTM C143 and ASTM C172. Make additional slump tests whenever consistency of concrete appears to vary. Slump tests corresponding to samples from which strength tests are made shall be reported with strength test results. Other slump tests need not be reported.
- J. Determine total air content of air entrained normal weight concrete sample for each strength test in accordance with ASTM C231.
- K. Determine air content and unit weight of lightweight concrete sample for each strength test in accordance with ASTM C173 and ASTM C567.
- L. Determine temperature of concrete sample for each strength test.
- M. Inspect each batch of concrete and monitor addition of mixing water to assure uniform consistency from truck to truck. Check mixing form mixers before mix begins to set and within time limits set forth in ASTM C94:
 - 1. Monitor addition of water and high range water reducer to concrete at job site and length of time concrete is allowed to remain in truck during placement.
- N. Testing agency shall furnish and maintain a competent inspector at the mixing plant at the start of each day's mixing. Inspector shall examine concrete materials for compliance with

Specifications and approved mix design, weighing and measuring devices, proportioning and mixing of materials, water and cement content of each batch, general operation of the plant, and transportation of concrete to jobsite. Inspector shall verify that the amount of free surface moisture contained in fine and course aggregate has been properly accounted for in the concrete mixing to achieve required consistency and water cement ratio.

- O. Testing laboratory shall monitor addition of water to concrete at the jobsite and the length of time concrete is allowed to remain in the truck before placement. Inspector shall compare mixture with criteria on the approved mix design and report any significant deviation to Architect, Contractor, and concrete supplier. Do not permit addition of water that will exceed maximum water/cement ratio for the mix as given on the approved mix design.
- P. Observe placing of concrete except nonstructural slabs on grade and site Work. Observe and report on placing method, consolidation, cold joints, length of drop, and displacement of reinforcement. Report deficiencies to Contractor immediately for corrective action. Inspections may be reduced to a periodic basis when all procedures have been deemed satisfactory by the laboratory.
- Q. Test reports shall include but not be limited to the following information:
 - 1. Date of concrete placement.
 - 2. Concrete mix identification number or proportion of ingredients.
 - 3. Truck ticket number.
 - 4. Time test was made.
 - 5. Time of batching.
 - 6. Location of each placement.
 - 7. Slump, unit weight, water content (microwave test), and air content of concrete sampled.
 - 8. Date and results of strength test.
- R. Report promptly to Architect all details of reasons for rejection of any and all quantities of concrete. Give all information concerning locations of the concrete pours, quantities, date of pours, and other pertinent facts concerning concrete represented by the specimens.
- S. Testing laboratory shall certify each delivery ticket indicating class of concrete delivered (or placed), amount of water added and time at which cement and aggregate were dispensed into the truck, and time at which concrete was discharged from the truck.
- T. Evaluation and Acceptance:
 - 1. If measured slump or air content of air entrained concrete falls outside specified limits, a check test shall be made immediately on another portion of the same sample. In the event of a second failure, concrete shall be considered to have failed to meet the requirements of the Specifications, and shall not be used in the structure.
 - 2. Strength level of concrete will be considered satisfactory if the averages of sets of three (3) consecutive strength test results are equal to, or exceed, specified strength and no individual test result (average of two [2] cylinders) is below specified strength by more than 500 psi.
 - 3. Completed concrete work will be accepted when requirements of ACI 301 Chapter 18 *Specifications for Structural Concrete for Buildings* have been met.
- U. Concrete Test Reports:
 - 1. Reports shall be made and distributed immediately after respective tests or inspections are made:
 - a. Where reports indicate deviations from Contract Documents, they shall also include a determination of the probable cause of deviation and where applicable, a recommendation for corrective action.

- V. Furnish a statistical analysis for each class of concrete placed on the Project in accordance with ACI 214 and ACI 318. Information shall be updated and distributed once a month as directed by the Architect. Information shall include, but not be limited to, the following:
 1. Strength tests at seven (7) days.
 2. Strength tests at 28 days of two (2) cylinder averages.
 3. 28-day moving average strength tests of last three (3) test groups.
 4. Standard deviation and coefficient of variation based on 28-day strength tests.
 5. Average strength and number of 28-day tests for most recent month.
 6. Strength test one (1) cylinder at 56 days in the event the 28-day strength tests do not meet strength requirements.
- W. Test Footings (Shafts; Piers; Caissons): Same diameter and type specified for footings, placed in same manner. Accepted test footings may be used in the Work.
- X. Noncompliant Test Reports: Fax test reports indicating noncompliance immediately to each party on the test report distribution list. Copies shall be on different colored paper.
- Y. Inspect application of curing compound and monitor curing conditions to assure compliance with Specification requirements. Report curing deficiencies to Contractor immediately and submit a written report to Architect.

3.9 TESTING OF NONSHRINK GROUT

- A. Make one (1) strength test for all plates grouted and for all grout used in joints between members.
- B. Each test shall consist of four (4) cubes, two (2) tested at seven (7) days and two (2) at 28 days, made and tested in accordance with ASTM C109, with the exception that grout shall be restrained from expansion by a top plate.

3.10 STRUCTURAL STEEL

- A. Inspect structural steel during and after erection for compliance with Contract Documents and shop drawings. Review and report on fabricator's quality control procedures and capabilities.
- B. Field Inspection:
 1. Proper erection of pieces.
 2. Proper touch up painting of shop primed structural steel exposed to view or in crawl space.
 3. Proper installation of bolts.
 4. Plumbness of structure and proper bracing.
 5. Proper field painting.
 6. Initial inspection of welding process and periodically thereafter as necessary.
 7. Visual examination of completed welds.
 8. Ultrasonic testing of penetration field welds.
 9. Installation of field welded shear studs.
 10. Inspect shop fabricated members, upon arrival at the site, for defects incurred during transit and handling.
 11. Measure and record camber of beams upon arrival and before erection for compliance with specified camber. Measure lying flat with web horizontal. Return members outside specified camber tolerance to shop for correction.
- C. Qualifications of Welders: Fabricator and erector shall provide the testing laboratory with names of welders employed on Work, along with certification that each welder has passed

qualification tests within the past 12 months, using procedures covered in AWS D1.1 *Structural Welding Code - Steel*. Verify welder qualifications.

- D. Inspection of Field Welding shall Include:
1. Visually inspect fillet welds for size, soundness, and proper return around ends. Inspect seams, folds, and delaminations.
 2. Visually inspect welds for proper repair of painting.
 3. Ultrasonically test penetration welds in accordance with ASTM E164.
 4. Inspect surfaces to be welded. Note surface preparations, fit up, and cleanliness of surface. Verify electrodes for size, type, and condition.
 5. Welding inspector shall be present during alignment and fit up of members being welded, and shall verify for correct surface preparation of root openings, sound weld metal, and proper penetration in the root pass. Where weld has not penetrated completely, inspector shall order the joint to be chipped down to sound metal, or gouged out, and rewelded. Thoroughly inspect root passes for cracks. Gouge out cracks and rewelded to two inches (2") beyond each end of crack.
 6. Inspector shall verify that welds have been marked with welder's symbol and shall mark welds requiring repairs and re-inspection. Inspector shall maintain a written record of welds. Work completed and inspected shall receive an identification mark by the inspector. Identify unacceptable material and Work identified by word *reject* or *repair* marked directly on the material.
 7. Testing agency shall advise the Owner and Architect of any shop and/or field conditions that may require further tests and examination by means other than those specified. Additional tests and examinations shall be performed as authorized by the Owner and Architect.
 8. Owner reserves the right to use ultrasonic or radiographic inspection to verify adequacy of welds. Testing procedures and acceptance criteria shall be as specified in AWS D1.1.
 9. Weld quality to comply with the American Institute of Steel Construction (AISC) Manual of Steel Construction.
 10. Determine percentage of weld tested by the number of welds that fail the initial testing.
 11. Reweld and retest welds that fail until the welds pass. Test two (2) additional welds for every weld failure.
- E. Inspect bolted construction in accordance with AISC *Specification for Structural Steel Buildings*:
1. Visually inspect bolts ensuring that plies have been brought into snug contact.
 2. Inspect high strength bolt in accordance with Section 9 of the *Specifications for Structural Joints Using ASTM A325 Bolts*.
- F. Inspect stud welding in accordance with AWS D1.1 *Structural Welding Code*:
1. Weld at least two (2) shear studs at the start of each production period to determine correct generator, control unit, and stud welder setting. The studs shall be capable of being bent 45 degrees from vertical without weld failure.
 2. When the temperature is below 32 degrees F, test one (1) stud in each 100 after cooling. Do not weld studs at temperatures below zero (0) degrees F or when surface is wet with rain or snow. If stud fails in the weld, two (2) new studs shall pass the test before resumption of welding.
 3. Visually inspect studs for compliance with the requirements of the Contract Documents. Verify number, spacing, and weld quality. If, after welding, visual inspection reveals that a sound weld or a full 360-degree fillet has not been obtained for a particular stud, that stud shall be struck with a hammer and bent 15 degrees off perpendicular in the direction away from the missing weld. Studs failing test shall be replaced.

3.11 REINFORCING STEEL MECHANICAL SPLICES

- A. Inspection and Observation Services:
 - 1. Visually inspect and report on completed condition of each mechanical splice of reinforcing steel.
 - 2. Visually inspect each mechanical splice to ensure compliance with the ICC-ES Reports and the manufacturer's published criteria for acceptable completed splices.
 - 3. Place special emphasis on the inspection of the end preparation of each bar to be spliced required by the ICC-ES Report.
- B. Reports:
 - 1. Submit reports to Architect:
 - a. Copies of manufacturer's published criteria for acceptable completed splices prior to observing mechanical splices.
 - b. Reports on each mechanical splice shall indicate location of the splice, size of bars spliced, and acceptability or rejection of splice. Indicate reasons for rejection on each report.

3.12 OPEN WEB JOISTS AND JOIST GIRDERS

- A. Inspect joists at jobsite for compliance with specified fabrication requirements. Verify welded connections between web and chord, splices, and straightness of members.
- B. Inspect installation of joists at jobsite. Check connections to supporting members, chord extensions, number of rows of bridging, and bridging connections for compliance with Contract Documents and referenced standards.
- C. Verify welder qualification certificates for both shop and field welding operators.

3.13 METAL FLOOR DECK

- A. Field inspection shall consist of:
 - 1. Verifying types, gauges, and finishes for compliance with Contract Documents and shop drawings.
 - 2. Examine composite floor deck exposed to crawl space for damage to galvanizing due to welding or construction activities. Repair galvanized composite floor deck in accordance with the Specifications.
 - 3. Examine the erection of metal deck, fastenings, reinforcing of holes, deck reinforcing, miscellaneous deck supports, hanger tabs, shear studs, deck closures, painting, or other coating.
 - 4. Certification of welders.
 - 5. Inspect and test field welded shear studs used to fasten metal floor decking to supporting steel as specified for structural steel.

3.14 METAL ROOF DECK

- A. Field inspection shall consist of:
 - 1. Verify types, gauges, and finishes for compliance with Contract Documents and shop drawings.
 - 2. Examine the erection of the metal deck, including fastenings at supports and side laps, reinforcing of holes, and miscellaneous deck supports.
 - 3. Certification of welders.
 - 4. Visual inspection of at least 25 percent of welds.

3.15 SPRAYED FIREPROOFING

- A. Verify that applied thickness, density, and bond strength of sprayed fireproofing meets fire

rating requirements of approved design.

- B. Verify that installation complies with fire rating requirements of approved design.
- C. Inspect and test for thickness:
 - 1. Test 25 percent of structural frame columns and beams in each building level.
 - 2. Test ten percent (10%) of beams other than structural frame in each building level.
 - 3. Test one (1) slab per 5,000 square feet of building area.
- D. Inspect and test in accordance procedures of ASTM E605 and ASTM E736.

3.16 EXPANSION BOLT INSTALLATION

- A. Inspect drilling of each hole and installation of each expansion bolt for compliance with Contract Documents and shop drawings.
- B. Verify installation torque for each expansion bolt for compliance with manufacturer's installation instructions.

3.17 LIGHTWEIGHT INSULATING CONCRETE FILL

- A. Inspection and Observation Services (As Required):
 - 1. Inspection of roof deck prior to start of Work.
 - 2. Inspection during installation of insulation and lightweight insulating concrete fill Work to ascertain compliance with Contract Documents.
 - 3. Observation of base ply fastener pull tests performed by Contractor to ascertain minimum withdrawal resistance of 40 pounds per fastener.
- B. Testing Services (As Required):
 - 1. References (as applicable for tests required):
 - a. American Society for Testing and Materials (ASTM):
 - 1) C177 - Standard Test Method for Steady State Heat Flux Measurements and Thermal Transmission Properties By Means of the Guarded Hot Plate Apparatus.
 - 2) C495 - Test Method for Compressive Strength of Lightweight Insulating Concrete.
 - 3) C578 - Specification for Rigid, Cellular Polystyrene Thermal Insulation.
 - 2. Test EPS insulation board for thermal insulation value in accordance with ASTM C177.
 - 3. Test lightweight insulating concrete fill in accordance with ASTM C495 for:
 - a. Mix design compressive strength.
 - b. Mix design wet and dry density range.
 - c. Number of Tests:
 - 1) One (1) per 5,000 square feet.
 - 2) Not less than one (1) for each day's Work.
 - 4. Test EPS insulation board for density in accordance with ASTM C578.

3.18 TESTING OF ROOFING

- A. Inspection and Observation Services (As Required):
 - 1. Inspection of roof deck prior to start of Work.
 - 2. Inspect onsite condition of stored roofing materials.
 - 3. Inspection during roofing, roof insulation, and sheet metal Work to ascertain compliance with Contract Documents.
 - 4. Observation of roof test cuts performed by Contractor to ascertain that they are properly made.

5. Observation of patching of roof test cuts to ascertain that they are properly made.
- B. Testing Services (As Required):
1. Perform dissection and analysis on cuts provided by Contractor to confirm number of plies, bonding of plies, weight of bitumen and softening temperature to ascertain compliance with Specifications.

3.19 MASONRY

- A. Inspection and Observation Services:
1. Inspection of placement of reinforcement including condition, grade, size, location, spacing, and lap splices.
 2. Review mortar design mixes.
 3. Inspection of laying, mortaring, and grouting of concrete masonry units and elements.
- B. Testing Services:
1. References (as applicable for tests required):
 - a. ASTM International (ASTM):
 - 1) C140 - Standard Test Methods of Sampling and Testing Concrete Masonry Units.
 - 2) C780 - Standard Test Method for Preconstruction and Construction Evaluation of Mortars for Plain and Reinforced Unit Masonry.
 - 3) C1019 - Standard Test Method for Sampling and Testing Grout.
 2. Testing of Concrete Masonry Units (CMU):
 - a. Pre-construction - Perform the following tests in accordance with ASTM C140:
 - 1) Compressive Strength.
 - 2) Absorption.
 - 3) Weight.
 - 4) Moisture Content.
 - 5) Dimensions.
 3. Mortar Tests:
 - a. Pre-construction - Perform the following tests in accordance with ASTM C780 on each type of mortar mix used on the Project:
 - 1) 28-day compressive strength.
 - 2) Water retention.
 - b. Construction: Perform 28-day compressive strength test in accordance with ASTM C780 on each type of mortar mix used on the Project at the rate of one (1) test per 2,000 square feet of masonry.
 4. Refer to and include Work for reinforcing steel specified.
 5. Grout tests:
 - a. Pre-construction - Perform the following tests in accordance with ASTM C1019 on each type of grout mix used on the Project:
 - 1) Slump test.
 - 2) 28-Day compressive strength.
 - b. Construction: Perform 28-day compressive strength test in accordance with ASTM C1019 on each type of grout mix used on the Project at the rate of one (1) test per 2,000 square feet of masonry.
 6. Prism test: Perform pre-construction 28-day compressive strength test on concrete masonry walls.

3.20 REPAIR AND PROTECTION

- A. 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.

- B. Protect construction exposed by or for quality control service activities.
- C. Repair and protection are Contractor's responsibility regardless of the assignment of responsibility for quality control services.

END OF SECTION 01 45 23

SECTION 01 45 24 - IMPORT MATERIALS TESTING

PART 1 – GENERAL

This Section specifies the requirements for the sampling, testing, transportation and certification of imported fill materials (i.e., earth materials, such as, soil, rock, crushed base, sand, compost, planter mix) to school sites.

1.01 SUMMARY

- A. This Section defines:
 - 1. CONTRACTOR submittal requirements.
 - 2. CONTRACTOR requirements for use of existing or imported materials on school sites.
 - 3. Testing requirements for all materials imported for use on a school site.
 - 4. CONTRACTOR requirements for stockpiling materials for use on school sites.

1.02 OBJECTIVES

- A. Ensure that fill materials imported to school sites are free of known and expected environmental contaminants for students, staff, and visitors.
- B. Ensure that materials imported to school sites comply with any and all applicable California Code of Regulations (CCR), Code of Federal Regulations (CFR), California Environmental Protection Agency (Cal EPA), and Department of Toxic Substances Control (DTSC) requirements for school site use.
- C. Ensure that representative data be collected so that analytical determinations can be made in regards to the first two objectives.

1.03 SUBMITTALS

CONTRACTOR shall submit to OWNER's Authorized Representative (OAR):

- A. Within ten (10) calendar days of receipt of Notice to Proceed, the contractor shall submit a spreadsheet listing all required import material types including but not limited to backfill soil, sand, gravel, and crushed material. The list shall include estimated volumes required by each subcontractor and the intended borrow site locations each contractor intends to utilize. See 2.01B for pre-evaluated sites. If this ten (10) day timeframe is not met, the CONTRACTOR takes responsibility for possible delays associated with import testing.
- B. Prior to the import of material from a District pre-evaluated site, the CONTRACTOR must provide a "Imported Materials Certification" form a minimum of ten calendar (10) days prior to needing material on site. The "Imported Materials Certification" form can be found at the end of this specification. Contractor shall be solely responsible for any schedule delay(s) and/or associated cost arising from pre-evaluated sites if this ten calendar (10) days timeframe is not met.
- C. For a non-pre-evaluated site, CONTRACTOR must provide the same form a minimum of ten calendar (10) days prior to needing material on site. **Contractor shall be solely responsible for any schedule delay(s) and/or associated cost arising from import from non-pre-evaluated facilities.**
- D. Written documentation, in the form of a memo or e-mail from the CONTRACTOR to the OAR, is required prior to import, verifying that the hauling contract specifies "clean" trucks and that the actual haul trucks utilized for import activities will be clean of visible contamination or deleterious materials.
- E. Written documentation that the trucks went directly from the source location to the recipient location with no detours or stops at other locations and that short loads were not

augmented by other materials that were not tested as part of the final import. It is the CONTRACTOR's responsibility to document that no other trips or short-load augmentation occurred and submit documentation within five (5) business days of the completion of the import activities. All import transportation activities shall be conducted in accordance with all applicable (local, State, Federal) rules and regulations.

- F. Certification, in the form of haul tickets or bill of lading, documenting the volume and recipient of all import materials and activities. This documentation shall be coordinated through the OAR. CONTRACTOR shall provide, track, and maintain a log of all imported materials
1. For approved import to school project sites, haul tickets will be utilized, and shall contain the following minimum information:
 - Date(s) of haul activity.
 - Address of source site.
 - Address of recipient.
 - Load volume.
 - Day of departure from source.
 - Day of arrival at recipient site.
 - Signature of recipient or recipient's agent.

1.04 APPROVALS

Import of soil, granular base, or geotechnical grading or filling materials at CNUSD sites will occur ONLY with PRIOR approval of the Owners Representative for environmental considerations and the geotechnical professional assigned to the project CM team for geotechnical considerations.

PART 2 – PRODUCTS

2.01 MATERIALS

- A. Imported:
1. Soils: Soils proposed for import shall be tested pursuant to the requirements as outlined in Part 3 of this Section.
 2. Gravels / CAB: Clean gravel, consisting of native rock from a commercial source, shall be tested pursuant to the requirements of this Section. Refer to part 2.01.B, of this Section, for the list of CNUSD pre-evaluated sites.
 3. Sands: Clean sand from a commercial source shall be tested pursuant to the requirements of this Section. Refer to part 2.01.B, of this Section, for the list of CNUSD pre-evaluated sites. Plaster sand is included in this classification and must be tested per the requirements in this section.
 4. Crushed Miscellaneous Base (CMB) per Section 200-2.4, fine sieve, of the Standard Specifications for Public Works Construction (Green Book). Prior to import, submit written certification to OAR that crushed Miscellaneous Base (CMB) does not contain Polychlorinated biphenyls (PCB) above laboratory detection limits when tested in accordance with EPA Method 8082.
- B. Pre-Evaluated Sites:

Vulcan Materials Company
Vulcan Corona
1709 Sherbon Street
Corona, CA 92879
Materials Tested: SE-30 Sand, CAB, 3/4 " Rock

Vulcan Materials Company
Reliance Plant
16005 E Foothill Blvd.
Irwindale, CA 91702
**Materials Tested: SE-30 Sand, CAB and 3/4" Crushed Rock,
3/4" Class II Permeable Base, Washed Concrete Sand**

Vulcan Materials Company
Durbin Sand and Gravel
13000 East Los Angeles Street
Irwindale, CA 91706
**Materials Tested: Washed Plaster Sand, SE-30, 3/4" Class II
Permeable Base**

All American Asphalt
1776 All American Way
Corona, Ca 92879
Materials Tested: CAB

Hanson Aggregates Irwindale
13550 Live Oak Lane
Irwindale, CA 91706
**Tested Materials: CAB, Washed Plaster Sand, SE-30 Sand,
3/4" Rock, and 3/4" Class II Permeable Base**

Materials at these facilities have been previously tested and approved.

PART 3 – EXECUTION

3.01 SAMPLING AND TESTING

- A. CONTRACTOR must coordinate with the District per Item 1.03, of this Section, to request testing for a non-pre-evaluated site. **CONTRACTOR shall be solely responsible for any schedule delay(s) and/or associated cost arising from import from non-pre-evaluated facilities.** Please note, any request for turn-around time (TAT) less than 72-hours (business hours) will be rejected. District will make an attempt to honor faster TAT request; however, it is subject to availability of laboratory capacity, analytical method procedures, and field sampling personnel. CONTRACTOR's submission of a request for a faster TAT (for analytical results) should not be construed as District's approval for such requests. District shall not be liable in any way if such request could not be approved and/or honored.
- B. The Contractor's Environmental Consultant shall perform testing of imported and site generated fill materials prior to importing and report results of all tests and shall furnish copies to the OAR, CONTRACTOR, Project Inspector, Architect, Contractor, DTSC, and/or others as required. **CONTRACTOR shall be solely responsible for the costs associated with the Environmental Consultant testing services.** Report shall state tests were conducted under the responsible charge of a licensed environmental professional (licensed State of California Professional Engineer [PE Civil], Professional Geologist [PG] or familiar with environmental site assessment and the material was tested in accordance with applicable provisions of the Contract Documents, CCR, CFR, DTSC, and DSA.

- C. All fill/grading material must be tested at the site of origin. Owner (i.e., the District) retains the right to refuse import of fill material(s) from any particular site (even if it is pre-evaluated).
- D. Import fill material may be deemed defective for use by CNUSD at a school site if any of the following results are obtained:
 - 1. Total petroleum hydrocarbons (TPH) are present at concentrations exceeding 10 milligrams per kilogram (mg/kg) for gasoline range organics, and/or 100 mg/kg for diesel range organics, and/or 500 mg/kg for oil range organics.
 - 2. Solvents and other volatile organic compounds (VOCs) are present at concentrations exceeding the human health risk levels for unrestricted land use and/or hazardous waste characterization criteria whichever is lower.
 - 3. Polychlorinated Biphenyl (PCBs) are present at concentrations exceeding the human health risk levels for unrestricted land use and/or hazardous waste characterization criteria whichever is lower.
 - 4. Semi volatile organic compounds (SVOCs) are present at concentrations exceeding the human health risk levels for unrestricted land use and/or hazardous waste characterization criteria whichever is lower.
 - 5. Organochlorine Pesticides (OCPs) are present at concentrations exceeding the human health risk levels for unrestricted land use and/or hazardous waste characterization criteria whichever is lower.
 - 6. Chlorinated herbicides are present at concentrations exceeding the human health risk levels for unrestricted land use and/or hazardous waste characterization criteria whichever is lower.
 - 7. California Code of Regulations Title 22 (CAM 17) Metals at concentrations exceeding human health risk levels for unrestricted land use or typical background levels expected in California and/or hazardous waste characterization criteria whichever is lower.
 - 8. Hexavalent chromium is present at concentrations exceeding 15 mg/kg or failing hazardous waste STLC leachate criteria.
- E. Specification test results and CNUSD approvals shall be valid for a period of 90 days from the date of the subject testing. Previously approved materials shall not be utilized after the 90 day limit without prior review and approval by the CNUSD.
- F. Import fill materials shall be stockpiled by CONTRACTOR (or the facility) at the site from where material is proposed to be imported, and are deemed acceptable for import only when it is demonstrated to the satisfaction of CNUSD that the subject materials meet the requirements of this Section.
- G. Apply appropriate dust control measures to prevent dust generation from import stockpiles/materials; and be compliant with appropriate rules and regulations prescribed by the South Coast Air Quality Management District. Maintain dust control measures at all times and under all environmental conditions. Contractor generating stockpile shall be held fully responsible for any violation(s) arising out of non-compliance related to air quality issues associated with the stockpile.
- H. Apply appropriate storm water pollution prevention best management practices (BMPs) on and around the imported stockpiles. Contractor generating stockpile shall be held fully responsible for any violation(s) arising out of non-compliance related to storm water pollution issues associated with the stockpile.

3.02 TRANSPORTATION

- A. Details of the samples and testing must be approved by CNUSD before the materials from which the samples were collected undergo transportation.
- B. Haul Routes and Regulations/Restrictions: Contractor must comply with requirements of project environmental disclosure documents (i.e., CEQA EIR) and authorities having jurisdiction over the project area and the proposed activities (e.g. Regional Water Quality Control Board, DTSC, etc.).

3.03 COSTS

- A. Contractor will incur the costs of testing for pre-evaluated sites identified in 2.01B.
- B. **CONTRACTOR shall pay all fees for testing any non-pre-approved site. CONTRACTOR shall be solely responsible for any schedule delay(s) associated with testing any non-pre-approved site.**
- C. CONTRACTOR shall pay all fees for loading, hauling, and importing fill materials identified in the contract documents.
- D. If fill material is imported from any site without prior written approval from CNUSD and/or from a previously un-evaluated source(s), CONTRACTOR shall remove such material from the District's site at their own cost immediately upon discovery of such. Any delay in removal of such material may incur liquidated damages for each day such violation continues. In addition, under such scenario the CNUSD Environmental Consultant may collect necessary samples from the area(s) where the said material has been placed (if deemed necessary). All costs associated with such (including sampling, testing, further delineation, removal and disposal of impacted materials, field oversight, consulting, legal charges, and regulatory oversight fees) efforts shall be the CONTRACTOR's sole responsibility.

TABLE 1: MINIMUM SAMPLING FREQUENCY	
Volume (Cubic Yards)	Sampling Frequency
0 – 1,000	1 per 250 CY
1,001 - 5,000	4 samples per first 1,000 CY and 1 sample per each additional 500 CY
Greater than 5,000	12 samples for first 5000 CY and 1 sample per each additional 1,000 CY

IMPORTED MATERIALS CERTIFICATION

This form shall be executed by Contractor and by all entities that, in any way, provide or deliver and/or supply any soils, aggregate, or related materials ("Fill") to the Project Site(s). All Fill shall satisfy the requirements of any environmental review of the Project performed pursuant to the statutes and guidelines of the California Environmental Quality Act, section 21000 et seq. of the Public Resources Code ("CEQA"), and the requirements of section 17210 et seq. of the Education Code, including requirements for a Phase I environmental assessment acceptable to the State of California Department of Education and Department of Toxic Substances Control.

To the furthest extent permitted by California law, the indemnification provisions in the Contract Documents apply to, without limitation, any claim(s) connected with providing, delivering, and/or supplying Fill.

Certification of: Delivery Firm/Transporter Supplier Manufacturer
 Wholesaler Broker Retailer
 Distributor Other _____

Type of Entity: Corporation General Partnership
 Limited Partnership Limited Liability Company
 Sole Proprietorship Other _____

Name of firm ("Firm"): _____

Mailing address: _____

Addresses of branch office used for this Project: _____

If subsidiary, name and address of parent company: _____

By my signature below, I hereby certify that I am aware of section 25260 of the Health and Safety Code and the sections referenced therein regarding the definition of hazardous material. I further certify on behalf of the Firm that all soils, aggregates, or related materials provided, delivered, and/or supplied or that will be provided, delivered, and/or supplied by this Firm to the Project Site(s) are free of any and all hazardous material as defined in section 25260 of the Health and Safety Code. I further certify that I am authorized to make this certification on behalf of the Firm.

Date: _____

Proper Name of Contractor: _____

Signature: _____

Print Name: _____

Title: _____

In addition to the requirement to provide this certification, Contractor agrees that it shall provide all documentation requested by the District to confirm compliance with the requirements herein.

END OF SECTION 01 45 24

SECTION 01 50 00 TEMPORARY FACILITIES AND CONTROLS

PART 1 GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section includes requirements for temporary utilities, support facilities, and security and protection facilities, including but not limited to:
 - 1. Water service and distribution.
 - 2. Sanitary facilities, including toilets, wash facilities, and drinking water facilities.
 - 3. Heating and cooling facilities.
 - 4. Ventilation.
 - 5. Electric power service.
 - 6. Lighting.
 - 7. Telephone service (land line)
 - 8. Waste disposal facilities.
 - 9. Field office.
 - 10. Storage and fabrication sheds.
 - 11. Lifts and hoists.
 - 12. Construction aids and miscellaneous services and facilities.
 - 13. Environmental protection.
 - 14. Pest control.
 - 15. Enclosure fence.
 - 16. Security enclosure and lockup.
 - 17. Barricades, warning signs, and lights.
 - 18. Temporary partitions.
 - 19. Fire protection.
 - 20. Accessories necessary for a complete installation.
- B. Use Charges:
 - 1. Installation, removal of, and use charges for temporary facilities shall be included in the Contract Sum unless otherwise indicated. Allow other entities to use temporary services and facilities without cost, including, but not limited to, Owner's construction forces, Architect, occupants of the Project, testing agencies, and authorities having jurisdiction.
 - 2. Water and sewer service: Pay sewer service use charges for water used and sewer usage by all entities for construction operations.
 - 3. Electric power service: Pay electric power service use charges for electricity used by all entities for construction operations.

1.3 SUBMITTALS

- A. Site Plan: Show temporary facilities, utility hookups, staging areas, and parking areas for construction personnel.
- B. Moisture Protection Plan:
 - 1. Describe procedures and controls for protecting materials and construction from water absorption and damage:
 - a. Describe delivery, handling, and storage provisions for materials subject to water

- absorption or water damage.
 - b. Indicate procedures for discarding water damaged materials, protocols for mitigating water intrusion into completed Work, and replacing water damaged work.
 - c. Indicate sequencing of work that requires water, such as sprayed fire resistive materials, plastering, and tile grinding, and describe plans for dealing with water from these operations. Show procedures for verifying that wet construction has dried sufficiently to permit installation of finish materials.
- C. Dust and HVAC Control Plan:
 - 1. Submit coordination drawing and narrative that indicates the dust and HVAC control measures proposed for use, proposed locations, and proposed time frame for their operation. Identify further options if proposed measures are later determined to be inadequate. Include the following:
 - a. HVAC system isolation schematic drawing.
 - b. Location of proposed air-filtration system discharge.
 - c. Waste handling procedures.
 - d. Other dust control measures.

1.4 QUALITY ASSURANCE

- A. Regulatory Requirements:
 - 1. Accessible Temporary Egress:
 - a. Comply with 2019 California Building Code (CBC) CCR Title 24, Part 2, (as adopted and amended by DSA).
 - b. Comply with applicable provisions in the U.S. Architectural and Transportation Barriers Compliance Board ADA-ABA Accessibility Guidelines (ADAAG), ICC/ANSI A117.1.
- B. Electric Service: Comply with NECA, NEMA, and UL standards and regulations for temporary electric service. Install service to comply with NFPA 70.
- C. Tests and Inspections: Arrange for authorities having jurisdiction to test and inspect each temporary utility before use. Obtain required certifications and permits.

PART 2 PRODUCTS

2.1 MATERIALS

- A. Provide new materials. Undamaged, previously used materials in serviceable condition may be used if approved by Architect. Provide materials suitable for use intended.
- B. Chain Link Fencing: Minimum 2 inches (50 mm), 0.148-inch (3.8 mm) thick, galvanized steel, chain link fabric fencing; minimum 6 feet (1.8 m) high with galvanized steel pipe posts; minimum 2-3/8-inch (60 mm) OD line posts and 2-7/8 inch (73 mm) OD corner and pull posts.
- C. Polyethylene Sheet: Reinforced, fire-resistive sheet, ten (10) mils (0.25 mm) minimum thickness, with flame spread rating of 15 or less per ASTM E84.
- D. Dust Control Adhesive Surface Walk-off Mats: Provide mats a minimum of 36 inches by 60 inches (914 mm x 1624 mm).
- E. Insulation: Unfaced mineral fiber blanket, manufactured from glass, slag wool, or rock wool; with maximum flame spread and smoke developed indexes of 25 and 50, respectively.

- F. Lumber and Plywood: Comply with requirements in Section 06 10 53: Miscellaneous Rough Carpentry.
- G. Gypsum Board: Minimum 1/2-inch (12.7 mm) thick by 48 inches (1219 mm) wide by maximum available lengths; Type X or Type C panels with tapered edges. Comply with Section 09 21 16: Gypsum Board Assemblies.
- H. Paint: Comply with requirements in Section 09 90 00: Painting and Coating.
- I. Tarpaulins: Fire resistive labeled with flame-spread rating of 15 or less.
- J. Water: Potable.

2.2 TEMPORARY FACILITIES

- A. Field Offices, General: Prefabricated or mobile units with serviceable finishes, temperature controls, and foundations adequate for normal loading.
- B. Common-Use Field Office: Of sufficient size to accommodate needs of Owner, Architect, and construction personnel office activities and to accommodate Project meetings specified in other Division 01 Sections. Keep office clean and orderly. Furnish and equip offices as follows:
 1. Furniture required for Project site documents including file cabinets, plan tables, plan racks, and bookcases.
 2. Conference room of sufficient size to accommodate meetings of 10 individuals. Provide electrical power service and 120-V ac duplex receptacles, with no fewer than one receptacle on each wall. Furnish room with conference table, chairs, and 4-foot-square tack and marker boards.
 3. Drinking water and private toilet.
 4. Coffee machine and supplies.
 5. Heating and cooling equipment necessary to maintain a uniform indoor temperature of 68 to 72 deg F
 6. Lighting fixtures capable of maintaining average illumination of 20 fc (215 lx) at desk height.
- C. Storage and Fabrication Sheds: Provide sheds sized, furnished, and equipped to accommodate materials and equipment for construction operations. Store combustible materials apart from building.

2.3 EQUIPMENT

- A. Fire Extinguishers: Portable, UL rated; with class and extinguishing agent as required by locations and classes of fire exposures.
- B. Drinking Water: Containerized, tap dispenser, bottled water drinking water units, including paper cup supply. Where power is accessible, provide electric water coolers to maintain dispensed water temperature at 45 degrees F to 55 degrees F (7.2 degrees C to 12.7 degrees C).
- C. Electrical Outlets: Properly configured, NEMA polarized outlets to prevent insertion of 110V to 120V plugs into higher voltage outlets; equipped with ground-fault circuit interrupters, reset button, and pilot light.
- D. Power Distribution System Circuits: Where permitted and overhead and exposed for surveillance, wiring circuits, not exceeding 125-V ac, 20-A rating, and lighting circuits may

be nonmetallic sheathed cable.

- E. HVAC Equipment:
 - 1. Unless Owner authorizes use of permanent HVAC system, provide vented, self-contained, liquid propane gas or fuel oil heaters with individual space thermostatic control:
 - a. Heating units: Listed and labeled for type of fuel being consumed by a qualified testing agency acceptable to authorities having jurisdiction and marked for intended location and application.
 - b. Permanent HVAC system: If Owner authorizes use of permanent HVAC system for temporary use during construction, provide filter with MERV of 8 at each return air grille in system and remove at end of construction. Clean HVAC system as required in Section 01 77 00: Closeout Procedures and install new filter with MERV 11 or greater.
- F. Air Filtration Units: Primary and secondary HEPA filter equipped portable units with four-stage filtration. Provide single switch for emergency shutoff. Configure to run continuously.

PART 3 EXECUTION

3.1 PROJECT CONDITIONS

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

3.2 INSTALLATION

- A. Locate facilities where they will serve the Project adequately and result in minimum interference with performance of the Work. Relocate and modify facilities as required by progress of the Work:
 - 1. Locate facilities to limit site disturbance as specified in Section 01 10 00: Summary.
- B. Provide each facility ready for use when needed to avoid delay. Do not remove until facilities are no longer needed or are replaced by authorized use of completed permanent facilities.

3.3 TEMPORARY UTILITY INSTALLATION

- A. Install temporary service. Arrange with utility company, Owner, and existing users for time when service can be interrupted, if necessary, to make connections for temporary services.
- B. Sewers and Drainage:
 - 1. Provide temporary utilities to remove effluent lawfully:
 - a. Connect temporary sewers to municipal system as directed by authorities having jurisdiction.
- C. Water Service: Install water service and distribution piping in sizes and pressures adequate for construction.
- D. Sanitary Facilities:
 - 1. Provide temporary toilets, wash facilities, and drinking water for use of construction personnel. Comply with requirements of authorities having jurisdiction for type, number, location, operation, and maintenance of fixtures and facilities:
 - a. Disposable supplies: Provide toilet tissue, paper towels, paper cups, and similar

- disposable materials for each facility. Maintain adequate supply. Provide covered waste containers for disposal of used material.
- b. Wash facilities: Install wash facilities supplied with potable water at convenient locations for personnel who handle materials that require wash up. Dispose of drainage properly. Supply cleaning compounds appropriate for each type of material handled. Provide safety showers, eyewash fountains, and similar facilities for convenience, safety, and sanitation of personnel.
- E. Heating and Cooling: Provide temporary heating and cooling required by construction activities for curing or drying of completed installations or for protecting installed construction from adverse effects of low temperatures or high humidity. Select equipment that will not have a harmful effect on completed installations or elements being installed.
- F. Isolation of Work Areas in Occupied Facilities:
1. Prevent dust, fumes, and odors from entering occupied areas:
 - a. Prior to commencing Work, isolate the HVAC system in area where Work is to be performed according to coordination drawings:
 - 1) Disconnect supply and return ductwork in Work area from HVAC systems servicing occupied areas.
 - 2) Maintain negative air pressure within Work area using HEPA equipped air filtration units, starting with commencement of temporary partition construction and continuing until removal of temporary partitions is complete.
 - b. Maintain dust partitions during the Work. Use vacuum collection attachments on dust producing equipment. Isolate limited Work within occupied areas using portable dust containment devices.
 - c. Perform daily construction cleanup and final cleanup using approved, HEPA filter equipped vacuum equipment.
- G. Ventilation and Humidity Control:
1. 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:
 - a. Provide dehumidification systems when required to reduce substrate moisture levels to level required to allow installation or application of finishes.
- H. Electric Power Service:
1. Provide electric power service and distribution system of sufficient size, capacity, and power characteristics required for construction operations. Install electric power service underground unless otherwise indicated:
 - a. Electric distribution - Provide receptacle outlets adequate for connection of power tools and equipment:
 - 1) Provide waterproof connectors to connect separate lengths of electrical power cords if single lengths will not reach areas where construction activities are in progress. Do not exceed safe length voltage ratio.
 - 2) Provide warning signs at power outlets other than 110 to 120-V.
 - 3) Provide metal conduit, tubing, or metallic cable for wiring exposed to possible damage. Provide rigid steel conduits for wiring exposed on grades, floors, decks, or traffic areas.
 - 4) Provide metal conduit enclosures or boxes for wiring devices.
 - 5) Provide four (4) gang outlets, spaced so 100-foot (30 m) extension cord can reach each area for power hand tools and task lighting. Provide a separate 125-V ac, 20-A circuit for each outlet.
- I. Lighting:

1. Provide temporary lighting with local switching that provides adequate illumination for construction operations, observations, inspections, and traffic conditions:
 - a. Install and operate temporary lighting that fulfills security and protection requirements without operating entire system.
 - b. Install lighting for Project identification sign.

- J. Telephone Service:
 1. Provide temporary telephone service in common use facilities for use by construction personnel, Architect, and inspection services. Install a minimum of one (1) telephone line(s) for each field office:
 - a. Provide dedicated telephone line for each facsimile machine in each field office.
 - b. At each telephone, post a list of important telephone numbers:
 - 1) Police and fire departments.
 - 2) Ambulance service.
 - 3) Contractor's home office.
 - 4) Contractor's emergency after-hours telephone number.
 - 5) Architect's office.
 - 6) Engineers' offices.
 - 7) Owner's office.
 - 8) Principal subcontractors' field and home offices.
 - c. Provide superintendent with cellular telephone or portable two-way radio for use when away from field office.

- K. Electronic Communication Service:
 1. Provide a desktop computer and printer/scanner in the primary field office adequate for use by Architect, inspection services, and Owner to access Project electronic documents and maintain electronic communications:
 - a. Internet service: Broadband modem, router, and ISP equipped with hardware firewall.
 - b. Internet security: Integrated software, providing software firewall, virus, spyware, phishing, and spam protection in a combined application.
 - c. Backup: External hard drive, minimum one (1) terabyte, with automated backup software providing daily backups.

3.4 SUPPORT FACILITIES INSTALLATION

- A. Provide construction for temporary offices, shops, and sheds located within construction area or within 30 feet (9 m) of building lines that is noncombustible according to ASTM E136. Comply with NFPA 241:
 1. Maintain support facilities until Architect schedules Substantial Completion inspection. Remove before Substantial Completion. Personnel remaining after Substantial Completion will be permitted to use permanent facilities under conditions acceptable to Owner.

- B. Temporary Use of Permanent Roads and Paved Areas:
 1. Locate temporary roads and paved areas in same location as permanent roads and paved areas. Construct and maintain temporary roads and paved areas adequate for construction operations. Extend temporary roads and paved areas, within construction limits indicated, as necessary for construction operations:
 - a. Coordinate elevations of temporary roads and paved areas with permanent roads and paved areas.
 - b. Prepare subgrade and install sub-base and base for temporary roads and paved areas.
 - c. Recondition base after temporary use, including removing contaminated material, regrading, proofrolling, compacting, and testing.
 - d. Delay installation of final course of permanent pavement until immediately before

Substantial Completion.

- C. Traffic Controls:
 - 1. Comply with requirements of authorities having jurisdiction:
 - a. Protect existing site improvements to remain including curbs, pavement, and utilities.
 - b. Maintain access for fire-fighting equipment and access to fire hydrants.
- D. Parking: Provide temporary parking areas for construction personnel.
- E. Dewatering Facilities and Drains:
 - 1. Comply with requirements of authorities having jurisdiction. Maintain Project site, excavations, and construction free of water:
 - a. Dispose of rainwater in a lawful manner that will not result in flooding the Project or adjoining properties, or endanger permanent Work or temporary facilities.
- F. Project Signs:
 - 1. Provide Project signs as indicated. Unauthorized signs are not permitted:
 - a. Identification signs: Provide Project identification signs as indicated on Drawings.
 - b. Temporary signs:
 - 1) Provide other signs as indicated and as required to inform public and individuals seeking entrance to the Project:
 - a) Provide temporary, directional signs for construction personnel and visitors.
 - c. Maintain and touchup signs so they are legible at all times.
- G. Waste Disposal Facilities: Provide waste collection containers in sizes adequate to handle waste from construction operations. Comply with requirements of authorities having jurisdiction. Comply with progress cleaning requirements in Section 01 73 00: Execution.
- H. Lifts and Hoists:
 - 1. Provide facilities necessary for hoisting materials and personnel:
 - a. Truck cranes and similar devices used for hoisting materials are considered "tools and equipment" and not temporary facilities.
- I. Temporary Elevator Use: Use of elevators is not permitted.
- J. Temporary Stairs: Until permanent stairs are available, provide temporary stairs where ladders are not adequate.
- K. Temporary Use of Permanent Stairs: Use of new stairs for construction traffic will be permitted, provided stairs are protected and finishes restored to new condition at time of Substantial Completion.

3.5 SECURITY AND PROTECTION FACILITIES INSTALLATION

- A. Protection of Existing Facilities:
 - 1. Protect existing vegetation, equipment, structures, utilities, and other improvements at Project site and on adjacent properties, except those indicated to be removed or altered. Repair damage to existing facilities to the satisfaction of Owner and Architect.
- B. Environmental Protection:
 - 1. Provide protection, operate temporary facilities, and conduct construction as required to comply with environmental regulations and that minimize possible air, waterway, and subsoil contamination or pollution or other undesirable effects.

- C. Temporary Erosion and Sedimentation Control:
 - 1. Provide measures to prevent soil erosion and discharge of soil bearing water runoff and airborne dust to undisturbed areas and to adjacent properties and walkways, according to requirements of authorities having jurisdiction:
 - a. Verify that flows of water redirected from construction areas or generated by construction activity do not enter or cross tree or plant protection zones.
 - b. Inspect, repair, and maintain erosion and sedimentation control measures during construction until permanent vegetation has been established.
 - c. Clean, repair, and restore adjoining properties and roads affected by erosion and sedimentation from Project site during the course of Project.
 - d. Remove erosion and sedimentation controls and restore and stabilize areas disturbed during removal.
- D. Stormwater Control:
 - 1. Comply with requirements of authorities having jurisdiction. Provide barriers in and around excavations and subgrade construction to prevent flooding by runoff of stormwater from heavy rains.
- E. Tree and Plant Protection:
 - 1. Install temporary fencing located as indicated or outside the drip line of trees to protect vegetation from damage from construction operations. Protect tree root systems from damage, flooding, and erosion.
- F. Pest Control:
 - 1. Engage pest control services to recommend practices to minimize attraction and harboring of rodents, roaches, and other pests and to perform extermination and control procedures at regular intervals so Project will be free of pests and their residues at Substantial Completion. Perform control operations lawfully, using environmentally safe materials.
- G. Site Enclosure Fence:
 - 1. Before construction operations begin, provide site enclosure fence to prevent people and animals from easily entering site except by entrance gates:
 - a. Extent of fence: As required to enclose entire Project site or portion determined sufficient to accommodate construction operations.
- H. Security Enclosure and Lockup:
 - 1. Install temporary enclosure around partially completed areas of construction. Provide lockable entrances to prevent unauthorized entrance, vandalism, theft, and similar violations of security. Lock entrances at end of each Work day.
- I. Barricades, Warning Signs, and Lights:
 - 1. Comply with requirements of authorities having jurisdiction for erecting structurally adequate barricades, including warning signs and lighting.
- J. Temporary Egress:
 - 1. Maintain temporary egress from existing occupied facilities as indicated and as required by authorities having jurisdiction.
- K. Temporary Enclosures:
 - 1. Provide temporary enclosures for protection of construction, in progress and completed, from exposure, foul weather, other construction operations, and similar activities. Provide temporary weather-tight enclosure for building exterior:
 - a. Where heating or cooling is needed and permanent enclosure is incomplete, insulate temporary enclosures.

- L. Temporary Partitions:
 1. Provide floor-to-ceiling dustproof partitions to limit dust and dirt migration and to separate occupied areas from fumes and noise:
 - a. Construct dustproof partitions with gypsum wallboard with joints taped on occupied side and fire retardant treated plywood on construction operations side.
 - b. Construct dustproof partitions with two layers of 6-mil (0.14 mm) polyethylene sheet on each side. Cover floor with two (2) layers of 6-mil (0.14 mm) polyethylene sheet, extending sheets 18 inches (460 mm) up the sidewalls. Overlap and tape full length of joints. Cover floor with fire retardant treated plywood. Do not apply tape to finish floor surfaces:
 - 1) Construct vestibule and airlock at each entrance through temporary partition with not less than 48 inches (1219 mm) between doors. Maintain water dampened foot mats in vestibule.
 - c. Where fire resistance rated temporary partitions are indicated or are required by authorities having jurisdiction, construct partitions according to the rated assemblies.
 - d. Insulate partitions to control noise transmission to occupied areas.
 - e. Seal joints and perimeter. Equip partitions with gasketed dustproof doors and security locks where openings are required.
 - f. Protect air handling equipment.
 - g. Provide walk-off mats at each entrance through temporary partition.

- M. Temporary Fire Protection:
 1. Install and maintain temporary fire protection facilities of types needed to protect against reasonably predictable and controllable fire losses. Comply with NFPA 241; manage fire-prevention program:
 - a. Prohibit smoking in construction areas.
 - b. Supervise welding operations, combustion type, temporary heating units, and similar sources of fire ignition according to requirements of authorities having jurisdiction.
 - c. Develop and supervise an overall fire prevention and protection program for personnel at Project site. Review needs with local fire department and establish procedures to be followed. Instruct personnel in methods and procedures. Post warnings and information.
 - d. Provide temporary standpipes and hoses for fire protection. Hang hoses with a warning sign stating that hoses are for fire protection purposes only and are not to be removed. Match hose size with outlet size and equip with suitable nozzles.

3.6 MOISTURE AND MOLD CONTROL

- A. Contractor's Moisture Protection Plan:
 1. Avoid trapping water in finished Work. Document visible signs of mold that may appear during construction.

- B. Exposed Construction Phase:
 1. Before installation of weather barriers, when materials are subject to wetting and exposure to airborne mold spores, protect as follows:
 - a. Protect porous materials from water damage.
 - b. Protect stored and installed material from flowing or standing water.
 - c. Keep porous and organic materials from coming into prolonged contact with concrete.
 - d. Remove standing water from decks.
 - e. Keep deck openings covered or dammed.

- C. Partially Enclosed Construction Phase:
 1. 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:

- a. Do not load or install drywall or other porous materials or components, or items with high organic content, into partially enclosed building.
- b. Keep interior spaces reasonably clean and protected from water damage.
- c. Periodically collect and remove waste containing cellulose or other organic matter.
- d. Discard or replace water-damaged material.
- e. Do not install material that is wet.
- f. Discard, replace, or clean stored or installed material that begins to grow mold.
- g. Perform Work in a sequence that allows any wet materials adequate time to dry before enclosing the material in drywall or other interior finishes.

D. Controlled Condition Phase of Construction:

1. After completing and sealing of the building enclosure but prior to the full operation of permanent HVAC systems, maintain as follows:
 - a. Control moisture and humidity inside building by maintaining effective dry-in conditions.
 - b. Use permanent HVAC system to control humidity.
 - c. Comply with manufacturer's written instructions for temperature, relative humidity, and exposure to water limits and moisture control:
 - 1) Hygroscopic materials that may support mold growth, including wood and gypsum based products, which become wet during the course of construction and remain wet for 48 hours are considered defective and are to be removed and replaced.
 - 2) Measure moisture content of materials that have been exposed to moisture during construction operations or after installation. Record readings beginning at time of exposure and continuing daily for 48 hours. Identify materials containing moisture levels higher than allowed. Report findings in writing to Architect.
 - 3) Remove materials that cannot be completely restored to their manufactured moisture level within 48 hours.

3.7 OPERATION, TERMINATION, AND REMOVAL

A. Supervision:

1. Enforce strict discipline in use of temporary facilities. To minimize waste and abuse, limit availability of temporary facilities to essential and intended uses.

B. Maintenance:

1. Maintain facilities in good operating condition until removal:
 - a. Maintain operation of temporary enclosures, heating, cooling, humidity control, ventilation, and similar facilities on a 24-hour basis where required to achieve indicated results and to avoid possibility of damage.

C. Temporary Facility Changeover:

1. Do not change over from using temporary security and protection facilities to permanent facilities until Substantial Completion unless otherwise required and approved by Owner and Architect.

D. Termination and Removal:

1. Remove each temporary facility when need when its service has ended, when it has been replaced by authorized use of a permanent facility, or no later than Substantial Completion. Complete or, if necessary, restore permanent construction that may have been delayed because of interference with temporary facility. Repair damaged Work, clean exposed surfaces, and replace construction that cannot be satisfactorily repaired:

- a. Materials and facilities that constitute temporary facilities are property of Contractor. Owner reserves right to take possession of Project identification signs.
- b. Remove temporary roads and paved areas not intended for or acceptable for integration into permanent construction. Where area is intended for landscape development, remove soil and aggregate fill that do not comply with requirements for fill or subsoil. Remove materials contaminated with road oil, asphalt and other petrochemical compounds, and other substances that might impair growth of plant materials or lawns. Repair or replace street paving, curbs, and sidewalks at temporary entrances, as required by authorities having jurisdiction.
- c. At Substantial Completion, repair, renovate, and clean permanent facilities used during construction period. Comply with final cleaning requirements specified in Section 01 77 22: Substantial Completion Procedures.

END OF SECTION 01 50 00

SECTION 01 60 00 PRODUCT REQUIREMENTS

PART 1 GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section includes administrative and procedural requirements for selection of products, including but not limited to:
 1. Product delivery, storage, and handling.
 2. Manufacturers' written warranties on products.
 3. Special warranties.
 4. Comparable products.

1.3 DEFINITIONS

- A. Basis of Design Product Specification:
 1. A Specification in which a specific manufacturer's product is named and accompanied by the words *basis of design*, including make, 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:
 1. Items obtained for incorporating into the Work, whether purchased for Project or taken from previously purchased stock. The term *product* includes the terms *material*, *equipment*, *system*, *assembly*, and terms of similar intent:
 - a. Named products: Items identified by manufacturer's product name, including make, model number, or other designation shown or listed in manufacturer's published product literature current as of date of the Contract Documents.
 - b. New products: Items that have not previously been incorporated into another project or facility. Products salvaged or recycled from other projects are not considered new products.
 - c. Comparable product: Product that is demonstrated and approved through submittal process to have the indicated qualities related to type, function, dimension, in-service performance, physical properties, appearance, and other characteristics that equal or exceed those of specified product.

1.4 SUBMITTALS

- A. Comparable Product Requests:
 1. Submit request for consideration of each comparable product. Identify product or fabrication or installation method to be replaced. Include Specification Section number and title, and Drawing number(s) and title(s):
 - a. Include data to indicate compliance with the specified requirements.
 - b. Architect's action: If necessary, Architect will request additional information or documentation for evaluation within one (1) week of receipt of a comparable product request. Architect will notify Contractor of approval or rejection of proposed comparable product request within 15 days of receipt of request, or seven (7) days

- of receipt of additional information or documentation, whichever is later:
- 1) Form of Approval: As specified in Section 01 33 00: Submittal Procedures.
 - 2) Use product specified if Architect does not issue a decision on use of a comparable product request within time allocated.

- B. Basis of Design Product Specification Submittal:
1. Comply with requirements in Section 01 33 00: Submittal Procedures. Show compliance with requirements.

1.5 QUALITY ASSURANCE

- A. Compatibility of Options:
1. If Contractor is given option of selecting between two (2) or more products for use on Project, select a product compatible with products previously selected, even if previously selected products were also options:
 - a. Each contractor is responsible for providing products and construction methods compatible with products and construction methods of other contractors.
 - b. If a dispute arises between contractors over concurrently selectable but incompatible products, Architect will determine which products shall be used.

1.6 WARRANTY

- A. Warranties specified in other Sections shall be in addition to, and run concurrent with, other warranties required by the Contract Documents. Manufacturer's disclaimers and limitations on product warranties do not relieve Contractor of obligations under requirements of the Contract Documents:
1. Manufacturer's warranty: Written warranty furnished by individual manufacturer for a particular product and specifically endorsed by manufacturer to Owner.
 2. Warranty: Written warranty required by the Contract Documents to provide specific rights for Owner.
- B. Warranties:
1. Prepare a written document that contains appropriate terms and identification, ready for execution:
 - a. Specified form: When specified forms are included with the Specifications, prepare a written document using indicated form properly executed.
 - b. See other Sections for specific content requirements and particular requirements for submitting special warranties.
- C. Submittal Time:
1. Comply with requirements in Section 01 77 00: Closeout Procedures.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Deliver, store, and handle products using means and methods that will prevent damage, deterioration, and loss, including theft and vandalism. Comply with manufacturer's written instructions.
- B. Delivery and Handling:
1. Schedule delivery to minimize long-term storage at site and to prevent overcrowding of construction spaces.
 2. Coordinate delivery with installation time to ensure minimum holding time for items that are flammable, hazardous, easily damaged, or sensitive to deterioration, theft, and other losses.
 3. Deliver products to Project site in an undamaged condition in manufacturer's original

sealed container or other packaging system, complete with labels and instructions for handling, storing, unpacking, protecting, and installing.

4. Inspect products on delivery to determine compliance with the Contract Documents, and to determine that products are undamaged and properly protected.

C. Storage:

1. Store products to allow for inspection and measurement of quantity or counting of units.
2. Store materials in a manner that will not endanger Project structure.
3. Store products that are subject to damage by the elements under cover in a weathertight enclosure above ground, with ventilation adequate to prevent condensation.
4. Protect foam plastic from exposure to sunlight, except to extent necessary for period of installation and concealment.
5. Comply with product manufacturer's written instructions for temperature, humidity, ventilation, and weather-protection requirements for storage.
6. Protect stored products from damage and liquids from freezing.
7. Provide a secure location and enclosure at site for storage of materials and equipment by Owner's construction forces. Coordinate location with Owner.

PART 2 PRODUCTS

2.1 PRODUCT SELECTION PROCEDURES

A. Product Requirements:

1. Provide products that comply with the Contract Documents, are undamaged, and unless otherwise indicated, are new at time of installation:
 - a. Provide products complete with accessories, trim, finish, fasteners, and items needed for complete installation and indicated use and effect.
 - b. Standard products: If available, and unless custom products or nonstandard options are specified, provide standard products of types that have been produced and used successfully in similar situations on other projects.
 - c. Owner reserves the right to limit selection to products with warranties not in conflict with requirements of the Contract Documents.
 - d. Where products are accompanied by the phrase *as selected*, Architect will make selection.
 - e. Descriptive, performance, and reference standard requirements in the Specifications establish salient characteristics of products.

B. Product Selection Procedures:

1. Product: Where Specifications name a single manufacturer and product, provide the named product that complies with requirements. Comparable products or substitutions for Contractor's convenience will not be considered.
2. 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.
3. Products: Where Specifications include a list of names of both manufacturers and products, provide one of the products listed that complies with requirements. Comparable products or substitutions for Contractor's convenience will not be considered.
4. Manufacturers: Where Specifications include a list of manufacturers' names, provide a product by one of the manufacturers listed that complies with requirements. Comparable products or substitutions for Contractor's convenience will not be considered.

5. Basis of Design Product: Where Specifications name a product, or refer to a product indicated on Drawings, and include a list of manufacturers, provide the specified or indicated product or a comparable product by one of the other named manufacturers. Drawings and Specifications indicate sizes, profiles, dimensions, and characteristics based on the product named. Comply with requirements for consideration of an unnamed product by one of the named manufacturers.
- C. Visual Matching Specification:
1. Where Specifications require *match Architect's sample*, provide a product that complies with requirements and matches Architect's sample. Architect's decision will be final on whether a proposed product matches:
 - a. If no product available within specified category matches and complies with specified requirements, comply with requirements of Section 01 25 00: Substitution Procedures and Form for proposal of product.
- D. Visual Selection Specification: Where Specifications include the phrase *selected by Architect* or similar phrase, select a product that complies with requirements. Architect will select color, gloss, pattern, density, or texture from manufacturer's product line that includes both standard and premium items.

2.2 COMPARABLE PRODUCTS

- A. Conditions for Consideration:
1. Architect will consider Contractor's request for comparable product when the following conditions are satisfied. If the following conditions are not satisfied, Architect may return requests without action, except to record noncompliance with these requirements:
 - a. Evidence that the proposed product does not require revisions to the Contract Documents, that it is consistent with the Contract Documents and will produce the indicated results, and that it is compatible with other portions of the Work.
 - b. Detailed comparison of significant qualities of proposed product with those named in the Specifications. Significant qualities include attributes such as performance, weight, size, durability, visual effect, and specific features and requirements indicated.
 - c. Evidence that proposed product provides specified warranty.
 - d. List of similar installations for completed projects with project names and addresses, and names and addresses of architects and owners, if requested.
 - e. Samples, if requested.

PART 3 EXECUTION (NOT USED)

END OF SECTION 01 60 00

SECTION 01 71 23 - FIELD ENGINEERING

PART 1 – GENERAL

1.01 SECTION INCLUDES

- A. Layout of the work.
- B. Verification of work.
 - 1. Owner reserves the right to verify any work that Inspector deems necessary.
 - 2. Other sections that require Surveyor to verify or measure installed work and related item. Surveyor shall perform such verifications or measurements at Contractor's expense. Contractor shall furnish a certification, signed by both Surveyor and Contractor, to Inspector.

1.02 RELATED SECTIONS

- A. General Conditions.
- B. Section 01 11 00: Summary of Work.
- C. Section 01 31 13: Project Coordination.
- D. Section 01 32 13: Construction Schedule.
- E. Section 01 33 00: Submittal Procedures.

1.03 SURVEY CONTROLS

- A. Vertical Control shall use same benchmark used in the preparation of topographic survey. When Work consists of both on-site and off-site and benchmarks differ, an equation shall be indicated on Drawings.
- B. Horizontal control for existing structures shall be the property line.

1.04 LAYOUT OF WORK

- A. All work related to staking shall be by a Land Surveyor, or Civil engineer, registered with the State of California to perform land surveying and employed by Contractor.
- B. Before commencement of Work, surveyor shall locate all reference points and benchmarks to be used for vertical and horizontal control.
- C. Surveyor shall lay out entire Work, set grades, lines, levels, control points, elevations, grids and positions.

1.05 RECORD DOCUMENTS

- A. Maintain complete and accurate log of all control and survey documentation as work progresses.
- B. Record, by coordinates, all utilities onsite with top of pipe elevations, at major grade and alignment changes, rim, grate or top of curb and flow line elevations of all drainage structures and sewer manholes.
- C. Indicate reference and control points on record drawings. The basis of elevation shall be one of the established benchmarks.
- D. Upon Beneficial Occupancy, obtain and pay for reproducible plans. Deliver plans to District Representative. Clearly indicate all differences between original drawings and completed work within specified tolerances.

1.06

SUBMITTALS

- A. Surveyor: Shall submit name, address and license number to Owner, including any changes as they occur.
- B. Field notes: Upon request by District Representative, submit copies of cut sheets, coordinate plots, data collector printouts, marked-up construction staking plans and other documentation as available to verify accuracy of field engineering work during and at completion of project. Submittals to Owner must be signed and sealed by Surveyor and counter-signed by Contractor
- C. Statement of Compliance: Contractor shall submit a statement of certification signed and sealed by Surveyor, counter-signed by Contractor indicating compliance with grades and alignment of construction plans at rough grade, fine grade and top of rock stages. Inspector shall approve survey submittals for each stage of construction prior to proceeding with work
- D. Upon Beneficial Occupancy, Contractor shall obtain and pay for reproducible survey drawings (or "As Built").
- E. Completed record drawings shall be signed and certified as correct and within specified tolerances by licensed surveyor. Originals and two sets of blueprints shall be submitted to Owner.

PART 2 – PRODUCTS (Not used)

PART 3 – EXECUTION

3.01

PREPARATION

- A. Pre-mark areas of excavation in accordance with the requirements of "Dig-Alert". Request locators 2 days before commencing excavation.
- B. Before commencing Work, establish all horizontal and vertical reference points used in Contract Documents according to existing field conditions.
- C. Preserve established reference lines and benchmarks.
- D. Differentiate school and city datum as applicable.
- E. Relocate bench marks that may interfere with Work.
- F. Reset and re-establish reference marks damaged or lost during construction.

3.02

SURVEY REQUIREMENTS GENERAL

- A. Establish a minimum of two permanent horizontal and vertical control points on Project site, remote from construction area, referenced to data established by control points.
- B. Indicate reference points, relative to benchmark elevation, on record drawings.
- C. Provide grade stakes and elevations to construct over excavation and re-compaction, rough and final grades, paved areas, curbs, gutters, sidewalks, building pads, landscaped areas, and other areas as required.
- D. Calculate and layout proposed finished elevations and intermediate controls, as required, to provide smooth transitions between spot elevations indicated on Drawings.
- E. Provide stakes and elevations for grading, fill, and topsoil placement.
- F. Provide adequate horizontal and vertical control to locate utility lines, including but not limited to, storm, sewers, water mains, gas, electric and signal and provide vertical

control in proportion to the slope of the line as required for accurate construction. Dry utilities will be based upon adequate horizontal and vertical control layout. Prior to trench closure, survey and record invert and flow line elevations. Survey and record top of curb and flow line elevations on finished concrete or asphaltic concrete (AC) surfaces at key locations such as beginning-of-curve (BC), end-of-curve (EC), grade breaks, corners or angle points in sufficient number to demonstrate the Work complies with the intent of the Contract Documents.

- G. Provide horizontal and vertical control for batter boards for drainage, utility, and other on-site structures as required.
- H. Furnish building corner offsets as required to adequately locate building pads. Provide cut and fill stakes within the building pad perimeter adequate to control both over excavation and re-compaction and the final sub-grade elevation of the building pad.
- I. Submit a certification signed by the surveyor confirming the elevations and locations of improvements are in conformance with the Contract Documents. The statement shall include survey notes for the finish floor and building pad, showing the actual measured elevations on the completed sub-grade, recorded to the nearest 0.01 of a foot. Building pad tolerance will be plus or minus 0.1 of a foot.
- J. Establish a minimum of two permanent horizontal and vertical control points on Project site, remote from building area, referenced to data established by survey control points.
- K. Mark boundaries for rights-of-way dedications and easements for utilities prior to making location of buildings and utilities.
- L. Layout all lines, elevations, and measurements needed for construction or installation of buildings, grading, paving utilities according to the following:
 - 1. Identify site boundary, property lines.
 - 2. Provide working benchmarks.
 - 3. Set stakes for Bottom of Excavated Plane (B.E.P.).
 - 4. Set gridlines, radii, working points etcetera, for foundation.
 - 5. Set and verify building pad elevations.
 - 6. Set finish floor elevations.
 - 7. Stake location and elevations for exterior ramps and stairs.
 - 8. Set gridlines, radii, working points, etcetera, for all floors of multi-story buildings.
 - 9. Set storm drain and sanitary sewer inverts and other utilities as needed at 5-foot off-set from building lines.
 - 10. For new facilities, establish permanent onsite Benchmark with 2-inch diameter brass disk. Location of Benchmark to be determined by Owner.

3.03 SURVEY REQUIREMENTS FOR GRADING

- A. Provide grade stakes and elevations as follows:
 - 1. Removal limits (cut lines).
 - 2. Rough grade staking: 60-foot maximum grid plus additional stakes at grade changes and pertinent locations. Flag all grade changes including ridges, flow lines and grade breaks.

3. Fine grade for top of dirt: 30-foot maximum grid plus additional stakes at grade changes and pertinent locations. Flag all grade changes including ridges, flow lines and grade breaks.
 4. Verify fine grade for top of rock: 30-foot maximum grid plus additional stakes at grade changes and pertinent locations. Flag all grade changes including ridges, flow lines and grade breaks.
 5. Finish grade marks on all buildings, structures and at pertinent locations
 6. Finish grades and offsets for all concrete work, utilities, landscape areas, and structures.
 7. Provide controls and baselines for playground striping.
 8. Offsite improvements: set grades and provide grade sheets as required by local authorities.
- B. Provide a minimum of two permanent horizontal and vertical control points onsite, remote from building area, referenced to data established by survey control points.

3.04 SURVEY REQUIREMENTS FOR UTILITIES

- A. Locate "wet" utility lines and provide vertical control proportionate to slope of line as required for accurate construction. "Dry" utilities shall have adequate horizontal and vertical control layout supplied by others.
- B. Prior to back-filling trench, survey and record invert and flow line elevations. Survey and record top of curb and flow line elevations on finished surfaces at key locations (such as Back of Curbs, grade breaks, corners or angle points) in sufficient number to demonstrate Work complies with intent of Contract Documents.
- C. Provide horizontal and vertical control for batter boards for drainage, utility, and other on-site structures as required.
 1. Set grades for vaults one inch higher than adjacent surrounding design grades, unless noted otherwise.
- D. Leave all trenches open until required inspection is completed.

3.05 SURVEY REQUIREMENTS FOR STRUCTURES

- A. Furnish building corner offsets as required to adequately locate building pads. Provide cut and fill stakes within building pad perimeter adequate to control both over excavation and re-compaction and final sub-grade elevation of building pad.
- B. Submit a certification signed by surveyor confirming elevations and locations of improvements are in conformance with Contract Documents. Statement shall include survey notes for finish floor and building pad, showing actual measured elevations on completed sub-grade, recorded to nearest 0.01 of a foot. Building pad tolerance will be plus or minus 0.1 of a foot.

END OF SECTION 01 71 23

SECTION 01 74 19 CONSTRUCTION WASTE MANAGEMENT AND DISPOSAL

PART 1 GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section includes administrative and procedural requirements for the following:
 1. Salvaging nonhazardous demolition and construction waste.
 2. Recycling nonhazardous demolition and construction waste.
 3. Disposing of nonhazardous demolition and construction waste.

1.3 DEFINITIONS

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

1.4 SUBMITTALS

- A. Waste Management Plan: Submit plan within ten (10) days of date established for commencement of the Work.
- B. Waste Reduction Progress Reports:
 1. Concurrent with each Application for Payment, submit report. Use Form CWM-7 for construction waste and Form CWM-8 for demolition waste. Include the following information:
 - a. Material category.
 - b. Generation point of waste.
 - c. Total quantity of waste in tons (tonnes).
 - d. Quantity of waste salvaged, both estimated and actual in tons (tonnes).
 - e. Quantity of waste recycled, both estimated and actual in tons (tonnes).
 - f. Total quantity of waste recovered (salvaged plus recycled) in tons (tonnes).
 - g. Total quantity of waste recovered (salvaged plus recycled) as a percentage of total

waste.

- C. Waste Reduction Calculations: Before request for Substantial Completion, submit calculated end of Project rates for salvage, recycling, and disposal as a percentage of total waste generated by the Work.
- D. Records of Donations: Indicate receipt and acceptance of salvageable waste donated to individuals and organizations. Indicate whether organization is tax exempt.
- E. Records of Sales: Indicate receipt and acceptance of salvageable waste sold to individuals and organizations. Indicate whether organization is tax exempt.
- F. Recycling and Processing Facility Records: Indicate receipt and acceptance of recyclable waste by recycling and processing facilities licensed to accept them. Include manifests, weight tickets, receipts, and invoices.
- G. Landfill and Incinerator Disposal Records: Indicate receipt and acceptance of waste by landfills and incinerator facilities licensed to accept them. Include manifests, weight tickets, receipts, and invoices.
- H. Statement of Refrigerant Recovery: Signed by refrigerant recovery technician responsible for recovering refrigerant, stating that refrigerant that was present was recovered and that recovery was performed according to EPA regulations. Include name and address of technician and date refrigerant was recovered.

1.5 QUALITY ASSURANCE

- A. Waste Management Coordinator Qualifications: Firm having minimum ten (10) years of documented experience in specializing in waste management coordination.
- B. Refrigerant Recovery Technician Qualifications: Certified by EPA-approved certification program.
- C. Regulatory Requirements: Comply with hauling and disposal regulations of authorities having jurisdiction.
- D. Waste Management Conference:
 - 1. Conduct conference at site. Review methods and procedures related to waste management including, but not limited to, the following:
 - a. Review and discuss waste management plan including responsibilities of waste management coordinator.
 - b. Review requirements for documenting quantities of each type of waste and its disposition.
 - c. Review and finalize procedures for materials separation and verify availability of containers and bins needed to avoid delays.
 - d. Review procedures for periodic waste collection and transportation to recycling and disposal facilities.
 - e. Review waste management requirements for each trade.

1.6 PERFORMANCE REQUIREMENTS

- A. Conform to County regulations regarding Solid Waste Control.
- B. Achieve end of Project rates for salvage/recycling of 50 percent by weight of total nonhazardous solid waste generated by the Work. Practice efficient waste management in

the use of materials in the course of the Work. Use all reasonable means to divert construction and demolition waste from landfills and incinerators. Facilitate recycling and salvage of materials:

1. Demolition waste:
 - a. Asphalt paving.
 - b. Concrete.
 - c. Concrete reinforcing steel.
 - d. Brick.
 - e. Concrete masonry units.
 - f. Wood studs.
 - g. Wood joists.
 - h. Plywood and oriented strand board.
 - i. Wood paneling.
 - j. Wood trim.
 - k. Structural and miscellaneous steel.
 - l. Rough hardware.
 - m. Roofing.
 - n. Insulation.
 - o. Doors and frames.
 - p. Door hardware.
 - q. Windows.
 - r. Glazing.
 - s. Metal studs.
 - t. Gypsum board.
 - u. Acoustical tile and panels.
 - v. Carpet.
 - w. Carpet pad.
 - x. Demountable partitions.
 - y. Equipment.
 - z. Cabinets.
 - aa. Plumbing fixtures.
 - bb. Piping.
 - cc. Supports and hangers.
 - dd. Valves.
 - ee. Sprinklers.
 - ff. Mechanical equipment.
 - gg. Refrigerants.
 - hh. Electrical conduit.
 - ii. Copper wiring.
 - jj. Lighting fixtures.
 - kk. Lamps.
 - ll. Ballasts.
 - mm. Electrical devices.
 - nn. Switchgear and panelboards.
 - oo. Transformers.
2. Construction waste:
 - a. Masonry and CMU.
 - b. Lumber.
 - c. Wood sheet materials.
 - d. Wood trim.
 - e. Metals.
 - f. Roofing.
 - g. Insulation.
 - h. Carpet and pad.
 - i. Gypsum board.
 - j. Piping.

- k. Electrical conduit.
- l. Packaging - Regardless of salvage/recycle goal indicated in "General" Paragraph above, salvage or recycle 100 percent of the following uncontaminated packaging materials:
 - 1) Paper.
 - 2) Cardboard.
 - 3) Boxes.
 - 4) Plastic sheet and film.
 - 5) Polystyrene packaging.
 - 6) Wood crates.
 - 7) Plastic pails.

1.7 WASTE MANAGEMENT PLAN

- A. Develop a waste management plan and requirements. Plan shall consist of waste identification, waste reduction work plan, and cost/revenue analysis. Distinguish between demolition and construction waste. Indicate quantities by weight or volume but use same units of measure throughout waste management plan.
- B. Waste Identification: Indicate anticipated types and quantities of demolition site clearing and construction waste generated by the Work. Use Form CWM-1 for construction waste and Form CWM-2 for demolition waste. Include estimated quantities and assumptions for estimates.
- C. Waste Reduction Work Plan:
 - 1. List each type of waste and whether it will be salvaged, recycled, or disposed of in landfill or incinerator. Use Form CWM-3 for construction waste and Form CWM-4 for demolition waste. Include points of waste generation, total quantity of each type of waste, quantity for each means of recovery, and handling and transportation procedures:
 - a. Salvaged materials for reuse: For materials that will be salvaged and reused in this Project, describe methods for preparing salvaged materials before incorporation into the Work.
 - b. Salvaged materials for sale: For materials that will be sold to individuals and organizations, include list of their names, addresses, and telephone numbers.
 - c. Salvaged materials for donation: For materials that will be donated to individuals and organizations, include list of their names, addresses, and telephone numbers.
 - d. Recycled materials: Include list of local receivers and processors and type of recycled materials each will accept. Include names, addresses, and telephone numbers.
 - e. Disposed materials: Indicate how and where materials will be disposed of. Include name, address, and telephone number of each landfill and incinerator facility.
 - f. Handling and transportation procedures: Include method that will be used for separating recyclable waste including sizes of containers, container labeling, and designated location where materials separation will be performed.
- D. Cost/Revenue Analysis:
 - 1. Indicate total cost of waste disposal as if there was no waste management plan and net additional cost or net savings resulting from implementing waste management plan. Use Form CWM-5 for construction waste and Form CWM-6 for demolition waste. Include the following:
 - a. Total quantity of waste.
 - b. Estimated cost of disposal (cost per unit). Include hauling and tipping fees and cost of collection containers for each type of waste.
 - c. Total cost of disposal (with no waste management).
 - d. Revenue from salvaged materials.

- e. Revenue from recycled materials.
- f. Savings in hauling and tipping fees by donating materials.
- g. Savings in hauling and tipping fees that are avoided.
- h. Handling and transportation costs. Include cost of collection containers for each type of waste.
- i. Net additional cost or net savings from waste management plan.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION

3.1 PLAN IMPLEMENTATION

- A. Implement approved waste management plan. Provide handling, containers, storage, signage, transportation, and other items as required to implement waste management plan during the entire duration of the Contract:
 - 1. Comply with operation, termination, and removal requirements in Section 01 50 00: Temporary Facilities and Controls.
- B. Waste Management Coordinator: Engage a waste management coordinator to be responsible for implementing, monitoring, and reporting status of waste management work plan.
- C. Training:
 - 1. Train workers, subcontractors, and suppliers on proper waste management procedures, as appropriate for the Work:
 - a. Distribute waste management plan to everyone concerned within three (3) days of submittal return.
 - b. Distribute waste management plan to entities when they first begin work onsite. Review plan procedures and locations established for salvage, recycling, and disposal.
- D. Site Access and Temporary Controls:
 - 1. Conduct waste management operations to ensure minimum interference with roads, streets, walks, walkways, and other adjacent occupied and used facilities:
 - a. Designate and label specific areas on Project site necessary for separating materials that are to be salvaged, recycled, reused, donated, and sold.
 - b. Comply with Section 01 50 00: Temporary Facilities and Controls for the control of dust and dirt, environmental protection, and noise control.
- E. Waste Management in Historic Zones or Areas: Hauling equipment and other materials shall be of sizes that clear surfaces within historic spaces, areas, rooms, and openings, by 12 inches (300 mm) or more.

3.2 SALVAGING DEMOLITION WASTE

- A. Salvaged Items for Reuse in the Work:
 - 1. Salvage items for reuse and handle:
 - a. Clean salvaged items.
 - b. Pack or crate items after cleaning. Identify contents of containers with label indicating elements, date of removal, quantity, and location where removed.
 - c. Store items in a secure area until installation.
 - d. Protect items from damage during transport and storage.
 - e. Install salvaged items to comply with installation requirements for new materials

and equipment. Provide connections, supports, and miscellaneous materials necessary to make items functional for use indicated.

- B. Salvaged Items for Sale and Donation: Not permitted on Project site.
- C. Salvaged Items for Owner's Use:
 - 1. Salvage items for Owner's use and handle as follows:
 - a. Clean salvaged items.
 - b. Pack or crate items after cleaning. Identify contents of containers with label indicating elements, date of removal, quantity, and location where removed.
 - c. Store items in a secure area until delivery to Owner.
 - d. Transport items to Owner's storage area designated by Owner.
 - e. Protect items from damage during transport and storage.
- D. Doors and Hardware: Brace open end of door frames. Except for removing door closers, leave door hardware attached to doors, unless otherwise designated by Owner.
- E. Equipment: Drain tanks, piping, and fixtures. Seal openings with caps or plugs. Protect equipment from exposure to weather.
- F. Plumbing Fixtures: Separate by type and size.
- G. Lighting Fixtures: Separate lamps by type and protect from breakage.
- H. Electrical Devices: Separate switches, receptacles, switchgear, transformers, meters, panelboards, circuit breakers, and other devices by type.

3.3 RECYCLING WASTE

- A. Recycle paper and beverage containers used by onsite workers.
- B. Recycling Incentives: Revenues, savings, rebates, tax credits, and other incentives received for recycling waste materials shall accrue to Owner.
- C. Preparation of Waste: Prepare and maintain recyclable waste materials according to recycling or reuse facility requirements. Maintain materials free of dirt, adhesives, solvents, petroleum contamination, and other substances deleterious to the recycling process.
- D. Procedures:
 - 1. Separate recyclable waste from other waste materials, trash, and debris. Separate recyclable waste by type at Project site to the maximum extent practical according to approved construction waste management plan:
 - a. Provide appropriately marked containers or bins for controlling recyclable waste until removed from Project site. Include list of acceptable and unacceptable materials at each container and bin:
 - 1) Inspect containers and bins for contamination and remove contaminated materials if found.
 - b. Stockpile processed materials onsite without intermixing with other materials. Place, grade, and shape stockpiles to drain surface water. Cover to prevent windblown dust.
 - c. Stockpile materials away from construction area. Do not store within drip line of remaining trees.
 - d. Store components off the ground and protect from the weather.
 - e. Remove recyclable waste from Owner's property and transport to recycling receiver or processor.

3.4 DISPOSAL OF WASTE

- A. Except for items or materials to be salvaged, recycled, or otherwise reused, remove waste materials from Project site and legally dispose of them in a landfill or incinerator acceptable to authorities having jurisdiction:
 - 1. Except as otherwise specified, do not allow waste materials that are to be disposed of to accumulate onsite.
 - 2. Remove and transport debris in a manner that will prevent spillage on adjacent surfaces and areas.
- B. Burning:
 - 1. Do not burn waste materials:
 - a. Burning of waste materials is permitted only at designated areas on Owner's property, provided required permits are obtained. Provide full-time monitoring for burning materials until fires are extinguished.
- C. Disposal: Remove waste materials and dispose of at designated spoil areas on Owner's property.

3.5 ATTACHMENTS

- A. Form CWM-1 for construction waste identification.
- B. Form CWM-2 for demolition waste identification.
- C. Form CWM-3 for construction waste reduction work plan.
- D. Form CWM-4 for demolition waste reduction work plan.
- E. Form CWM-5 cost/revenue analysis of construction waste reduction work plan.
- F. Form CWM-6 cost/revenue analysis of demolition waste reduction work plan.
- G. Form CWM-7 for construction waste
- H. Form CWM-8 for demolition waste.

CWM FORMS ON FOLLOWING PAGES

FORM CWM-1: CONSTRUCTION WASTE IDENTIFICATION							
MATERIAL CATEGORY	GENERATION POINT	EST. QUANTITY OF MATERIALS RECEIVED* (A)	EST. WASTE - % (B)	TOTAL EST. QUANTITY OF WASTE* (C = A x B)	EST. VOLUME CY (CM)	EST. WEIGHT TONS (TONNES)	REMARKS AND ASSUMPTIONS
Packaging: Cardboard							
Packaging: Boxes							
Packaging: Plastic Sheet or Film							
Packaging: Polystyrene							
Packaging: Pallets or Skids							
Packaging: Crates							
Packaging: Paint Cans							
Packaging: Plastic Pails							
Site-Clearing Waste							
Masonry or CMU							
Lumber: Cut-Offs							
Lumber: Warped Pieces							
Plywood or OSB (scraps)							
Wood Forms							
Wood Waste Chutes							
Wood Trim (cut-offs)							
Metals							
Insulation							
Roofing							
Joint Sealant Tubes							
Gypsum Board (scraps)							
Carpet and Pad (scraps)							
Piping							
Electrical Conduit							
Other:							

FORM CWM-2: DEMOLITION WASTE IDENTIFICATION				
MATERIAL DESCRIPTION	EST. QUANTITY	EST. VOLUME CY (CM)	EST. WEIGHT TONS (TONNES)	REMARKS AND ASSUMPTIONS
Asphaltic Concrete Paving				
Concrete				
Brick				
CMU				
Lumber				
Plywood and OSB				
Wood Paneling				
Wood Trim				
Miscellaneous Metals				
Structural Steel				
Rough Hardware				
Insulation				
Roofing				
Doors and Frames				
Door Hardware				
Windows				
Glazing				
Acoustical Tile				
Carpet				
Carpet Pad				
Demountable Partitions				
Equipment				
Cabinets				
Plumbing Fixtures				
Piping				
Piping Supports and Hangers				
Valves				
Sprinklers				
Mechanical Equipment				
Electrical Conduit				
Copper Wiring				
Light Fixtures				
Lamps				
Lighting Ballasts				
Electrical Devices				
Switchgear and Panelboards				
Transformers				
Other:				

FORM CWM-3: CONSTRUCTION WASTE REDUCTION WORK PLAN						
MATERIAL CATEGORY	GENERATION POINT	TOTAL EST. QUANTITY OF WASTE TONS (TONNES)	DISPOSAL METHOD AND QUANTITY			HANDLING AND TRANSPORTION PROCEDURES
			EST. AMOUNT SALVAGED TONS (TONNES)	EST. AMOUNT RECYCLED TONS (TONNES)	EST. AMOUNT DISPOSED TO LANDFILL TONS (TONNES)	
Packaging: Cardboard						
Packaging: Boxes						
Packaging: Plastic Sheet or Film						
Packaging: Polystyrene						
Packaging: Pallets or Skids						
Packaging: Crates						
Packaging: Paint Cans						
Packaging: Plastic Pails						
Site-Clearing Waste						
Masonry or CMU						
Lumber: Cut-Offs						
Lumber: Warped Pieces						
Plywood or OSB (scraps)						
Wood Forms						
Wood Waste Chutes						
Wood Trim (cut-offs)						
Metals						
Insulation						
Roofing						
Joint Sealant Tubes						
Gypsum Board (scraps)						
Carpet and Pad (scraps)						
Piping						
Electrical Conduit						
Other:						

FORM CWM-4: DEMOLITION WASTE REDUCTION WORK PLAN						
MATERIAL CATEGORY	GENERATION POINT	TOTAL EST. QUANTITY OF WASTE TONS (TONNES)	DISPOSAL METHOD AND QUANTITY			HANDLING AND TRANSPORTION PROCEDURES
			EST. AMOUNT SALVAGED TONS (TONNES)	EST. AMOUNT RECYCLED TONS (TONNES)	EST. AMOUNT DISPOSED TO LANDFILL TONS (TONNES)	
Asphaltic Concrete Paving						
Concrete						
Brick						
CMU						
Lumber						
Plywood and OSB						
Wood Paneling						
Wood Trim						
Miscellaneous Metals						
Structural Steel						
Rough Hardware						
Insulation						
Roofing						
Doors and Frames						
Door Hardware						
Windows						
Glazing						
Acoustical Tile						
Carpet						
Carpet Pad						
Demountable Partitions						
Equipment						
Cabinets						
Plumbing Fixtures						
Piping						
Supports and Hangers						
Valves						
Sprinklers						
Mechanical Equipment						
Electrical Conduit						
Copper Wiring						
Light Fixtures						
Lamps						
Lighting Ballasts						
Electrical Devices						
Switchgear and Panelboards						
Transformers						
Other:						

FORM CWM-5: COST/REVENUE ANALYSIS OF CONSTRUCTION WASTE REDUCTION WORK PLAN								
MATERIALS	TOTAL QUANTITY OF MATERIALS (VOL. OR WEIGHT) (A)	EST. COST OF DISPOSAL (B)	TOTAL EST. COST OF DISPOSAL (C = A x B)	REVENUE FROM SALVAGED MATERIALS (D)	REVENUE FROM RECYCLED MATERIALS (E)	LANDFILL TIPPING FEES AVOIDED (F)	HANDLING AND TRANSPORTATION COSTS AVOIDED (G)	NET COST SAVINGS OF WORK PLAN (H = D+E+F+G)
Packaging: Cardboard								
Packaging: Boxes								
Packaging: Plastic Sheet or Film								
Packaging: Polystyrene								
Packaging: Pallets or Skids								
Packaging: Crates								
Packaging: Paint Cans								
Packaging: Plastic Pails								
Site-Clearing Waste								
Masonry or CMU								
Lumber: Cut-Offs								
Lumber: Warped Pieces								
Plywood or OSB (scraps)								
Wood Forms								
Wood Waste Chutes								
Wood Trim (cut-offs)								
Metals								
Insulation								
Roofing								
Joint Sealant Tubes								
Gypsum Board (scraps)								
Carpet and Pad (scraps)								
Piping								
Electrical Conduit								
Other:								

FORM CWM-6: COST/REVENUE ANALYSIS OF DEMOLITION WASTE REDUCTION WORK PLAN								
MATERIALS	TOTAL QUANTITY OF MATERIALS (VOL. OR WEIGHT) (A)	EST. COST OF DISPOSAL (B)	TOTAL EST. COST OF DISPOSAL (C = A x B)	REVENUE FROM SALVAGED MATERIALS (D)	REVENUE FROM RECYCLED MATERIALS (E)	LANDFILL TIPPING FEES AVOIDED (F)	HANDLING AND TRANSPORTATION COSTS AVOIDED (G)	NET COST SAVINGS OF WORK PLAN (H = D+E+F+G)
Asphaltic Concrete Paving								
Concrete								
Brick								
CMU								
Lumber								
Plywood and OSB								
Wood Paneling								
Wood Trim								
Miscellaneous Metals								
Structural Steel								
Rough Hardware								
Insulation								
Roofing								
Doors and Frames								
Door Hardware								
Windows								
Glazing								
Acoustical Tile								
Carpet								
Carpet Pad								
Demountable Partitions								
Equipment								
Cabinets								
Plumbing Fixtures								
Piping								
Supports and Hangers								
Valves								
Sprinklers								
Mech. Equipment								
Electrical Conduit								
Copper Wiring								
Light Fixtures								
Lamps								
Lighting Ballasts								
Electrical Devices								
Switchgear and Panelboards								
Transformers								
Other:								

FORM CWM-7: CONSTRUCTION WASTE REDUCTION PROGRESS REPORT								
MATERIAL CATEGORY	GENERATION POINT	TOTAL QUANTITY OF WASTE TONS (TONNES) (A)	QUANTITY OF WASTE SALVAGED		QUANTITY OF WASTE RECYCLED		TOTAL QUANTITY OF WASTE RECOVERED TONS (TONNES) (D = B + C)	TOTAL QUANTITY OF WASTE RECOVERED % (D / A x 100)
			ESTIMATED TONS (TONNES)	ACTUAL TONS (TONNES) (B)	ESTIMATED TONS (TONNES)	ACTUAL TONS (TONNES) (C)		
Packaging: Cardboard								
Packaging: Boxes								
Packaging: Plastic Sheet or Film								
Packaging: Polystyrene								
Packaging: Pallets or Skids								
Packaging: Crates								
Packaging: Paint Cans								
Packaging: Plastic Pails								
Site-Clearing Waste								
Masonry or CMU								
Lumber: Cut-Offs								
Lumber: Warped Pieces								
Plywood or OSB (scraps)								
Wood Forms								
Wood Waste Chutes								
Wood Trim (cut-offs)								
Metals								
Insulation								
Roofing								
Joint Sealant Tubes								
Gypsum Board (scraps)								
Carpet and Pad (scraps)								
Piping								
Electrical Conduit								
Other:								

FORM CWM-8: DEMOLITION WASTE REDUCTION PROGRESS REPORT								
MATERIAL CATEGORY	GENERATION POINT	TOTAL QUANTITY OF WASTE TONS (TONNES) (A)	QUANTITY OF WASTE SALVAGED		QUANTITY OF WASTE RECYCLED		TOTAL QUANTITY OF WASTE RECOVERED TONS (TONNES) (D = B + C)	TOTAL QUANTITY OF WASTE RECOVERED % (D / A x 100)
			ESTIMATED TONS (TONNES)	ACTUAL TONS (TONNES) (B)	ESTIMATED TONS (TONNES)	ACTUAL TONS (TONNES) (C)		
Asphaltic Concrete Paving								
Concrete								
Brick								
CMU								
Lumber								
Plywood and OSB								
Wood Paneling								
Wood Trim								
Miscellaneous Metals								
Structural Steel								
Rough Hardware								
Insulation								
Roofing								
Doors and Frames								
Door Hardware								
Windows								
Glazing								
Acoustical Tile								
Carpet								
Carpet Pad								
Demountable Partitions								
Equipment								
Cabinets								
Plumbing Fixtures								
Piping								
Supports and Hangers								
Valves								
Sprinklers								
Mechanical Equipment								
Electrical Conduit								
Copper Wiring								
Light Fixtures								
Lamps								
Lighting Ballasts								
Electrical Devices								
Switchgear and Panelboards								
Transformers								
Other:								

END OF SECTION 01 74 19

SECTION 01 77 00 CLOSEOUT PROCEDURES

PART 1 GENERAL

1.1 RELATED DOCUMENTS

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

1.2 PRE-CLOSEOUT MEETING

- A. Pre-Closeout Meeting: Schedule and convene a pre-closeout meeting with Owner and Architect in accordance with Section 01 31 00: Project Management and Coordination.

1.3 SUBSTANTIAL COMPLETION

- A. The items identified in the Contract Documents, including the Supplementary Conditions and the following items shall be completed before Substantial Completion will be granted:
 - 1. Contractor's completion list (punch list): Submit a thorough list of items to be completed or corrected, along with a written request for Substantial Completion and for review of the Work or portion of the Work. Architect's or Engineer's Project representative, at their discretion, may attend and assist in the preparation of Contractor's punch list.
 - 2. Architect's supplemental punch list: Architect/Engineer, along with Owner at Owner's discretion, will inspect the Work utilizing Contractor's prepared punch list, noting completed items and incomplete items, and will prepare a supplemental list of items that have been omitted or incomplete items that were not previously noted.
 - 3. Operations and maintenance manuals: Submit as described.
 - 4. Final cleaning: Provide final cleaning and adequate protection of installed construction as described.
 - 5. Starting of systems: Start up equipment and systems as described.
 - 6. Testing and balancing: Testing and balancing of systems must be performed and completed by Owner's forces, and the report submitted and accepted by Architect/Engineer and Owner, as described in the Contract Documents. Make adjustments to equipment as required to achieve acceptance.
 - 7. Demonstrations: If required by individual Specification Sections or by Owner, provide demonstrations and instructions for use of equipment as described.
- B. Date of Substantial Completion: Complete or correct items identified on punch list and confirm that all items have been corrected prior to Architect's re-inspection. Architect/Engineer, along with Owner, will re-inspect the corrected work to establish the Date of Substantial Completion. Incomplete items remaining will be appended to the Certificate of Substantial Completion (AIA G704). The Date of Substantial Completion represents day one of the closeout period and represents the date of commencement of Contractor's correctional period and all warranty periods as described and required by the Contract Documents, except as amended in the Certificate of Substantial Completion and elsewhere in the Contract Documents.
- C. Certificate of Substantial Completion: When the Work or designated portion thereof is substantially complete, Architect will prepare the Certificate of Substantial Completion to be executed by Owner and Contractor. Items on the appended punch list shall be completed or corrected within the time limits established in the Certificate.

1.4 PUNCH LIST

- A. A comprehensive list prepared by Contractor prior to Substantial Completion, and attached thereto, to establish all items to be corrected, or limited items of work to be completed, if any. This list is intended to represent a limited number of items needing attention.
- B. Punch lists shall be furnished to Architect in Microsoft Excel and PDF formats. The punch list shall be in matrix form and shall include the following information for each punch list item:
 - 1. Room number or other suitable location identifier.
 - 2. Description of the Work.
 - 3. Subcontractor/trade sign-off that the work has been verified to be 100 percent complete and in accordance with the Contract Documents.
 - 4. Subcontractor/trade sign-off date.
 - 5. General Contractor sign-off that the work has been verified to be 100 percent complete and in accordance with the Contract Documents.
 - 6. General Contractor/trade sign-off date.
 - 7. A/E consultant sign-off.
 - 8. A/E consultant sign-off date.
 - 9. If requested by Owner, provide two (2) additional similar columns for their sign-off.
 - 10. In the case of excessive repetition of the same item at various locations, the punch list may contain "general notes/items" that shall be applied to the entire Project. It shall be the responsibility of the Contractor/Subcontractor to thoroughly examine the entire Project and make corrective measures at all applicable locations.
- C. Should Architect determine that Contractor's punch list lacks sufficient detail or requires extensive supplementation, the punch list will be returned to Contractor for re-inspection and revision. The date of Substantial Completion will be delayed until the punch list submitted is a reasonable representation of the Work to be done.
- D. A significantly large number of items to be completed or corrected will preclude Architect from issuing a Certificate of Substantial Completion. Owner and Architect will be the sole judges of what constitutes a significantly large number of items. It is anticipated that the detailed list of items of Work to be completed or corrected at the Date of Substantial Completion will be no longer than five (5) typed pages.
- E. Contractor's superintendent shall participate in the preparation of Contractor's punch list that is submitted to Architect and Owner for supplementation. Upon receipt, Architect and consultants shall perform a spot review to determine the adequacy and completeness of Contractor's punch list.
- F. Upon receipt of an acceptable Contractor's punch list, Contractor's superintendent shall accompany Architect, his consultants and Owner (at his discretion) during their observation and the preparation of their supplements to Contractor's punch list:
 - 1. The superintendent shall record or otherwise take note of all supplementary items.
 - 2. Architect will endeavor to furnish to Contractor typed, hand written, or recorded supplements to the punch list in a prompt manner; however, any delay in Contractor receiving said supplements from Architect will not be cause for a claim for additional cost or extension of time as Contractor's superintendent shall have been in attendance during the inspections of Architect and his consultants and will have been expected to take his own notes.

1.5 OPERATIONS AND MAINTENANCE MANUAL

- A. As a requirement for Substantial Completion, the final operation and maintenance manual shall be submitted to, and reviewed and accepted by Architect prior to issuance of the Certificate.

- B. Prepare a 3-ring D-slant binder cover and spline with printed title "OPERATIONS AND MAINTENANCE MANUAL," title of Project, and subject matter of binder when multiple binders are required.
- C. Submit one (1) copy of preliminary operations and maintenance manuals to respective consultants (civil, MEP, structural, etc.) for review of conformance with Contract requirements prior to submitting final to Architect. Allow time for proper review.
- D. Internally subdivide binder contents with permanent page dividers, logically organized as described below; with tab titling clearly printed under reinforced laminated plastic tabs.
- E. Drawings: Provide with reinforced punched binder tab. Bind in with text; fold larger drawings to size of text pages.
- F. Contents:
 - 1. Prepare Table of Contents for each volume, with each product or system description identified, typed on white paper, in three parts as follows:
 - a. Part 1: Directory, listing names, addresses, and telephone numbers of Architect/Engineer, Contractor, subcontractors, and major equipment suppliers.
 - b. Part 2: Operation and Maintenance, arranged by system and subdivided by Specification Section. For each category, identify names, addresses, and telephone numbers of subcontractors and suppliers. Identify the following:
 - 1) Significant design criteria.
 - 2) List of equipment.
 - 3) Parts list for each component.
 - 4) Equipment start-up instructions
 - 5) Operating instructions.
 - 6) Maintenance instructions for equipment and systems.
 - 7) Maintenance instructions for finishes, including recommended cleaning methods and materials, and special precautions identifying detrimental agents.
 - c. Part 3: Project documents and certificates, including the following:
 - 1) Product data.
 - 2) Air and water balance reports.
 - 3) Photocopies of warranties, certificates and bonds. Submit originals with Closeout Documents as specified below.
- G. Submit one (1) final original and two (2) copies to Architect.
- H. Contractor shall provide a DVD, in PDF Format, the following documents after approval by Architect, consultants, and Owner: Closeout Manual, MSDS binder, O&M Manuals, Specifications and approved submittals. Documents shall be hyperlinked to the Table of Contents.

1.6 PROJECT CLOSEOUT

- A. Final Payment will not be authorized by Architect until Architect finds the Work acceptable under the Contract Documents, subject to the completion and acceptance of the following requirements and other applicable Contract requirements:
 - 1. Close-out Documents: Provide bound closeout documents as described. Refer to the Supplementary Conditions for additional information.
 - 2. Record Documents: Submit as described.
 - 3. Extra materials: Provide extra stock, materials, and products as described when required by individual Specification Sections.
 - 4. Locks: Make final changeover of permanent locks and transmit keys to Owner. Advise Owner's personnel of changeover in security provisions.

5. Temporary Facilities: Discontinue and remove temporary facilities from the site, along with mockups, construction aids, and similar elements.
6. Warranties, Certificates and Bonds: Execute and assemble transferable warranty documents, certificates, and bonds from subcontractors, suppliers, and manufacturers as described.
7. Final Inspection and Acceptance by Architect is achieved as described.

1.7 CLOSEOUT DOCUMENTS

- A. Coordinate the following items with the requirements of Document CB, Supplementary Conditions of the Contract.
- B. Prepare 3-ring D-slant binder cover and spline with printed title "CLOSEOUT DOCUMENTS", title of Project, and subject matter of binder when multiple binders are required. Submit one (1) original and two (2) copies.
- C. Internally subdivide binder contents with permanent page dividers, logically organized as described below; with tab titling clearly printed under reinforced laminated plastic tabs.
- D. The closeout documents shall be neatly organized and easily useable as determined by Architect and Owner. Separate closeout document binders from operations and maintenance manuals. Documents identified as "affidavit" shall be notarized.
- E. Prepare a table of contents for each volume, with each item description identified, typed on white paper, in five (5) parts as follows:
 1. Part 1: Directory listing names, addresses, and telephone numbers of Architect/Engineer, Contractor, subcontractors, and major equipment suppliers. All General Contractor's vendors/suppliers and subcontractors that provided materials or performed any work related to this Project must be listed on this form. Submit final list of subcontractors on Document AD.
 2. Part 2: Closeout documents and affidavits, including the following:
 - a. AIA G707 - Consent of Surety to Final Payment.
 - b. AIA G706 - Contractor's Affidavit of Payment of Debts and Claims.
 - c. AIA G706A - Contractor's Affidavit of Release of Liens.
 3. Part 3: Project documents and certificates, including the following:
 - a. Copy of Certificate of Substantial Completion (AIA G704).
 - b. Copy of All Permits.
 - c. Copy of Final Utility Bill or letter of transfer.
 - d. Copy of Certificate of Occupancy.
 - e. Copy of Certification of Project Compliance: Submit on attached **Closeout Form "B"**. Owner and Architect will initiate form and forward to Contractor for signature once Substantial Completion is established (Owner to be provided original separately).
 4. Part 4: Warranties and Release of Liens; compile sequentially based on Specification Sections:
 - a. General Contractor's warranty: Submit on company letterhead as described below. This Warranty shall state all sections of Work performed by General Contractor's own forces, and warranty period for each section of Work.
 - b. Subcontractor's release of lien: Include Contractor's, Subcontractor's, and direct material and equipment supplier's separate final releases. Submit on attached **Closeout Form "A"** – Subcontractor's Affidavit of Release of Lien.
 - c. Hazardous material certificate: Submit on attached **Closeout Form "C"**. Affidavits from Contractor, subcontractors and General Contractor's vendors or suppliers stating that no hazardous materials/products have been used or installed in this Project.
 - d. Subcontractor's warranty: Notarized and submitted on attached **Closeout Form**

immediate work area to prevent damage.

- C. Provide protective coverings at walls, projections, jambs, sills, and soffits of openings.
- D. Protect finished floors, stairs, and other surfaces from traffic, dirt, wear, damage, or movement of heavy objects, by protecting with durable sheet materials.
- E. Prohibit traffic or storage upon waterproofed or roofed surfaces. When traffic or activity is necessary, obtain recommendations for protection from waterproofing or roofing material manufacturer.
- F. Prohibit traffic from landscaped areas.

1.10 STARTING OF SYSTEMS

- A. Coordinate schedule for start-up of various equipment and systems.
- B. Notify Architect/Engineer and Owner 48 hours prior to start-up of each item.
- C. Verify each piece of equipment or system has been checked for proper lubrication, drive rotation, belt tension, control sequence, and for conditions which may cause damage.
- D. Verify tests, meter readings, and specified electrical characteristics agree with those required by equipment or system manufacturer.
- E. Verify wiring and support components for equipment are complete and tested.
- F. Execute start-up under supervision of Contractors' personnel, and installer in accordance with manufacturers' instructions.
- G. When specified in individual Specification Sections or required by manufacturer, 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. When specified in individual Specification Sections or required by Owner or Architect/Engineer, submit a written report in accordance with Section 01 33 00, Submittal Procedures, that equipment or system has been properly installed and is functioning correctly.

1.11 DEMONSTRATION AND INSTRUCTIONS

- A. Demonstrate operation and maintenance of products to Owner's personnel a minimum of 48 hours prior to date of Final Completion in accordance with Owner's requirements.
- B. Demonstrate Project equipment instructed by qualified manufacturer's representative who is knowledgeable about the Project and equipment.
- C. For equipment or systems requiring seasonal operation, perform demonstration for other season within six (6) months.
- D. Utilize maintenance manual as basis for instruction. Review contents of manual with Owner's personnel to explain all aspects of operation and maintenance.
- E. Demonstrate start-up, operation, control, adjustment, trouble-shooting, servicing,

maintenance, and shutdown of each item of equipment.

- F. Prepare and insert additional data in maintenance manuals when needed for when additional data becomes apparent during instruction.
- G. Review and verify proper start-up and operation of equipment prior to scheduling demonstrations with Owner.
- H. All demonstrations are to be documented by video and submitted to Owner in DVD format along with the closeout documents. General Contractor is responsible for all video and compilation onto DVD with linked menus.

1.12 PROJECT RECORD DOCUMENTS

- A. Project Record Documents, as described in Section 01 78 39: Project Record Documents, shall be submitted at Project closeout. Final payment will not be authorized by Architect until final review and acceptance by Architect and Engineers is achieved in accordance with Owner's requirements.
- B. At Contractor's request, and with associated fee, Architect may provide electronic versions of the construction Drawing and Specification files for Contractor's use, subject to the terms and conditions of Architect's standard electronic document transfer agreement.
- C. Submit reproducible to respective consultants (civil, structural, MEP, etc.) for review. Consultant will mark-up corrections and return to Contractor for final revisions. Make final revisions prior to submitting to Architect:
 - 1. Format: One (1) set of film positive reproducible and two (2) sets of blueprints of approved reproducible.
 - 2. Provide Owner with one (1) set of Record Drawings on a non-rewritable CD in AutoCAD® latest release.
 - 3. Provide Owner with one (1) set of Record Drawings on a non-rewritable CD in PDF format.
 - 4. Label electronic CAD files and PDF files in the same manner as the sheets (example, A2.02 First Floor Area 'A', etc.)

1.13 EXTRA STOCK, MATERIALS, AND MAINTENANCE PRODUCTS

- A. Furnish extra stock, maintenance, and extra products in quantities specified in individual Specification Sections.
- B. Deliver to Project site or to District Maintenance Department as directed by Owner; obtain signed receipt from Owner's authorized representative prior to final application for payment. Delivery of materials to, or obtaining receipt from anyone other than Owner's authorized representative may constitute breach of this requirement and may require delivery of additional materials at no cost to Owner if original materials are misplaced.
- C. Include signed receipts for delivery of extra stock and materials, including keys, with closeout documents.

1.14 WARRANTIES, CERTIFICATES, AND BONDS

- A. Definitions:
 - 1. Standard product warranties: Preprinted written warranties published by individual manufacturers for particular products and are specifically endorsed by the manufacturer to Owner.

2. Special warranties: Written warranties required by or incorporated in the Contract Documents, either to extend time limits provided by standard warranties or to provide coverage of specific defects, or both.
- B. In accordance with the general warranty obligations under the General Conditions as amended by the Supplementary Conditions, General Contractor's warranty shall be for a period of one (1) year following the date of Substantial Completion, hereinafter called the one-year warranty period. Contractor's one (1) year general warranty shall include all labor, material, and delivery costs required to correct defective material and installation. This warranty shall not limit Owner's rights with respect to latent defects, gross mistakes, or fraud.
 - C. Contractor's one (1) year warranty shall run concurrently with the one (1) year period for correction of Work required in the General Conditions.
 - D. No service charges or call out charges are allowed to investigate warranty claims.
 - E. In addition to Contractor's one (1) year warranty, special warranties, as described in individual Specifications Sections, shall extend the warranty period for the period specified without limitation in respect to other obligations for which Contractor has under the Contract Documents.
 - F. Manufacturer's disclaimers and limitations on product warranties do not relieve Contractor of the warranty on the Work that incorporates the products, nor does it relieve the suppliers, manufacturers, and subcontractors required to countersign special warranties with Contractor.
 - G. Warranty Requirements:
 1. When correcting warranted Work that has failed, remove and replace other Work that has been damaged as a result of such failure or that must be removed and replaced to provide access for correction of warranted Work.
 2. When Work covered by a warranty has failed and been corrected by replacement or reconstruction, reinstate the warranty by written endorsement. The reinstated warranty shall be equal to the original warranty with an equitable adjustment for depreciation.
 3. Upon determination that Work covered by a warranty has failed, replace or rebuild the Work to an acceptable condition complying with requirements of Contract Documents. Contractor is responsible for the cost of replacing defective Work regardless of whether Owner has benefited from use of the Work through a portion of its anticipated useful service life.
 4. Written warranties made to Owner are in addition to implied warranties, and shall not limit the duties, obligations, rights, and remedies otherwise available under the law, nor shall warranty periods be interpreted as limitations on time in which Owner can enforce such other duties, obligations, rights, or remedies.
 5. Owner reserves the right to refuse to accept Work for the Project where a special warranty, certification, or similar commitment is required on such Work or designated portion of the Work, until evidence is presented that entities required to countersign such commitments are willing to do so.
 - H. Compile copies of each required warranty properly executed by Contractor and the Subcontractor, supplier, or manufacturer. Verify documents are in proper form, contain full information, and are notarized. Co-execute warranties, certificates, and bonds when required and include signed warrantees with Closeout Documents submitted to Architect.

1.15 FINAL COMPLETION AND FINAL PAYMENT

- A. Final Notice and Inspection:
 - 1. When all items on the punch list have been corrected, final cleaning has been completed, and installed work has been protected, submit written notice to Architect that the Work is ready for final inspection and acceptance.
 - 2. Upon receipt of written notice that the Work is ready for final inspection and acceptance, Architect and Engineer will make final inspection.
- B. Final Change Order: When the Project closeout items described above are successfully completed and the Work is found acceptable to Architect/Engineer and Owner, a Final Change Order will be executed. This Change Order will include any Allowance adjustments as required by the Contract Documents.
- C. Final Application for Payment: When all of the above items are successfully complete, submit to Architect a final Application for Payment and request for release of retainage.
- D. Release of Retainage: Release of retainage will not be authorized by Architect until Contractor completes all requirements for closeout to the satisfaction of Owner and Architect as described herein.

1.16 TERMINAL INSPECTION

- A. Immediately prior to expiration of the one (1) year period for correction of the Work, Contractor shall make an inspection of the Work in the company of Architect and Owner. Architect and Owner shall be given not less than ten (10) days' notice prior to the anticipated date of terminal inspection.
- B. Where any portion of the work has proven to be defective and requires replacement, repair, or adjustment, Contractor shall immediately provide materials and labor necessary to remedy such defective work and shall execute such work without delay until completed to the satisfaction of Architect and Owner, even if the date of completion of the corrective work may extend beyond the expiration date of the correction period.
- C. Contractor shall not be responsible for correction of Work that has been damaged because of neglect or abuse by Owner, nor the replacement of parts necessitated by normal wear in use.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION (NOT USED)

END OF SECTION 01 77 00

SECTION 01 78 39 PROJECT RECORD DOCUMENTS

PART 1 GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section includes administrative and procedural requirements for Project record documents, including but not limited to:
 1. Record Drawings.
 2. Record Specifications.
 3. Record Product data.
 4. Miscellaneous record submittals.

1.3 SUBMITTALS

- A. Record Drawings:
 1. Number of copies - Submit one (1) set of marked up record prints.
 2. Number of Copies - Submit copies of record Drawings:
 - a. Initial submittal:
 - 1) Submit PDF electronic files of scanned record prints and one (1) of file prints.
 - 2) Submit record digital data files and one (1) set of plots.
 - 3) Architect will indicate whether general scope of changes, additional information recorded, and quality of drafting are acceptable.
 - b. Final submittal:
 - 1) Submit PDF electronic files of scanned record prints and three (3) sets of prints.
 - 2) Submit record digital data files and three (3) sets of record digital data file plots.
 - 3) Plot each Drawing file, whether or not changes and additional information were recorded.
- B. Record Specifications: Submit one (1) paper copy and one (1) annotated PDF electronic files of the Project Specifications, including addenda and Contract modifications.
- C. Record Product Data:
 1. Submit one (1) paper copy and one (1) annotated PDF electronic file and directories of each submittal:
 - a. Where record product data are required as part of operation and maintenance manuals, submit duplicate marked up product data as a component of manual.
- D. Miscellaneous Record Submittals: Refer to the individual Specification Sections for miscellaneous record keeping requirements and submittals in connection with various construction activities. Submit one (1) paper copy and annotated PDF electronic files and directories of each submittal.
- E. Reports: Submit written report monthly indicating items incorporated into Project record documents concurrent with progress of the Work, including revisions, concealed conditions, field changes, product selections, and other notations incorporated.

1.4 PROJECT RECORD DOCUMENT PROCEDURES

- A. Do not use Project record documents for construction purposes. Protect Project record documents from deterioration and loss. Provide access to Project record documents for Architect's reference:
 - 1. **Do not use** as-built Drawings and Specifications for record Drawings and Specifications.
- B. Recording Procedures: Update Drawings and Specifications on daily bases to record actual conditions. Record information concurrently with construction progress. Do not conceal work until required information is accurately recorded.
- C. Store record documents and samples apart from as-built documents used for construction:
 - 1. Label and file record documents and samples in accordance with Section number listings in table of contents. Label each document **PROJECT RECORD** in neat, large, printed letters.
 - 2. Maintain record documents in clean, dry, and legible condition.
 - 3. Make record documents and samples available for inspection upon request of Architect.

PART 2 PRODUCTS

2.1 RECORD DRAWINGS

- A. Record Prints:
 - 1. Maintain one (1) set of marked up paper copies of the Contract Drawings and shop drawings:
 - a. Preparation:
 - 1) Mark record prints to show the actual installation where installation varies from that shown originally. Require individual or entity who obtained record data, whether individual or entity is installer, Subcontractor, or similar entity, to provide information for preparation of corresponding marked up record prints. Show actual installation conditions where installation varies from that shown originally:
 - a) Give attention to information on concealed elements difficult to identify or measure and record later.
 - b) Accurately record information in an acceptable drawing technique.
 - c) Record data as soon as possible after obtaining it.
 - d) Record and check the markup before enclosing concealed installations.
 - e) Cross reference record prints to corresponding shop drawings or archive photographic documentation.
 - 2. Content:
 - a. Types of items requiring marking include, but are not limited to, the following:
 - 1) Dimensional changes to Drawings.
 - 2) Revisions to details shown on Drawings.
 - 3) Depths of foundations below first floor.
 - 4) Locations and depths of underground utilities.
 - 5) Revisions to routing of piping and conduits.
 - 6) Revisions to electrical circuitry.
 - 7) Actual equipment locations.
 - 8) Duct size and routing.
 - 9) Locations of concealed internal utilities.
 - 10) Changes made by Change Order or Construction Change Directive.
 - 11) Changes made following Architect's written orders.
 - 12) Details not on the original Contract Drawings.

- 13) Field records for variable and concealed conditions.
 - 14) Record information on the Work that is shown only schematically.
3. Mark the Contract Drawings and shop drawings completely and accurately. Utilize personnel proficient at recording graphic information in production of marked up record prints.
 4. Mark record sets with erasable, red colored pencil. Use colors to distinguish between changes for different categories of the work at same location.
 5. Mark important additional information that was either shown schematically or omitted from original Drawings.
 6. Note Construction Change Directive numbers, alternate numbers, Change Order numbers, and similar identification, where applicable.
- B. Record Digital Data Files:
1. Immediately before inspection for Certificate of Substantial Completion, review marked up record prints with Architect. When authorized, prepare full set of corrected digital data files of the Contract Drawings:
 - a. Format: Same digital data software program, version, and operating system as the original Contract Drawings and annotated PDF electronic file with comment function enabled.
 - b. Incorporate changes and additional information previously marked on record prints. Delete, redraw, and add details and notations where applicable.
 - c. Refer instances of uncertainty to Architect for resolution.
 - d. Architect will furnish Contractor one (1) set of digital data files of the Contract Drawings for use in recording information:
 - 1) Refer to Section 01 33 00: Submittal Procedures for requirements related to use of Architect's digital data files.
 - 2) Architect will provide data file layer information. Record markups in separate layers.
- C. Newly Prepared Record Drawings:
1. Prepare new Drawings instead of preparing record Drawings where Architect determines that neither the original Contract Drawings nor shop drawings are suitable to show actual installation:
 - a. New Drawings may be required when a Change Order is issued as a result of accepting an alternate, substitution, or modification. Including ALL documents used for Construction Change Directive to DSA.
 - b. Consult Architect for proper scale and scope of detailing and notations required to record the actual physical installation and its relation to other construction. Integrate newly prepared record Drawings into record Drawing sets; comply with procedures for formatting, organizing, copying, binding, and submitting.
- D. Format:
1. Identify and date each record Drawing; include the designation *PROJECT RECORD DRAWING* in a prominent location:
 - a. Record prints: Organize record prints and newly prepared record Drawings into manageable sets. Bind each set with durable paper cover sheets. Include identification on cover sheets.
 - b. Format: Annotated PDF electronic file with comment function enabled.
 - c. Record digital data files: Organize digital data information into separate electronic files that correspond to each sheet of the Contract Drawings. Name each file with the sheet identification. Include identification in each digital data file.
 - d. Identification:
 - 1) As follows:
 - a) Project name.
 - b) Date.
 - c) Designation PROJECT RECORD DRAWINGS.

- d) Name of Architect.
- e) Name of Contractor.

2.2 RECORD SPECIFICATIONS

- A. Preparation:
 - 1. Mark Specifications to indicate the actual product installation where installation varies from that indicated in Specifications, addenda, and Contract modifications:
 - a. Give particular attention to information on concealed products and installations that cannot be readily identified and recorded later.
 - b. Mark copy with the proprietary name and model number of products, materials, and equipment furnished, including substitutions and product options selected.
 - c. Record the name of manufacturer, supplier, installer, and other information necessary to provide a record of selections made.
 - d. For each principal product, indicate whether record product data has been submitted in operation and maintenance manuals instead of submitted as record product data.
 - e. Note related Change Orders, record product data, and record Drawings where applicable.
- B. Format: Submit record Specifications as annotated PDF electronic file and marked up paper copy of Specifications. ALL documents to match PBK format.

2.3 RECORD PRODUCT DATA

- A. Preparation:
 - 1. Mark product data to indicate the actual product installation where installation varies substantially from that indicated in product data submittal:
 - a. Give particular attention to information on concealed products and installations that cannot be readily identified and recorded later.
 - b. Include significant changes in the product delivered to Project site and changes in manufacturer's written instructions for installation.
 - c. Note related Change Orders, record Specifications, and record Drawings where applicable.
- B. Format: Submit record product data as annotated PDF electronic file. Include record product data directory organized by Specification Section number and title, electronically linked to each item of record product data.

2.4 RECORD SAMPLES

- A. Record Samples: Determine with Architect and Owner which submitted samples are to be maintained as record samples. Maintain and mark one (1) set to indicate date of review and approval by Architect; note any deviations or variations between reviewed sample and installed product or material.

2.5 MISCELLANEOUS RECORD SUBMITTALS

- A. Assemble miscellaneous records required by the individual Specification Sections for miscellaneous record keeping and submittal in connection with actual performance of the Work. Bind or file miscellaneous records and identify each, ready for continued use and reference. Include the following:
 - 1. Reviewed shop drawings, product data, and samples.
 - 2. Field test reports.
 - 3. Inspection certificates and manufacturer's certificates.

4. Inspections by authorities having jurisdiction (AHJ [DSA]).
 5. Documentation of foundation depths.
 6. Special measurements or adjustments.
 7. Tests and inspections.
 8. Surveys.
 9. Design mixes.
 10. DSA submitted CCDs.
- B. Format: Submit miscellaneous record submittals as scanned PDF electronic file(s) of marked up miscellaneous record submittals. Include miscellaneous record submittals directory organized by Specification Section number and title, electronically linked to each item of miscellaneous record submittals.

PART 3 EXECUTION

3.1 RECORDING AND MAINTENANCE

- A. Recording: Maintain one (1) copy of each submittal during the construction period for Project record document purposes. Post changes and revisions to Project record documents as they occur; do not wait until end of Project.
- B. Maintenance of Record Documents and Samples: Store record documents and samples in the field office apart from the Contract Documents used for construction. Do not use Project record documents for construction. Maintain record documents in good order and in a clean, dry, legible condition, protected from deterioration and loss. Provide access to Project record documents for Architect's reference during normal working hours.

END OF SECTION 01 78 39

SECTION 024119
SELECTIVE DEMOLITION

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Demolition and removal of selected portions of building or structure.
2. Demolition and removal of selected site elements.
3. Salvage of existing items to be reused or recycled.

1.2 DEFINITIONS

- A. Remove: Detach items from existing construction and dispose of them off-site unless indicated to be salvaged or reinstalled.
- B. Remove and Salvage: Detach items from existing construction, in a manner to prevent damage,
- C. Remove and Reinstall: Detach items from existing construction, in a manner to prevent damage, prepare for reuse, and reinstall where indicated.
- D. Existing to Remain: Leave existing items that are not to be removed and that are not otherwise indicated to be salvaged or reinstalled.
- E. Dismantle: To remove by disassembling or detaching an item from a surface, using gentle methods and equipment to prevent damage to the item and surfaces; disposing of items unless indicated to be salvaged or reinstalled.

1.3 MATERIALS OWNERSHIP

- A. Unless otherwise indicated, demolition waste becomes property of Contractor.
- B. Historic items, relics, antiques, and similar objects including, but not limited to, cornerstones and their contents, commemorative plaques and tablets, and other items of interest or value to Owner that may be uncovered during demolition remain the property of Owner.
 1. Carefully salvage in a manner to prevent damage and promptly return to Owner.

1.4 PREINSTALLATION MEETINGS

A. Predemolition Conference:

1. Inspect and discuss condition of construction to be selectively demolished.

2. Review structural load limitations of existing structure.
3. Review and finalize selective demolition schedule and verify availability of materials, demolition personnel, equipment, and facilities needed to make progress and avoid delays.
4. Review requirements of work performed by other trades that rely on substrates exposed by selective demolition operations.
5. Review areas where existing construction is to remain and requires protection.

1.5 INFORMATIONAL SUBMITTALS

- A. Schedule of Selective Demolition Activities: Indicate the following:
 1. Detailed sequence of selective demolition and removal work, with starting and ending dates for each activity. Ensure Owner's representative on-site operations are uninterrupted.
 2. Interruption of utility services. Indicate how long utility services will be interrupted.
 3. Coordination for shutoff, capping, and continuation of utility services.
 4. Use of elevator and stairs.
 5. Coordination of Owner's continuing occupancy of portions of existing building and of Owner's partial occupancy of completed Work.
- B. Predemolition Photographs or Video: Show existing conditions of adjoining construction, including finish surfaces, that might be misconstrued as damage caused by salvage and demolition operations.
- C. Statement of Refrigerant Recovery: Signed by refrigerant recovery technician responsible for recovering refrigerant, stating that all refrigerant that was present was recovered and that recovery was performed according to EPA regulations. Include name and address of technician and date refrigerant was recovered.
- D. Warranties: Documentation indicating that existing warranties are still in effect after completion of selective demolition.

1.6 CLOSEOUT SUBMITTALS

- A. Inventory: Submit a list of items that have been salvaged.

1.7 QUALITY ASSURANCE

- A. Refrigerant Recovery Technician Qualifications: Certified by an EPA-approved certification program.

1.8 FIELD CONDITIONS

- A. Owner will occupy portions of building immediately adjacent to selective demolition area. Conduct selective demolition so Owner's operations will not be disrupted.

- B. Notify Architect of discrepancies between existing conditions and Drawings before proceeding with selective demolition.
- C. Hazardous Materials: It is not expected that hazardous materials will be encountered in the Work.
 - 1. Hazardous materials will be removed by Owner before start of the Work.
 - 2. If suspected hazardous materials are encountered, do not disturb; immediately notify Architect and Owner. Hazardous materials will be removed by Owner under a separate contract.
- D. Hazardous Materials: Present in buildings and structures to be selectively demolished. A report on the presence of hazardous materials is on file for review and use. Examine report to become aware of locations where hazardous materials are present.
- E. Storage or sale of removed items or materials on-site is not permitted.
- F. Utility Service: Maintain existing utilities indicated to remain in service and protect them against damage during selective demolition operations.
 - 1. Maintain fire-protection facilities in service during selective demolition operations.

1.9 COORDINATION

- A. Arrange selective demolition schedule so as not to interfere with Owner's operations.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Regulatory Requirements: Comply with governing EPA notification regulations before beginning selective demolition. Comply with hauling and disposal regulations of authorities having jurisdiction.
- B. Standards: Comply with ANSI/ASSP A10.6 and NFPA 241.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Verify that utilities have been disconnected and capped before starting selective demolition operations.
- B. Perform an engineering survey of condition of building to determine whether removing any element might result in structural deficiency or unplanned collapse of any portion of structure or adjacent structures during selective building demolition operations.

1. Perform surveys as the Work progresses to detect hazards resulting from selective demolition activities.
- C. Survey of Existing Conditions: Record existing conditions by use of measured drawings, preconstruction photographs or video
- D. Inventory and record the condition of items to be removed and salvaged.

3.2 PREPARATION

- A. Refrigerant: Before starting demolition, remove refrigerant from mechanical equipment according to 40 CFR 82 and regulations of authorities having jurisdiction.

3.3 UTILITY SERVICES AND MECHANICAL/ELECTRICAL SYSTEMS

- A. Existing Services/Systems to Remain: Maintain services/systems indicated to remain and protect them against damage.
- B. Existing Services/Systems to Be Removed, Relocated, or Abandoned: Locate, identify, disconnect, and seal or cap off utility services and mechanical/electrical systems serving areas to be selectively demolished.

1. If services/systems are required to be removed, relocated, or abandoned, provide temporary services/systems that bypass area of selective demolition and that maintain continuity of services/systems to other parts of building.
2. Disconnect, demolish, and remove fire-suppression systems, plumbing, and HVAC systems, equipment, and components indicated on Drawings to be removed.
 - a. Piping to Be Removed: Remove portion of piping indicated to be removed and cap or plug remaining piping with same or compatible piping material.
 - b. Piping to Be Abandoned in Place: Drain piping and cap or plug piping with same or compatible piping material and leave in place.
 - c. Equipment to Be Removed: Disconnect and cap services and remove equipment.
 - d. Equipment to Be Removed and Reinstalled: Disconnect and cap services and remove, clean, and store equipment; when appropriate, reinstall, reconnect, and make equipment operational.
 - e. Equipment to Be Removed and Salvaged: Disconnect and cap services and remove equipment and deliver to Owner.
 - f. Ducts to Be Removed: Remove portion of ducts indicated to be removed and plug remaining ducts with same or compatible ductwork material.
 - g. Ducts to Be Abandoned in Place: Cap or plug ducts with same or compatible ductwork material and leave in place.

3.4 PROTECTION

- A. Temporary Protection: Provide temporary barricades and other protection required to prevent injury to people and damage to adjacent buildings and facilities to remain.

1. Provide protection to ensure safe passage of people around selective demolition area and to and from occupied portions of building.
 2. Provide temporary weather protection, during interval between selective demolition of existing construction on exterior surfaces and new construction, to prevent water leakage and damage to structure and interior areas.
 3. Protect walls, ceilings, floors, and other existing finish work that are to remain or that are exposed during selective demolition operations.
 4. Cover and protect furniture, furnishings, and equipment that have not been removed.
 5. Comply with requirements for temporary enclosures, dust control, heating, and cooling specified in Section 015000 "Temporary Facilities and Controls."
- B. Temporary Shoring: Design, provide, and maintain shoring, bracing, and structural supports as required to preserve stability and prevent movement, settlement, or collapse of construction and finishes to remain, and to prevent unexpected or uncontrolled movement or collapse of construction being demolished.
1. Strengthen or add new supports when required during progress of selective demolition.
- C. Remove temporary barricades and protections where hazards no longer exist.

3.5 SELECTIVE DEMOLITION, GENERAL

- A. General: Demolish and remove existing construction only to the extent required by new construction and as indicated. Use methods required to complete the Work within limitations of governing regulations and as follows:
1. Proceed with selective demolition systematically, from higher to lower level. Complete selective demolition operations above each floor or tier before disturbing supporting members on the next lower level.
 2. Neatly cut openings and holes plumb, square, and true to dimensions required. Use cutting methods least likely to damage construction to remain or adjoining construction. Use hand tools or small power tools designed for sawing or grinding, not hammering and chopping. Temporarily cover openings to remain.
 3. Cut or drill from the exposed or finished side into concealed surfaces to avoid marring existing finished surfaces.
 4. Do not use cutting torches until work area is cleared of flammable materials. At concealed spaces, such as duct and pipe interiors, verify condition and contents of hidden space before starting flame-cutting operations. Maintain portable fire-suppression devices during flame-cutting operations.
 5. Maintain fire watch during and for at least 4 hours after flame-cutting operations.
 6. Maintain adequate ventilation when using cutting torches.
 7. Remove decayed, vermin-infested, or otherwise dangerous or unsuitable materials and promptly dispose of off-site.
 8. Remove structural framing members and lower to ground by method suitable to avoid free fall and to prevent ground impact or dust generation.
 9. Locate selective demolition equipment and remove debris and materials so as not to impose excessive loads on supporting walls, floors, or framing.
 10. Dispose of demolished items and materials promptly. Comply with requirements in Section 017419 "Construction Waste Management and Disposal."

- B. Site Access and Temporary Controls: Conduct selective demolition and debris-removal operations to ensure minimum interference with roads, streets, walks, walkways, and other adjacent occupied and used facilities.
- C. Removed and Salvaged Items:
 - 1. Clean salvaged items.
 - 2. Pack or crate items after cleaning. Identify contents of containers.
 - 3. Store items in a secure area until delivery to Owner.
 - 4. Transport items to Owner's storage area
 - 5. Protect items from damage during transport and storage.
- D. Removed and Reinstalled Items:
 - 1. Clean and repair items to functional condition adequate for intended reuse.
 - 2. Pack or crate items after cleaning and repairing. Identify contents of containers.
 - 3. Protect items from damage during transport and storage.
 - 4. Reinstall items in locations indicated. Comply with installation requirements for new materials and equipment. Provide connections, supports, and miscellaneous materials necessary to make item functional for use indicated.
- E. Existing Items to Remain: Protect construction indicated to remain against damage and soiling during selective demolition. When permitted by Architect, items may be removed to a suitable, protected storage location during selective demolition and cleaned and reinstalled in their original locations after selective demolition operations are complete.

3.6 DISPOSAL OF DEMOLISHED MATERIALS

- A. Remove demolition waste materials from Project site and dispose of them in an EPA-approved construction and demolition waste landfill acceptable to authorities having jurisdiction.] [and recycle or dispose of them according to Section 017419 "Construction Waste Management and Disposal."
 - 1. Do not allow demolished materials to accumulate on-site.
 - 2. Remove and transport debris in a manner that will prevent spillage on adjacent surfaces and areas.
 - 3. Comply with requirements specified in Section 017419 "Construction Waste Management and Disposal."
- B. Burning: Do not burn demolished materials.

3.7 CLEANING

- A. Clean adjacent structures and improvements of dust, dirt, and debris caused by selective demolition operations. Return adjacent areas to condition existing before selective demolition operations began.

END OF SECTION 024119

SECTION 051200
STRUCTURAL STEEL

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Structural steel work is as shown on drawings, including schedules, notes and details to show size and location of members, typical connections and type of steel required.
- B. Structural steel is that work defined in AISC” Code of Standard Practice” and as otherwise shown on drawings.
- C. Shop priming and field touch-up to extent specified.
- D. Employment of a licensed surveyor registered in the state in which the project is located to certify lines and levels of installed structural steel.

1.2 RELATED SECTIONS

- A. Section 053100 - Steel Deck: Support framing for small openings in deck.
- B. deck systems.
- C. REFERENCES
- D. AISC (MAN) - Steel Construction Manual; American Institute of Steel Construction, Inc. – 15th edition.
- E. AISC Specifications for the Design Fabrication and Erection of Structural Steel for Buildings, including the Commentary and Supplements thereto as issued.
- F. AISC 303 - Code of Standard Practice for Steel Buildings and Bridges; American Institute of Steel Construction, Inc.
- G. ANSI/AISC 341 – Seismic Design Provisions for Structural Steel Buildings, 2016
- H. AISC Specification for Structural Joints Using ASTM F3125/F3125M Bolts.
- I. ANSI/AISC 360 – Specification for Structural Steel Buildings; 2016.
- J.
- K. AWS D1.1/D1.1M - Structural Welding Code - Steel; American Welding Society, 2015.
- L. AWS D1.8/D1.8M –Structural Welding Code - Seismic Supplement, 2016.
- M. AWS A2.4 - Standard Symbols for Welding, Brazing, and Nondestructive Examination; American Welding Society, 2012.

- N. SSPC-Paint 15 - Steel Joist Shop Primer; Society for Protective Coatings.
- O. SSPC-Paint 20 - Zinc-Rich Primers (Type I, "Inorganic," and Type II, "Organic"); Society for Protective Coatings.
- P. UL (FRD) - Fire Resistance Directory; Underwriters Laboratories Inc.
- Q. ASTM A36/A36M - Standard Specification for Carbon Structural Steel, 2014
- R. ASTM A53/A53M - Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless, 2012
- S. ASTM A108 - Standard Specification for Steel Bar, Carbon and Alloy, Cold Finished, 2013
- T. ASTM A123/A123M - Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products, 2015.
- U. ASTM A153/A153M - Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware, 2016
- V. ASTM A307 - Standard Specification for Carbon Steel Bolts and Studs, and Threaded Rod 60 000 PSI Tensile Strength, 2014.
- W. ASTM A449 - Standard Specification for Hex Cap Screws, Bolts and Studs, Steel, Heat Treated, 120/105/90 ksi Minimum Tensile Strength, General Use, 2014.
- X. ASTM A500 - Standard Specification for Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes, 2013.
- Y. ASTM A501 - Standard Specification for Hot-Formed Welded and Seamless Carbon Steel Structural Tubing, 2014.
- Z. ASTM A563 - Standard Specification for Carbon and Alloy Steel Nuts, 2015
- AA. ASTM A572/A572M - Standard Specification for High-Strength Low-Alloy Columbium-Vanadium Structural Steel, 2015.
- BB. ASTM A913/A913M Standard Specification for High Strength Low-Alloy Steel Shapes of Structural Quality, Produced by Quenching and Self-Tempering Process (QST), 2015.
- CC. ASTM A992/A992M - Standard Specification for Structural Steel Shapes, 2015.
- DD. ASTM C1107/C1107M - Standard Specification for Packaged Dry, Hydraulic-Cement Grout (Non-shrink), 2014.
- EE. ASTM E94 - Standard Guide for Radiographic Examination Using Industrial Radiographic Film; 2017.
- FF. ASTM E164 - Standard Practice for Contact Ultrasonic Testing of Weldments, 2013.
- GG. ASTM E165/E165M - Standard Practice for Liquid Penetrant Examination for General Industry; 2012

- HH. ASTM E709 - Standard Guide for Magnetic Particle Testing; 2015.
- II. ASTM F436/F436M - Standard Specification for Hardened Steel Washers, Inch and Metric Dimensions; 2016
- JJ. ASTM F959/F959M - Standard Specification for Compressible-Washer-Type Direct Tension Indicators for Use with Structural Fasteners, Inch and Metric Dimension; 2017.
- KK. ASTM F1554 - Standard Specification for Anchor Bolts, Steel, 36, 55, and 105-ksi Yield Strength, 2015.
- LL. ASTM F3125/F3125M – Standard Specifications for High Strength Structural Bolts, Steel and Alloy Steel, Heat Treated, 120 ksi (830MPa) and 150 ksi (1040 MPa) Minimum Tensile Strength, Inch and Metric Dimensions; 2015.

1.3 SUBMITTALS

- A. See Section 013300 - Administrative Requirements, for submittal procedures. Allow adequate time to check the number of drawings in each submittal. A normal two-week turnaround time applies to individual non-overlapping submittals not exceeding 250 sheets.
- B. Certified Mill Test Reports: Structural Steel (each type) indicates chemical, physical properties, destructive test analysis and non-destructive test analysis.
- C. Welding electrodes.
- D. Welding gas.
- E. Unfinished bolts and nuts.
- F. Structural Steel Primer Paint.
- G. High-strength bolts, including nuts and washers.
- H. Shop Drawings: Submit shop drawings, including complete details and schedules for fabrication and shop assembly of members, and details, schedules, procedures, and diagrams showing the sequence of erections. Fully detail minor connections and fastenings not shown or specified in the Contract Documents to meet required conditions using similar details as shown in the Contract Documents. Include a fully detailed, well controlled sequence and technique plan for shop and field welding that minimizes locked-in stresses and distortion; submit sequence and technique plan for review by the Architect.
 1. Include details of cuts, connections, camber, holes per Figure 5.2 of AWS D1.1 or AISC Section J1.8, weld position plan and other pertinent data. Indicate welds by standard AWS symbols, and show size, length and type of each weld, and the requirements of AISC 341 Section 5.2.
 2. Provide setting drawings, templates and directions for installation of anchor bolts and other anchorages to be installed for work specified in other sections.
 3. Shop drawings shall use the “United States Standards” system dimensioning (feet, inches, etc.). Shop drawings which use only metric system of measurements will be rejected.
 4. Shop drawings shall be drawn on sheet sizes not less than 24” x 32”.

5. During the shop drawings submittal phase if the Contractor cannot establish approved document within two submissions he will assume the responsibility for the additional cost incurred by the Architect for the additional reviews.
 6. No deviation of structural details or framing shall be made in the shop drawings without prior approval by DSA and the Architect.
 7. All approved deviations from the contract documents through the Request for Information (RFI) process shall be referenced on the shop drawings with appropriate RFI numbers.
 8. Maximum number of shop drawing sheets in any submittal shall not exceed 200 for a minimum two-week review period by the structural engineer. The review period for additional submittal will begin at the end of the previous submittal review.
 9. Erection and Bracing Plan and Erection Procedure: Employ a professional engineer licensed in the state in which the project is located to prepare an erection and framing plan including column, beams, and girders. In accordance with Title 8 CCR, Section 1710. This engineer shall be solely responsible for compliance with the plans. Keep a copy at site as required by the governing agency and the California Division of Industrial Safety. The plan shall follow the minimum procedures described below. Provide descriptive data to illustrate structural steel erection procedure including the following:
 - a. Equipment & method to be used in structural steel erection.
 - b. Sequence of erection.
 - c. Extent of completion and guying required for the intermediate floors between the floors being erected and the concrete poured floors.
 - 1) List of beams to be galvanized.
- I. Weld Procedures: Contractor shall submit all welding procedures applicable to the project, stamped and signed by an AWS/CWI Inspector licensed in the state in which the project is located, for review by the owners testing and inspection firm, the structural engineer of record, and the Building Department. Welding procedures shall be qualified as described in AWS D1.1, Section 3 or 4. All CJP single and/or double groove welds shall be back gouged unless otherwise noted on the drawings. Weld procedure shall indicate joints details and tolerances, back gouge, preheat and interpass temperature, post heat treatment, single or multiple stringer passes, peening of stringer passes for groove welds except for the first and the last layers, electrode type and size, welding current polarity and amperes and root treatment. The welding variables for each stringer pass shall be recorded and averaged, from these averages the weld heat input shall be calculated.
 - J. Test Reports: Submit copies of test conducted on shop and field welds and bolted connections. Include data on type of tests conducted and test results.
 - K. Provide Procedure Qualification Record (PQRs) in accordance with AWS D1.1.
 - L. Welders Certificates: All field welders shall be job certified per AWS D1.1. All shop welders shall be job certified for FCAWS per AWS D1.1. Welders working on restricted access joints shall be certified per AWS D1.8.
 - M. QUALITY ASSURANCE
 - N. Fabricate structural steel members in accordance with AISC "Steel Construction Manual" in AISC certified shop.

- O. Comply with Section 10 of AISC 303 "Code of Standard Practice for Steel Buildings and Bridges" for architecturally exposed structural steel.
- P. Maintain one copy of each document on site.
- Q. Fabricator: See Paragraph 1.4B.
- R. Erector: See Paragraph 1.4C.
- S. Except per prequalified welds per AWS D1.1, weld procedures for non-rigid frame connections shall be qualified and must be reviewed and approved by the Architect and by the governing agency.
- T. Continuous inspection by a Registered Deputy Inspector hired by the owner and approved by the Architect and governing agency will be provided during fabrication. Not required for work done in an L.A. City approved shop.
- U. To assure the proper amperage and voltage of the welding process, the use of the handheld calibrated amp and voltmeter shall be used. The hand-held amperage and volt meters shall be calibrated at the start of each shift or once a day as a minimum.

This equipment shall be used by the fabricator, erector, and the inspectors. Amperage and voltage shall be measured near the arc. Travel speed and electrode stick out shall be verified to be in compliance with the approved welding procedures.

- V. Inspection agency approved by the Architect and by the governing agency will perform visual inspection of all welds.
- W. Contractor's Responsibility: The Contractor alone shall be responsible for correct fitting of structural members and the elevation and alignment of the finished structure. The Contractor shall be responsible for establishing, setting and maintaining control points and building lines to be used in plumbing the structural steel frame in accordance with AISC Code of Standard Practice, Sections 7.12 and 7.13, and shall verify the following:
 - 1. Verify that anchor bolts are located as specified on the Drawings and are in proper relation to the control points and building lines, prior to setting of structural steel.
 - 2. Verify that structural steel members have been located, elevated, plumbed and aligned in relation to the control points and buildings lines, within the tolerance permitted by AISC Code of Standard Practice, Sections 7.12 and 7.13, and as specified in Section 3.3. Any adjustments necessary in the steel frame because of fabrication, construction or erection discrepancies in elevations and alignment shall be the responsibility of the Contractor.
 - 3. Survey Work:
 - 4. Contractor shall employ a registered surveyor to establish control points and layout work for the Building Control Lines, The Contractor shall conduct layout work and elevations for erection of structural steel.
 - 5. Check elevations of concrete and masonry bearing surfaces and anchor bolts locations prior to erection and submit any discrepancies to Architect prior to start of erection. Corrections or adjustments to the structural steel shall be made and submitted for approval prior to start of erection.

6. Upon completion of erection of steel frame and before the start of work specified in other sections that are supported, attached or applied to the frame, make a final survey of the frame and submit a report to the Architect within 3 days certifying compliance with the specified tolerances.
- X. Codes and Standards: Comply with Paragraph 1.2C and provisions of following, except as otherwise indicated:
- AISC “Code of Standard Practice for Steel Buildings and Bridges AISC “Specifications for the Design, Fabrication, and Erection of Structural Steel for Buildings” and including the Commentary” and Supplements thereto as issued.
- AWS D1.1 “Structural Welding Code.
- ASTM-A6 “General Requirements for Delivery of Rolled Steel Plates, Shapes. Sheet Piling and Bars for Structural Use.”
- CCR, Title 24, Chapter 22A – California Building Code
- Y. Qualifications for Welding Work: Qualify welding processes and welding operators in accordance with the AWS “Procedure Qualification” and “Welder Qualification”.
- Z. Source Quality Control: Materials and fabrication procedures are subject to inspection and test in mill, shop and field, conducted by a qualified inspection agency appointed by the Architect. Such inspections and tests will not relieve contractor of responsibility for providing materials and fabrication procedures in compliance with specified requirements.
- AA. Testing Laboratory shall perform conformance testing in accordance with CBC Chapter 17A.
1. Identified Structural Steel: Steel shall be identified in accordance with ASTM A6 and bear legible heat numbers acceptable to the Testing Laboratory which shall make positive identification of structural steel as to mill source, heat numbers, and certified mill analysis and test report for each heat. Obtain the mill test reports and furnish report certifying identity of steel.
 2. Unidentified Structural Steel: Steel not identified and certified as specified above shall be tested according to following requirements. Structural steel fabricator shall cut samples under direction of the Testing Laboratory. Testing Laboratory shall machine or otherwise prepare the specimens and perform testing of each 5 tons or fraction thereof, for each size of unidentified steel except, in the case of random pieces or steel having F_y equal to or greater than 36 ksi, testing of each piece is required. Tests required are:
 - a. For pipe, one tension and elongation test and one flattening test of each size.
 - b. For all other steel, one tension and elongation test and one bend test for each size.
 - c. Additional test per Paragraph 1.1A.1 may be required for quantity when deemed necessary by the Architects or by the governing agency.
 - d. Contractor shall reimburse to the owner all costs paid by the owner for testing unidentified steel.
 3. For all other unidentified steel having F_y equal to or greater than 36 ksi, one tension and elongation test and one bend or flattening test, as applicable, for each heat plus steel manufacturer’s certified mill analysis and test report as specified above shall be performed.

4. Lamellar Tearing: Prior to welding all plates 1-1/2 inches thick and greater and all rolled shapes within the distance from 6 inches above the top of the moment frame joint to 6 inches below the bottom of the moment frame joint shall be checked by ultrasonic testing for laminations in base metal which may interfere with the inspection of the completed joint. Should these defects occur members will be rejected, or corrections made subject to the approval of the architect and governing agency. Welding procedures specifications in Paragraph 1.3I shall address proper welding practices to help minimize the danger of lamellar tearing.
5. Testing of High Strength, Bolts, Nuts and Washers: In accordance with CBC Chapter 17A.
6. Promptly remove and replace materials or fabricated components which do not comply.

BB. Design of Members and Connections: Details shown are typical; similar details apply to similar conditions, unless otherwise indicated. Verify dimensions at site whenever possible without causing delay in the work.

Promptly notify the Architect whenever design of members and connections for any portion of structure are not clearly indicated.

CC. For Exposed Structural Steel: Perform work in accordance with AISC – Specification for Architectural Exposed Structural Steel.

DD. Preheat and Interpass Temperatures:

1. The preheat temperatures and conditions given in AWS D1.1, Chapter 3 shall be strictly observed with special attention given to Paragraph 3.5 for the thickness of material to be welded.
2. Preheat temperatures should be measured at a distance from the weld equal to the thickness of the part being welded, but not less than three inches in any direction including the through thickness of the piece. Where plates are of different thickness, the pre-heat requirements for the thicker plate should govern. Maintenance of pre-heat temperatures through the execution of the weld (i.e. the interpass temperature) is essential. Maximum interpass temperature should be limited to 550 degrees Fahrenheit for all complete joint penetration welds. Welding operators and inspectors shall be in possession of and utilizing temperature measure devices. Temperature indicating sticks may be used.

EE. When ambient temperature drops below 50°F or under circumstances where the wind chill at higher temperature would increase the heat loss to be equivalent to a temperature of 50°F controlled cooling shall be provided by wrapping insulating blankets over the welded assembly immediately after completion of welding.

FF. Where noted on drawings, perform work in accordance with AISC “Specification for Architectural Exposed Structural Steel” (AESS).

1.4 QUALIFICATIONS

A. Qualifications: Contractor shall determine, warrant, and certify that producer, detailer, fabricator, erector, materials suppliers and all other involved in the Work of this Section with minimum five years documented experienced for at least five building 5 stories or more in height.

- B. Fabricator: AISC certified shop for complex structures specializing in standard building structures (BU) with minimum five years of documented experience in fabrication of structural steel for at least five buildings 5 stories or more in height.
- C. Erector: AISC certified steel erector with minimum five years of documented experience in the erection of structural steel for at least five buildings 5 or more stories in height.

1.5 FIELD MEASUREMENTS

- A. Verify that field measurements are as shown on the Contract Documents. Contractor shall furnish accurate as-built drawings of bolt settings for work specified in this section and other sections.

1.6 DELIVERY, STORAGE AND HANDLING

- A. Deliver materials to site at such intervals to insure uninterrupted progress of work. Protect all steel materials from damage during shipping, handling, and storage on the site. Steel showing dents, creases, deformations, weathering, or other defects is not acceptable. Deliver welding electrodes to site in unbroken packages bearing the manufacturer's name and label identifying the contents.
 - 1. Deliver anchor bolts and anchorage devices, which are to be embedded in cast-in-place concrete, in ample time to not delay that work. Anchor bolts and template delivery shall be indicated as a milestone date on the project construction schedule.
- B. Storage of fabricated steel at the site shall be the responsibility of the Contractor. Store materials to permit easy access for inspection and identification. Keep steel members off ground, using pallets, platforms, or other supports. Protect steel members and package materials from corrosion and deterioration.
- C. Do not store materials on structure in a manner that might cause distortion or damage to members or supporting structures. Repair or replace damaged materials or structures as required by the architect.
- D. Other material shall be stored in weather-tight containers until ready for use in the Work. Containers must be stored in a dry place.
- E. The Architect reserves the right to reject any material that has become damaged because of improper storage.
- F. Storage areas must be shown on the current site use plan.
- G. High-strength bolts and certificates shall be identified, stored and tracked at the site until they are installed.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Steel Angles and Channels: ASTM A36/A36M, ASTM/A572 Grade 50 if noted on the drawings.
- B. Steel W Shapes and Tees: ASTM A992/A992M.

- C. Rolled Shapes: ASTM A913/A913M Grade 65 if noted on the drawings.
- D. Built-up column and connection plates ASTM A572, Grade 50 steel.
- E. Steel Plates and Bars: ASTM A572/A572M, Grade 50 (345) high-strength, columbium-vanadium steel, or as indicated on the drawings.
- F. Structural Tubing: ASTM A500, Grade C.
- G. Pipe: ASTM A53/A53M, Grade B, Finish black.
- H. Shear Stud Connectors: Made from ASTM A108 Grade 1015 bars.
- I. Structural Bolts and Nuts: Carbon steel, ASTM A307, Grade A galvanized to ASTM A153/A153M, Class C.
- J. High-Strength Structural Bolts, Nuts, and Washers: ASTM F3125/F3125M, Type 1, medium carbon.
- K. High-Strength Structural Bolts: ASTM F3125/F3125M, with matching ASTM A563 (ASTM A563M) nuts and ASTM F436 washers; Type 1 alloy steel.
- L. Unheaded Anchor Rods: ASTM F1554, Grade 55 S1 (UNO), plain, with matching ASTM A563 or A563M nuts and ASTM F436 Type 1 washers.
- M. Headed Anchor Rods: ASTM F1554, Grade 55 S1, (UNO).
- N. High-Strength Anchor Bolts: ASTM F3125/F3125M, Type 1 medium carbon, plain.
- O. Load Indicator Washers: Provide washers complying with ASTM F959 at all connections requiring high-strength bolts.
- P. Welding Materials: AWS D1.1; type required for materials being welded.
- Q. Sliding Bearing Plates: Teflon coated.
- R. Grout: Non-shrink, non-metallic aggregate type, complying with ASTM C1107 and capable of developing a minimum compressive strength of 7,000 psi at 28 days.
- S. Shop and Touch-Up Primer: Fabricator's standard, complying with VOC limitations of authorities having jurisdiction.
- T. Touch-Up Primer for Galvanized Surfaces: Fabricator's standard, complying with VOC limitations of authorities having jurisdiction.
- U. Unfinished Threaded Fasteners: ASTM A307, Grade A, regular low-carbon steel bolts and nuts. Provide hexagonal heads and nuts for all connections.
- V. High-Strength Threaded Fasteners: Heavy hexagon structural bolts, heavy hexagon nuts, and hardened washers, as follows:

Quenched and Tempered Medium-Carbon Steel Bolts, nuts and washers, complying with ASTM-A325, and/or as called for on the drawings.

- W. Anchor Bolts: ASTM A36, non-headed type or ASTM F1554 Headed unless otherwise indicated. ASTM A572 and/or ASTM F1554 where indicated on drawings.
- X. Electrodes for Flux Cored Arch welding (FCAW) shall not have diameter greater than 7/64 inch and an electrical stick out greater than two inches.

2.2 FABRICATION

- A. Shop Fabrication and Assembly: Fabricate and assemble structural assemblies in the shop to greatest extent possible. Fabricate items of structural steel in accordance with AISC Specifications and as indicated on contract documents. Properly mark and match- mark materials for field assembly. Fabricate for delivery sequence which will expedite erection and minimize field handling of materials.
- B. Cleaning and Straightening: Wire brush steel materials and clean off loose mill scale and rust. Straighten steel members by non-injurious methods prior to fabrication. Remove twists or bends after punching or working component parts of a member before the parts are assembled. Produce finished members free from twists, bends, and open joints when erected.
- C. Provide and deliver test samples for material properties verifications per Paragraph 1.6.O.3 and 1.6.O.4 to the testing laboratory.
- D. Connections: Weld or bolt shop connections, as indicated.
- E. Welded Construction: Strictly comply with AWS D1.1 code for procedures, appearance, and quality of welds, and methods used in correcting defective welding work.
- F. Assemble and weld built-up sections by some method which will produce true alignment of axes without warp.
- G. Holes for Other Work: Provide holes required for securing other work to structural steel framing and for passage of other work through steel framing members. Provide threaded nuts welded to framing, and other specialty items as indicated to receive other work including hole reinforcing as shown or required.

Cut, drill, or punch holes perpendicular to metal surfaces. Do not flame cut holes or enlarge holes by burning.

Holes in steel may be punched 1/16" larger than nominal diameter of bolt if steel thickness is equal to or less than 1/8" plus bolt diameter. If the steel is thicker than the diameter of the bolt plus 1/8", the holes shall be drilled or sub-punched and reamed. Diameter of sub-punched holes, and the drill for sub-drilled holes, shall be 1/16" smaller than the nominal diameter of bolt to be installed. Precisely locate finished holes to ensure passage of all bolts through steel assemblies without drifting. Enlarge holes only by reaming. Poor matching of holes is cause for rejection.

- H. Anchor Bolts: Furnish anchor bolts and other connectors required for securing structural steel to foundations and other in-place work.

Furnish templates and other devices as necessary for presetting bolts and other anchors to accurate locations.

Punch and drill or ream holes in base and bearing plates. Do not make or enlarge the holes by burning except at grouting holes in column bases plates and then only with the approval of the Architect.

- I. Base Plates: Finish column bases and base plates per AISC 360 Section M2-8.
- J. Gas Cutting: Use of a cutting torch is allowed where the metal being cut is not stressed during the operation, and provided stresses are not transmitted through flame-cut surface. Make gas cuts with a smooth regular contour. Deduct 1/8" from the width of gas cut edges to determine the effective width of gas cut members. Make reentrant gas cut radius as large as possible, but 1" minimum. For reentrant corners (e.g. slots in tube steel braces) drill 1" (inch) diameter pilot holes.
- K. Welded Construction: Strictly comply with AWS Codes for procedures, appearance and quality of welds, and methods used in correcting welding work. Assemble and weld built-up sections by methods that will produce true alignment of axes without warp.
 1. Conform to AWS D1.1 and D1.3, as modified by referenced AISC Standards, and as indicated or noted on Drawings. Employ welding operators qualified in accordance to AWS D1.1 and D1.3, as applicable, who are thoroughly trained and experienced in arc welding and that produce uniformly reliable groove and fillet welds in flat, vertical, and overhead positions, and make neat and consistent welds. Weld all structural steel joints by shielded electric-arc method unless otherwise shown, specified, or approved.
 2. Qualifications of Welders: Each welder working on the Project shall be assigned an identification symbol or mark. Each welder shall mark or stamp his identification symbol at each completed weldment.
 3. Welders and Welding operators shall be qualified per AWS "Standard for Qualifications". The Contractor shall require any welder to retake the test when, in the opinion of the Architect, the Work of the welder creates a reasonable doubt as to the proficiency of the welder. All such tests shall be made using the filler metal to be used in actual fabrication.
 4. Test, when required, and costs for qualifying welders shall be conducted at no additional expense to the Owner.
 5. Recertification of the welder shall be made to Architects only after the welder has taken and passed the required retest. The architect may require coupon to be cut from any location in any joint for testing. All sections of welds found defective shall be chipped or cut out to base metal and properly re welded before proceeding with the Work.
 - a. Should any 2 coupons cut from the work of any welder show strengths that, under test, are less than that of the base metal, it will be considered evidence of negligence or incompetence and such welder shall be permanently removed from the Work.
 - b. When coupons are removed from any part of a structure, the members cut shall be repaired, at no additional cost to the owner. Make repairs in a neat and workmanlike manner with joints of proper type to develop the full strength of the member and joint cut. Peen as necessary or directed to relieve residual stress.

6. Storage and Care of Electrodes: Coating of low-hydrogen type electrodes shall be thoroughly dry as used. Conform to AWS D1.1. Use electrodes taken from hermetically sealed packages within time limit specified therein after package is opened. Electrodes not used within allowable time period and electrodes that have been exposed more than one hour to air having a relative humidity of 75% or greater shall be dried according to AWS D1.1 before they are used, or shall be reconditioned according to electrode manufacturer's recommendations. Electrodes so dried or reconditioned and not used within allowable time period shall be redried before use. Electrodes of any class that have been wet shall not be used under any conditions.
7. Preparation: Clean surfaces to be welded of all paint, grease, oil, mill scale, and foreign matter. Clean weld each time the electrode is changed. Chip full surface of hand guided and controlled flame-cut edges before welding. Steel surfaces prepared with automatic or mechanically guided and controlled equipment need not be ground or chipped before welding.
8. Procedures: During assembling and welding, hold components of a built-up member with adequate clamps, bolts, or other means to keep parts straight and in tight contact. GMAW, FCAW-G, GTAW and EGW shall not be performed when the wind velocity in the immediate vicinity of the weld exceeds three miles per hour. Welding performed within an enclosed area, and not subject to drafts may be deemed to satisfy this requirement. SMAW, FCAW-S, AND SAW may be performed without limitation to wind velocity, provided the wind does not affect the appearance of the molten weld puddle. Cut out defective welding with chisel or air arc and replace.
9. Maintain record of welding procedures, welders employed, date of qualification and identification symbol of mark. Submit at completion of Work, or upon request, certified copies of records.
10. Related Welding: Conform to AWS D1.1 for fillet, plug, slot, partial or flared groove, and lap. Welding starts and stops do not count as part of the effective length of any weld.
11. Connection to Embedment's in Concrete and Masonry: Make welds to metal embedment's installed in concrete or masonry construction with electrodes of size and by methods that will ensure against damage to adjacent construction due to heat input to and connection from embedded metal.
12. Weather Exposed Welds: Seal weld around entire connection where welds remain exposed to weather, in addition to required structural welding.
13. Weld Characteristics: Clean and wire brush all welds. Visual inspection of finished welds must show uniform section, smoothness of welded metal, feather edges without undercuts or overlays, freedom from porosity and inclusions, and good fusion and penetration into base metal at edges and ends of fillet welds.
14. Weld Finishing: Grind exposed welds to smooth surfaces free of holes, slag, or other defects, flush with adjoining surfaces. No finish treatment is required for permanently concealed welds.

L. Bolted Construction

1. Machine Bolts: Make connections with machine bolts only where indicated.
2. High-Strength Steel Bolting: For joints connected by high strength steel bolts, hardened washers, and nuts tightened to high tension, conform materials, methods of installation and tension control, and wrenches to Reference Standards.

Install all high-strength bolts under inspection required by CBC Chapter 17A.

- a. Connections shall be the bearing type bolts (N or X) unless noted to be Slip Critical" (SC)

- b. Minimum bolt lengths shall be per AISC - 15th edition Table 7-14.
 - c. Clean all contact surfaces of bolted parts and threads free of scale, slag, burrs, pits, dirt, paint, and other foreign material or defects which would prevent solid seating of connected parts.
 - d. Install hardened washers per AISC Standards.
 - e. Tighten bolts systematically from most rigid part of connection to the free edges.
 - f. Retighten first installed bolts that may have loosened by tightening of subsequent bolts so all bolts are tightened to correct tension.
 - g. Mark fully tightened bolts with identifying symbol.
- 3. Load Indicator Washers: Manufactured and licensed by Cooper and Turner, or equal, may be used for field installation of high-strength bolts. Load indicator washers do not replace required washers but may be used in conjunction with required washers. Conform tightening to Paragraph 5e of "Reference Specifications". After sufficient bolts in a joint are snugged to bring the members into close contact, perform tightening from most rigid part to free edges until load indicators on all bolts are closed to required gap of 0.015" under bolts heads or 0.010" under the nuts. Do not completely close the gap to prevent overtightening and damage to the bolts.
 - 4. Tension Set or Load Indicator Bolts, Nuts, and Washers: As manufactured by Cold Form Specialties, or equal, may be used for the field installation of high-strength bolts. In multi-bolts joints, tighten the nuts in stages (a little at a time) without breaking spline in any of them until final stage, to minimize slackening of the installed bolts.
- M. Space shear stud connectors at spacing indicated on the drawings.
 - N. Fabricate connections for bolt, nut, and washer connectors.
 - O. Develop required camber for members.
- 2.3 FINISH
- A. General: Shop paint structural steel work, except as follows:
 - 1. Steel surfaces embedded in concrete or masonry.
 - 2. Structural steel which is completely closed-in by interior or exterior building finish.
 - 3. Do not paint surfaces which are to be welded or high-strength bolted with slip critical (SC)-type connection.
 - 4. Do not paint surfaces which are scheduled to receive sprayed-on fireproofing.
 - B. Prepare structural component surfaces in accordance with SSPC-Paint 20.
 - C. Shop prime all structural steel which will be exposed in the finished work. Do not prime surfaces that will be fireproofed, field welded, in contact with concrete, high strength bolted, or where concealed by building finishes unless noted on the drawings.
 - D. Painting: Immediately after surface preparation, apply structural steel primer paint in accordance with manufacturer's instructions and at a rate to provide a uniform dry film thickness of not less than 1.5 mils. Use painting methods which will result in full coverage of joints, corners, edges, and exposed surfaces.

E. Galvanize all steel exposed to weather per ASTM A123. Provide minimum 1.7 oz/sq ft. galvanized coating.

F. EXECUTION

2.4 EXAMINATION

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

B. Beginning of installation means erector accepts existing conditions.

2.5 ERECTION

A. General: Comply with AISC Specifications and Code of Standard Practice, and as herein specified.

B. Temporary Shoring and Bracing: Provide temporary shoring and bracing members with connections of sufficient strength to bear imposed loads. Remove temporary members and connections when permanent members are in place and final connections are made. Provide temporary guy lines to achieve proper alignment of structures as erection proceeds.

C. Temporary Planking: Provide temporary planking and working platforms as necessary to effectively complete the work.

D. Setting Bases and Bearing Plates: Furnish and deliver anchor bolts with setting drawings and templates. Verify position of bolts prior to delivery of steel; report errors or deviation for correction to the architect.

1. Clean concrete bearing surfaces of bond-reducing materials and roughen to improve bond to surfaces. Clean the bottom surface of base and bearing plates.
2. Set loose and attached base plates and bearing plates for structural members on wedges or other adjusting devices.
3. Snug tightened anchor bolts after supported members have been positioned and plumbed. Do not remove wedges or shims but, if protruding, cut off flush with edge of base or bearing plate prior to packing with grout.

E. Field Assembly: Set structural frames accurately to lines and elevations. Align and adjust various members forming a part of a complete frame or structure before permanently fastening. Clean bearing surfaces and other surfaces that will be in permanent contact before assembly. Perform necessary adjustments to compensate for discrepancies in elevations and alignment.

1. Level and plumb individual members of structure within specified tolerances.
2. Splice members only where indicated and accepted on final shop drawings.
3. Do not enlarge unfair holes in members by burning or by use of drift pins except in secondary bracing members. Ream holes that must be enlarged to admit bolts.
4. Gas Cutting: Do not use gas cutting torches in field for correcting fabrication errors in structural framing without the approval of the architect. Cutting will be permitted only on secondary members which are not under stress. Finish gas-cuts sections equal to a sheared appearance when permitted.

- F. Damaged Members: Remove members damaged to an extent impairing appearance, strength or serviceability, as determined by architect and replace with new members at no extra cost to the owner.
- G. Grouting of Base Plates and Bearing Plates
 - 1. Plates shall be set and anchored to the proper line and elevation. Metal wedges, shims and/or setting nuts shall be used for leveling and plumbing the structural members, including plumbing of columns. Concrete surfaces shall be rough, clean, free of oil, grease and laitance, and shall be damp. Metal surfaces shall be clean and free of oil, grease, and rust. Addition of water, mixing and placing shall be in conformance with the material manufacturer's instructions. Grout shall be mixed by using a mortar mixer. Batches shall be of size to allow continuous placement of freshly mixed grout. Placing shall be quick and continuous. Exposed surfaces shall have smooth, dense finish. Fill grout space solid with non-shrink grout.
 - 2. Base plates shall be grouted prior to the placement of structural concrete slabs and/or concrete fill on metal decks.
- H. Field Touch-up Painting: After structural steel erection and connections are completed, inspected, and approved, clean all connections to be painted and damage to shop painted surfaces, and apply a field touch-up coat of same primer used for shop coat.

2.6 TOLERANCES: ERECT MEMBERS TO THE TOLERANCES CONFORMING TO REFERENCED AISC STANDARDS AND CBC, EXCEPT AS FOLLOWS:

- A. Vertical Dimensions: Measured from top of beams at their connections at any column, variation not more than 1/4" plus or minus per story or, when variations are accumulative from floor to floor, not exceeding 3/8" per story exclusive of column shortening due to dead load.
- B. Plumb Displacement: Center line of columns from established column line, no more than 1" toward or away from established center line.
- C. Horizontal Dimension Variances: Governed by specified column plumb displacement.

2.7 QUALITY CONTROL – SHOP AND FIELD

- A. The Owner will engage an independent testing and inspection agency to inspect high-strength bolted connections and welded connections and to perform tests and prepare test reports in accordance with CBC Chapter 17A.
- B. Testing Agency shall conduct and interpret test and state in each report whether test specimens comply with requirements, and specifically state any deviations therefrom.
- C. Provide access for testing agency to places where structural steel work is being fabricated or produced so that required inspection and testing can be accomplished safely.
- D. The testing agency may inspect structural steel at plant before shipment; however, Architect reserves the right at any time before final acceptance to reject material not complying with specified requirements.

- E. Correct deficiencies in structural work which inspections and laboratory test reports have indicated to be not in compliance with requirements. Perform additional tests, at Contractor's expense, as may be necessary to reconfirm any non-compliance of original work, and as may be necessary to show compliance of corrected work.
- F. Welding: Inspect and test during fabrication and erection of structural steel assemblies, as follows:
1. Certify welders and conduct inspections and tests as required. Record types and locations of defects found in the work. Record work required and performed to correct deficiencies.
 2. Inspect all welds. All welds shall be accepted visually prior to performing any non-destructive testing. Groove weld shall be inspected by ultrasonic or other approved non-destructive test methods. All testing shall be performed to AWS D1.1 Table 6.2 *statically* loaded non-tubular connections.
 3. Ultrasonic testing shall be performed by a specially trained and qualified technician who shall operate the equipment, examine welds, and maintain a record of welds examined, defects found, and disposition of each defect. All defective welds shall be repaired and costs for retesting defective welds shall be paid by Contractor.
 4. Rate of Testing: All completed welds contained in joints and splices shall be tested 100 percent either by ultrasonic testing or by radiography.
 5. Base metal thicker than 1 1/2 inches, when subjected to through-thickness weld shrinkage strains, shall be ultrasonically inspected by shear wave methods for discontinuities directly behind such welds. Tests shall be performed not less than 48 hours after completed joint has cooled down to ambient air temperature.
 6. Any material discontinuities shall be accepted or rejected on the basis of the defect rating in accordance with the criteria of AWS D1.1 *Table 6.2* by the Architect.
 7. Welds inspected by visual or ultrasonic testing or any other approved method that does not meet the requirements of AWS D1.1 shall be repaired or replaced as prescribed by AWS D1.1. Additional testing of repaired or replaced areas shall be made at the Contractor's expense.
 8. Should defects appear in base metal and/or in welds tested, repairs of defects in base metal or welds shall be similarly inspected, as approved by architect at the Contractor's expense until satisfactory performance is assured.
 9. Other method of non-destructive testing and inspection, for example, liquid dye penetrant testing, magnetic particle inspection or radiographic inspection, may be used on weld if required.
 10. Lamellar Tearing: Lamellar tearing resulting from welding is a crack (with zero tolerance) and shall be repaired per AWS D1.1.
 11. Lamination: Lamination are defects in the base metal. The rejection criteria shall be based on ASTM A435.
 12. Where lamination or conditions of lamellar tearing in base metal are revealed by testing, the steel fabricator shall submit a proposed method of repair for approval. Retesting of repaired areas is required. Costs of repair and retesting shall be borne by the Contractor.
 13. Magnetic Particle Testing: Magnetic particle testing when required shall be provided in accordance with AWS D1.1 for procedure and technique. The standards of acceptance shall be in accordance with AWS D1.1 - Qualification.
 14. Lamellar Tearing: See Paragraph 1.3AA.4.
- G. Prior Testing of Base Material: Test material prior to fabrication in order to detect possible defects that would require difficult and expensive repair.

- H. Lines and levels of erected steel to be certified by a licensed surveyor. See additional requirements in Division 1 Sections.
- I. Welded studs shall be tested and inspected by the owner's testing laboratory in accordance with the requirements of AWS D1.1 - Stud Welding.
- J. As erected Drawings: After all steel has been erected, correct or revise shop drawings and erection diagrams to correspond with the changes made in the field.
- K. High-Strength Bolts: Provide testing and verification of field-bolted connections in accordance with AISC "Specification for Structural Joints Using ASTM F3125/F3125M Bolts".

END OF SECTION

SECTION 055213

PIPE AND TUBE RAILINGS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Steel railings.
 - 2. Stainless steel railings.

1.2 COORDINATION

- A. Coordinate selection of shop primers with topcoats to be applied over them. Comply with paint and coating manufacturers' written recommendations to ensure that shop primers and topcoats are compatible with one another.
- B. Coordinate installation of anchorages for railings. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, and items with integral anchors, that are to be embedded in concrete or masonry. Deliver such items to Project site in time for installation.

1.3 ACTION SUBMITTALS

- A. Product Data:
 - 1. Manufacturer's product lines of mechanically connected railings.
 - 2. Post-installed anchors.
 - 3. Rail brackets.
- B. Shop Drawings: Include plans, elevations, sections, details, and attachments to other work.

1.4 INFORMATIONAL SUBMITTALS

- A. Qualification Data: Testing agency
- B. Welding certificates.
- C. Product Test Reports: For tests on railings performed by a qualified testing agency, in accordance with ASTM E894 and ASTM E935.

1.5 QUALITY ASSURANCE

- A. Welding Qualifications: Qualify procedures and personnel in accordance with the following:
 - 1. AWS D1.1/D1.1M, "Structural Welding Code - Steel."
 - 2. AWS D1.2/D1.2M, "Structural Welding Code - Aluminum."
 - 3. AWS D1.6/D1.6M, "Structural Welding Code - Stainless Steel."

1.6 DELIVERY, STORAGE, AND HANDLING

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

1.7 FIELD CONDITIONS

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

PART 2 - PRODUCTS

2.1 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.
 - 1. Provide type of bracket with predrilled hole for exposed bolt anchorage and that provides 1-1/2-inch (38-mm) clearance from inside face of handrail to finished wall surface.

2.2 STEEL RAILINGS

- A. Pipe: ASTM A53/A53M, Type F or Type S, Grade A, Standard Weight (Schedule 40), unless another grade and weight are required by structural loads.
- B. Plates, Shapes, and Bars: ASTM A36/A36M.

2.3 STAINLESS STEEL RAILINGS

- A. Pipe: ASTM A312/A312M, Grade TP 304
- B. Castings: ASTM A743/A743M, Grade CF 8 or CF 20
- C. Plate and Sheet: ASTM A240/A240M or ASTM A666, Type 304

2.4 FASTENERS

A. Fastener Materials:

1. Ungalvanized-Steel Railing Components: Plated steel fasteners complying with ASTM F1941/F1941M, Class Fe/Zn 5 for zinc coating.
2. Hot-Dip Galvanized Railing Components: Type 304 stainless steel or hot-dip zinc-coated steel fasteners complying with ASTM A153/A153M or ASTM F2329/F2329M for zinc coating.
3. Finish exposed fasteners to match appearance, including color and texture, of railings.

B. Fasteners for Anchoring Railings to Other Construction: Select fasteners of type, grade, and class required to produce connections suitable for anchoring railings to other types of construction and capable of withstanding required loads.

C. Fasteners for Interconnecting Railing Components:

D. Post-Installed Anchors: Fastener systems with working capacity greater than or equal to the design load, according to an evaluation report acceptable to authorities having jurisdiction, based on ICC-ES AC193 or ICC-ES AC308.

1. Material for Interior Locations: Carbon-steel components zinc-plated to comply with ASTM B633 or ASTM F1941/F1941M, Class Fe/Zn 5, unless otherwise indicated.
2. Material for Exterior Locations and Where Stainless Steel Is Indicated: Alloy Group 1 (A1), Group 2 (A4) stainless steel bolts, ASTM F593, and nuts, ASTM F594.

2.5 CODE COMPLIANCE

A. Railings and Handrails: CBC SECTION 11B-505

1. Top of gripping surfaces of handrails shall be 34" minimum and 38" maximum vertically above walking surfaces, stair nosings, and ramp, surfaces. Handrails shall be at a consistent height above such surfaces.
2. Clearance between handrail gripping surfaces and adjacent surfaces shall be 1 ½" minimum. Handrail may be located in a recess if the recess is 3" maximum deep and provides 18" minimum clear space above the top of the handrail.
3. Handrail gripping surfaces shall be continuous along their length and shall not be obstructed along their tops or sides. The bottoms of handrail gripping surfaces shall not be obstructed for more than 20% of their length. Where supports are provided, horizontal projections shall occur 1 ½" minimum below the bottom of the handrail gripping surfaces.
4. Handrail gripping surface with a circular cross section shall have an outside diameter of 1 ¼" minimum and 2" maximum.
5. Handrail gripping surface with a non-circular cross section shall have an outside dimension of 4" minimum and 6 ¼" maximum, and a cross-section dimensions of 2 ¼" maximum.
6. Handrail gripping surfaces and any surfaces adjacent to them shall be free of sharp or abrasive elements and shall have rounded edges.
7. Handrails shall not rotate within their fittings.

8. Handrail gripping surfaces shall not extend beyond and in the same direction of stair flights and ramp runs in accordance with CBC Section 11B-505.10. Such extensions are not required for continuous handrails at the inside turn of switchback or dogleg stairs and ramps.
9. The orientation of at least one handrail shall be in the direction of the stair run, perpendicular to the direction of the stair nosing, and shall not reduce the minimum required width of the stair. CBC Section 11B-505.2.1
10. A 2" minimum high curb or barrier shall be provided to prevent the passage of a 4" diameter sphere rolling off the edges on a ramp or landing surface. Such a curb or barrier shall be continuous and uninterrupted along the length of a ramp. CBC Section 11B-405.9.2

2.6 FABRICATION

- A. General: Fabricate railings to comply with requirements indicated for design, dimensions, member sizes and spacing, details, finish, and anchorage, but not less than that required to support structural loads.
- B. Shop assemble railings to greatest extent possible to minimize field splicing and assembly. Disassemble units only as necessary for shipping and handling limitations.
 1. Clearly mark units for reassembly and coordinated installation.
 2. Use connections that maintain structural value of joined pieces.
- C. Cut, drill, and punch metals cleanly and accurately.
 1. Remove burrs and ease edges to a radius of approximately 1/32 inch (1 mm) unless otherwise indicated.
 2. Remove sharp or rough areas on exposed surfaces.
- D. Fabricate connections that are exposed to weather in a manner that excludes water.
 1. Provide weep holes where water may accumulate.
 2. Locate weep holes in inconspicuous locations.
- E. Cut, reinforce, drill, and tap as indicated to receive finish hardware, screws, and similar items.
- F. Connections: Fabricate railings with welded connections unless otherwise indicated.

2.7 STEEL AND IRON FINISHES

- A. Galvanized Railings:
 1. Hot-dip galvanize exterior steel railings, including hardware, after fabrication.
 2. Comply with ASTM A123/A123M for hot-dip galvanized railings.
 3. Comply with ASTM A153/A153M for hot-dip galvanized hardware.
- B. For galvanized railings, provide hot-dip galvanized fittings, brackets, fasteners, sleeves, and other ferrous components.

- C. Preparing Galvanized Railings for Shop Priming: After galvanizing, thoroughly clean railings of grease, dirt, oil, flux, and other foreign matter, and treat with etching cleaner and as follows.
 - 1. Comply with SSPC-SP 16.

2.8 STAINLESS STEEL FINISHES

- A. Surface Preparation: Remove tool and die marks and stretch lines, or blend into finish.
- B. Polished Finishes: Grind and polish surfaces to produce uniform finish, free of cross scratches.

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

- A. Perform cutting, drilling, and fitting required for installing railings.
 - 1. Fit exposed connections together to form tight, hairline joints.
 - 2. Install railings level, plumb, square, true to line; without distortion, warp, or rack.
 - 3. Set railings accurately in location, alignment, and elevation; measured from established lines and levels.
 - 4. Do not weld, cut, or abrade surfaces of railing components that are coated or finished after fabrication and that are intended for field connection by mechanical or other means without further cutting or fitting.
- B. Control of Corrosion: Prevent galvanic action and other forms of corrosion by insulating metals and other materials from direct contact with incompatible materials.
 - 1. 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. Adjust railings before anchoring to ensure matching alignment at abutting joints.
- D. Fastening to In-Place Construction: Use anchorage devices and fasteners where necessary for securing railings and for properly transferring loads to in-place construction.

3.2 RAILING CONNECTIONS

- A. Welded Connections: Use fully welded joints for permanently connecting railing components. Comply with requirements for welded connections in "Fabrication" Article, whether welding is performed in the shop or in the field.
- B. Expansion Joints: Install expansion joints at locations indicated but not farther apart than required to accommodate thermal movement. Provide slip-joint internal sleeve, extending 2 inches (50 mm) beyond joint on either side; fasten internal sleeve securely to one side; and locate joint within 6 inches (150 mm) of post.

3.3 ATTACHING RAILINGS

- A. 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.
- B. Install railing gates level, plumb, and secure for full opening without interference.
 - 1. Attach hardware using tamper-resistant or concealed means.
 - 2. Adjust hardware for smooth operation.

3.4 CLEANING

- A. Clean stainless steel by washing thoroughly with clean water and soap and rinsing with clean water.
- B. Galvanized Surfaces: Clean field welds, bolted connections, and abraded areas, and repair galvanizing to comply with ASTM A780/A780M.

3.5 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 finishes 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 055213

SECTION 061600

SHEATHING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Wall sheathing.
2. Sheathing joint-and-penetration treatment materials.

B. Related Requirements:

1. Section 072500 "Weather Barriers" for water-resistive barrier applied over wall sheathing.

1.2 ACTION SUBMITTALS

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

B. Shop Drawings: For air-barrier and water-resistant glass-mat gypsum sheathing assemblies.

1. Show locations and extent of sheathing, accessories, and assemblies specific to Project conditions.
2. Include details for sheathing joints and cracks, counterflashing strips, penetrations, inside and outside corners, terminations, and tie-ins with adjoining construction.
3. Include details of interfaces with other materials that form part of air barrier.

1.3 INFORMATIONAL SUBMITTALS

A. Product Certificates: From air-barrier and water-resistant glass-mat gypsum sheathing manufacturer, certifying compatibility of sheathing accessory materials with Project materials that connect to or that come in contact with the sheathing.

B. Product Test Reports: For each air-barrier and water-resistant glass-mat gypsum sheathing assembly, indicating compliance with specified requirements, for tests performed by a qualified testing agency.

1.4 QUALITY ASSURANCE

A. Installer Qualifications: An entity that employs installers and supervisors who are trained and approved by manufacturer of air-barrier and water-resistant glass-mat gypsum sheathing.

1. Installer is to be licensed by ABAA in accordance with ABAA's Quality Assurance Program and is to employ ABAA-certified installers and supervisors on Project.

1.5 DELIVERY, STORAGE, AND HANDLING

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

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Fire-Resistance Ratings: As tested in accordance with ASTM E119; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.
 1. Fire-Resistance Ratings: Indicated by design designations from UL's "Fire Resistance Directory" or from the listings of another qualified testing agency.
- B. Air-Barrier and Water-Resistant Glass-Mat Gypsum Sheathing Performance: Air-barrier and water-resistant glass-mat gypsum sheathing assembly, and seals with adjacent construction, are to be capable of performing as a continuous air barrier and as a liquid-water drainage plane flashed to discharge to the exterior incidental condensation or water penetration. Air-barrier assemblies are to be capable of accommodating substrate movement and of sealing substrate expansion and control joints, construction material changes, penetrations, tie-ins to installed waterproofing, and transitions at perimeter conditions without deterioration and air leakage exceeding specified limits.

2.2 WALL SHEATHING

- A. Glass-Mat Gypsum Sheathing, Walls: ASTM C1177/C1177M.
 1. Type and Thickness: Type X, 5/8 inch (15.9 mm) thick.
 2. Size: 48 by 96 inches (1219 by 2438 mm)

2.3 FASTENERS

- A. General: Provide fasteners of size and type indicated that comply with requirements specified in this article for material and manufacture.
 1. For wall sheathing, provide fasteners with hot-dip zinc coating complying with ASTM A153/A153M
- B. Nails, Brads, and Staples: ASTM F1667.
- C. Power-Driven Fasteners: Fastener systems with an evaluation report acceptable to authorities having jurisdiction, based on ICC-ES AC70.

- D. Screws for Fastening Sheathing to Wood Framing: ASTM C1002.
- E. Screws for Fastening Wood Structural Panels to Cold-Formed Metal Framing: ASTM C954, except with wafer heads and reamer wings, length as recommended by screw manufacturer for material being fastened.
- F. Screws for Fastening Gypsum Sheathing to Cold-Formed Metal Framing: Steel drill screws, in length recommended by sheathing manufacturer for thickness of sheathing to be attached.
 - 1. For steel framing less than 0.0329 inch (0.835 mm) thick, use screws that comply with ASTM C1002.
 - 2. For steel framing from 0.033 to 0.112 inch (0.84 to 2.84 mm) thick, use screws that comply with ASTM C954.
- G. Screws for Fastening Composite Nail Base Insulated Roof Sheathing to Metal Roof Deck: Steel drill screws, in type and length recommended by sheathing manufacturer for thickness of sheathing to be attached, with organic-polymer or other corrosion-protective coating having a salt-spray resistance of more than 800 hours in accordance with ASTM B117. Provide washers or plates if recommended by sheathing manufacturer.

2.4 SHEATHING JOINT-AND-PENETRATION TREATMENT MATERIALS

- A. Sealant for Paper-Surfaced and Glass-Mat Gypsum Sheathing: Elastomeric, medium-modulus, neutral-curing silicone joint sealant compatible with joint substrates formed by gypsum sheathing and other materials, recommended by sheathing manufacturer for application indicated and complying with requirements for elastomeric sealants specified in Section 079200 "Joint Sealants."
- B. Sealant for Glass-Mat Gypsum Sheathing: Silicone emulsion sealant complying with ASTM C834, compatible with sheathing tape and sheathing and recommended by tape and sheathing manufacturers for use with glass-fiber sheathing tape and for covering exposed fasteners.
 - 1. Sheathing Tape: Self-adhering glass-fiber tape, minimum 2 inches (50 mm) wide, 10 by 10 or 10 by 20 threads/inch (390 by 390 or 390 by 780 threads/m), of type recommended by sheathing and tape manufacturers for use with silicone emulsion sealant in sealing joints in glass-mat gypsum sheathing and with a history of successful in-service use.
- C. Sheathing Tape for Foam-Plastic Sheathing: Pressure-sensitive plastic tape recommended by sheathing manufacturer for sealing joints and penetrations in sheathing.

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

- A. Do not use materials with defects that impair quality of sheathing or pieces that are too small to use with minimum number of joints or optimum joint arrangement. Arrange joints so that pieces do not span between fewer than three support members.

- B. Cut panels at penetrations, edges, and other obstructions of work; fit tightly against abutting construction unless otherwise indicated.
- C. Securely attach to substrate by fastening as indicated, complying with the following:
 - 1. Table 2304.10.1, "Fastening Schedule," in the ICC's International Building Code.

3.2 INSTALLATION OF GYPSUM SHEATHING

- A. Comply with GA-253 and with manufacturer's written instructions.
 - 1. Fasten gypsum sheathing to cold-formed metal framing with screws.
 - 2. Install panels with a 3/8-inch (9.5-mm) gap where non-load-bearing construction abuts structural elements.
 - 3. Install panels with a 1/4-inch (6.4-mm) gap where they abut masonry or similar materials that might retain moisture, to prevent wicking.
- B. Apply fasteners so heads bear tightly against face of sheathing, but do not cut into facing.
- C. Horizontal Installation: Install sheathing with V-grooved edge down and tongue edge up. Interlock tongue with groove to bring long edges in contact with edges of adjacent panels without forcing. Abut ends over centers of studs, and stagger end joints of adjacent panels not less than one stud spacing. Attach at perimeter and within field of panel to each stud.
 - 1. Space fasteners approximately 8 inches (200 mm) o.c. and set back a minimum of 3/8 inch (9.5 mm) from edges and ends of panels.
 - 2. For sheathing under stucco cladding, panels may be initially tacked in place with screws if overlying self-furring metal lath is screw-attached through sheathing to studs immediately after sheathing is installed.
- D. Vertical Installation: Install vertical edges centered over studs. Abut ends and edges with those of adjacent panels. Attach at perimeter and within field of panel to each stud.
 - 1. Space fasteners approximately 8 inches (200 mm) o.c. and set back a minimum of 3/8 inch (9.5 mm) from edges and ends of panels.
 - 2. For sheathing under stucco cladding, panels may be initially tacked in place with screws if overlying self-furring metal lath is screw-attached through sheathing to studs immediately after sheathing is installed.
- E. Seal sheathing joints in accordance with sheathing manufacturer's written instructions.
 - 1. Apply glass-fiber sheathing tape to glass-mat gypsum sheathing joints and apply and trowel sealant to embed entire face of tape in sealant. Apply sealant to exposed fasteners with a trowel so fasteners are completely covered. Seal other penetrations and openings.
- F. Air-Barrier and Water-Resistant Glass-Mat Gypsum Sheathing:
 - 1. Install accessory materials in accordance with sheathing manufacturer's written instructions and details to form a seal with adjacent construction, to seal fasteners, and ensure continuity of air and water barrier.

- a. Coordinate the installation of sheathing with installation of roofing membrane and base flashing to ensure continuity of air barrier with roofing membrane.
 - b. Install transition strip on roofing membrane or base flashing, so that a minimum of 3 inches (75 mm) of coverage is achieved over each substrate.
2. Connect and seal sheathing material continuously to air barriers specified under other Sections as well as to roofing-membrane air barrier, concrete below-grade structures, floor-to-floor construction, exterior glazing and window systems, glazed curtain-wall systems, storefront systems, exterior louvers, exterior door framing, and other construction used in exterior wall openings, using accessory materials.
 3. Apply joint sealants forming part of air-barrier assembly within manufacturer's recommended application temperature ranges. Consult manufacturer when sealant cannot be applied within these temperature ranges.
 4. Wall Openings: Prime concealed, perimeter frame surfaces of windows, curtain walls, storefronts, and doors. Apply transition strip so that a minimum of 3 inches (75 mm) of coverage is achieved over each substrate. Maintain 3 inches (75 mm) of full contact over firm bearing to perimeter frames, with not less than 1 inch (25 mm) of full contact.
 - a. Transition Strip: Roll firmly to enhance adhesion.
 - b. Preformed Silicone Extrusion: Set in full bed of silicone sealant applied to walls, frame, and air-barrier material.
 5. Fill gaps in perimeter frame surfaces of windows, curtain walls, storefronts, doors, and miscellaneous penetrations of sheathing material with foam sealant.
 6. Seal strips and transition strips around masonry reinforcing or ties and penetrations with termination mastic.
 7. Seal top of through-wall flashings to sheathing with an additional 6-inch- (150-mm-) wide, transition strip.
 8. Seal exposed edges of strips at seams, cuts, penetrations, and terminations not concealed by metal counterflashings or ending in reglets with termination mastic.
 9. Repair punctures, voids, and deficient lapped seams in strips and transition strips extending 6 inches (150 mm) beyond repaired areas in strip direction.

3.3 FIELD QUALITY CONTROL.

- A. ABAA Quality Assurance Program: Perform examinations, preparation, installation, testing, and inspections under ABAA's Quality Assurance Program.
- B. Inspections: Air-barrier and water-resistant glass-mat gypsum sheathing, accessories, and installation are subject to inspection for compliance with requirements. Inspections may include the following:
 1. Continuity of air-barrier system has been achieved throughout the building envelope with no gaps or holes.
 2. Laps in strips and transition strips have complied with minimum requirements and have been shingled in the correct direction (or mastic has been applied on exposed edges), with no fishmouths.
 3. Termination mastic has been applied on cut edges.
 4. Strips and transition strips have been firmly adhered to substrate.
 5. Compatible materials have been used.

6. Transitions at changes in direction and structural support at gaps have been provided.
 7. Connections between assemblies (sheathing and sealants) have complied with requirements for cleanliness, surface preparation and priming, structural support, integrity, and continuity of seal.
 8. All penetrations have been sealed.
- C. Air barriers will be considered defective if they do not pass tests and inspections.
- D. Repair damage to air barriers caused by testing; follow manufacturer's written instructions.
- E. Prepare test and inspection reports.

END OF SECTION 061600

SECTION 72100
THERMAL INSULATION

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
1. Mineral-wool blanket insulation.
 2. Loose-fill insulation.

1.2 ACTION SUBMITTALS

- A. Product Data:
1. Mineral-wool board insulation.
 2. Loose-fill insulation.

1.3 DELIVERY, STORAGE, AND HANDLING

- A. Protect insulation materials from physical damage and from deterioration due to moisture, soiling, and other sources. Store inside and in a dry location. Comply with manufacturer's written instructions for handling, storing, and protecting during installation.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Surface-Burning Characteristics: Maximum flame-spread and smoke-developed indexes less than 25 and 450 when tested in accordance with ASTM E84.
- B. Labeling: Provide identification of mark indicating R-value of each piece of insulation 12 inches (305 mm) and wider in width.

2.2 MINERAL-WOOL BLANKET INSULATION

- A. Mineral-Wool Blanket Insulation, Unfaced ASTM C665, Type I (blankets without membrane facing); consisting of fibers; passing ASTM E136 for combustion characteristics.
- B. Mineral-Wool Blanket Insulation, Reinforced-Foil Faced ASTM C665, Type III (reflective faced); Category 1 (membrane is a vapor barrier), faced with foil scrim, foil-scrim kraft, or foil-scrim polyethylene.

2.3 LOOSE-FILL INSULATION

- A. Glass-Fiber Loose-Fill Insulation ASTM C764

2.4 INSULATION FASTENERS

- A. Adhesively Attached, Spindle-Type Anchors: Plate welded to projecting spindle; capable of holding insulation of specified thickness securely in position with self-locking washer in place.
 - 1. Spindle: Copper-coated, low-carbon steel; fully annealed; 0.105 inch (2.67 mm) in diameter; length to suit depth of insulation.
 - 2. String Wires: Minimum 18 gage galvanized steel wire

PART 3 - EXECUTION

3.1 PREPARATION

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

3.2 INSTALLATION, GENERAL

- A. Comply with insulation manufacturer's written instructions applicable to products and applications.
- B. Install insulation that is undamaged, dry, and unsoiled and that has not been left exposed to ice, rain, or snow at any time.
- C. Install insulation with manufacturer's R-value label exposed after insulation is installed.
- D. Extend insulation to envelop entire area to be insulated. Fit tightly around obstructions and fill voids with insulation. Remove projections that interfere with placement.
- E. Provide sizes to fit applications and selected from manufacturer's standard thicknesses, widths, and lengths. Apply single layer of insulation units unless multiple layers are otherwise shown or required to make up total thickness or to achieve R-value.

3.3 INSTALLATION OF SLAB INSULATION

- A. On vertical slab edge and foundation surfaces, set insulation units using manufacturer's recommended adhesive according to manufacturer's written instructions.

1. If not otherwise indicated, extend insulation a minimum of 24 inches below exterior grade line.
- B. On horizontal surfaces, loosely lay insulation units according to manufacturer's written instructions. Stagger end joints and tightly abut insulation units.
 1. If not otherwise indicated, extend insulation a minimum of 24 inches (610 mm) in from exterior walls.

3.4 INSTALLATION OF INSULATION IN FRAMED CONSTRUCTION

- A. Blanket Insulation: Install in cavities formed by framing members according to the following requirements:
 1. Use insulation widths and lengths that fill the cavities formed by framing members. If more than one length is required to fill the cavities, provide lengths that will produce a snug fit between ends.
 2. Place insulation in cavities formed by framing members to produce a friction fit between edges of insulation and adjoining framing members.
 3. Maintain 3-inch (76-mm) clearance of insulation around recessed lighting fixtures not rated for or protected from contact with insulation.
- B. Loose-Fill Insulation: Apply in accordance with ASTM C1015 and manufacturer's written instructions.
 1. Level horizontal applications to uniform thickness as indicated, lightly settle to uniform density, but do not compact excessively.

3.5 PROTECTION

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

END OF SECTION 072100

SECTION 072500
WEATHER BARRIERS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
1. Building paper.
 2. Building wrap.
 3. Drainage wrap.
 4. Flexible flashing.

1.2 ACTION SUBMITTALS

- A. Product Data:
1. Building paper.
 2. Building wrap.
 3. Drainage wrap.
 4. Flexible flashing.
- B. Product Data Submittals: For building wrap include data on air and water-vapor permeance based on testing in accordance with referenced standards.
- C. Shop Drawings: Show details of building paper, building wrap and drainage wrap at terminations, openings, and penetrations. Show details of flexible flashing applications.

1.3 INFORMATIONAL SUBMITTALS

PART 2 - PRODUCTS

2.1 WATER-RESISTIVE BARRIER

- A. Building Paper:
1. ASTM D226/D226M, Type 1 (No. 15 asphalt-saturated organic felt), unperforated.
 2. Water-vapor-permeable, asphalt-saturated kraft building paper that complies with ICC-ES AC38, Grade D
- B. Building Wrap: ASTM E2556/E2556M, Type I air barrier; with flame-spread and smoke-developed indexes of less than 25 and 450, respectively, when tested in accordance with ASTM E84; UV stabilized; and acceptable to authorities having jurisdiction.

1. Dupont Tyvek CommercialWrap or Equal
 2. Water-Vapor Permeance: Minimum 20 perms (1150 ng/Pa x s x sq. m) > per ASTM E96/E96M, Desiccant Method (Procedure A).
 3. Air Permeance: Maximum 0.004 cfm/sq. ft. at 0.3-inch wg (0.02 L/s x sq. m at 75 Pa) when tested in accordance with ASTM E2178.
 4. Allowable UV Exposure Time: Not more than 120 days.
 5. Flame Propagation Test: Materials and construction to be as tested in accordance with NFPA 285.
- C. Drainage Wrap: ASTM E2556/E2556M, Type I dimensional water-resistive barrier that also creates a drainage plane; with flame-spread and smoke-developed indexes of less than 25 and 450, respectively, when tested in accordance with ASTM E84; and acceptable to authorities having jurisdiction.
1. Dupont Tyvek CommercialWrap or Equal
 2. Water-Vapor Permeance: Minimum 35 perms (2002 ng/Pa x s x sq. m) per ASTM E96/E96M, Desiccant Method (Procedure A).
 3. Air Permeance: Maximum 0.004 cfm/sq. ft. at 0.3-inch wg (0.02 L/s x sq. m at 75 Pa)
 4. Drainage: Not less than 98 percent when tested in accordance with ASTM E2273.
 5. Allowable UV Exposure Time: Not more than 120 days.
- D. Acrylic Seam Tape: Composite tape consisting of a pressure-sensitive acrylic adhesive, bonded to a polyethylene or polypropylene film for sealing joints and penetrations in building wrap. Provide tape from same manufacturer as approved wrap product.

2.2 FLEXIBLE FLASHING

- A. Butyl Rubber Flashing: Composite, self-adhesive, flashing product consisting of a pliable, butyl rubber compound, bonded to a high-density polyethylene film, aluminum foil, or spunbonded polyolefin to produce an overall thickness of not less than. Provide tape from same manufacturer as approved wrap product.
1. Flame Propagation Test: Materials and construction to be as tested in accordance with NFPA 285.
- B. Primer for Flexible Flashing: Product recommended in writing by flexible flashing manufacturer for substrate.
- C. Nails and Staples: Product recommended in writing by flexible flashing manufacturer and complying with ASTM F1667.

PART 3 - EXECUTION

3.1 INSTALLATION OF WATER-RESISTIVE BARRIER

- A. Cover exposed exterior surface of sheathing with water-resistive barrier securely fastened to framing immediately after sheathing is installed.
- B. Cover sheathing with water-resistive barrier as follows:

1. Cut back barrier 1/2 inch (13 mm) on each side of the break in supporting members at expansion- or control-joint locations.
 2. Apply barrier to cover vertical flashing with a minimum 4-inch (100-mm) overlap unless otherwise indicated.
- C. Building Paper: Apply horizontally with a 2-inch (50-mm) overlap and a 6-inch (150-mm) end lap; fasten to sheathing with galvanized staples or roofing nails.
- D. Building Wrap or Drainage Wrap: Comply with manufacturer's written instructions and warranty requirements.
1. Seal seams, edges, fasteners, and penetrations with tape.
 2. Extend into jambs of openings and seal corners with tape.

3.2 INSTALLATION OF FLEXIBLE FLASHING

- A. Apply flexible flashing where indicated to comply with manufacturer's written instructions.
1. Prime substrates as recommended by flashing manufacturer.
 2. Lap seams and junctures with other materials at least 4 inches (100 mm) except that at flashing flanges of other construction, laps need not exceed flange width.
 3. Lap flashing over water-resistive barrier at bottom and sides of openings.
 4. Lap water-resistive barrier over flashing at heads of openings.
 5. After flashing has been applied, roll surfaces with a hard rubber or metal roller to ensure that flashing is completely adhered to substrates.

3.3 INSTALLATION OF DRAINAGE MATERIAL

- A. Install drainage material over building wrap and flashing to comply with manufacturer's written instructions.

END OF SECTION 072500

SECTION 072715

NONBITUMINOUS SELF-ADHERING SHEET AIR BARRIERS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes: Self-adhering air barrier.
 - 1. Vapor-retarding nonbituminous sheet.
 - 2. Vapor-permeable nonbituminous sheet.
- B. Related Requirements:
 - 1. Section 061600 "Sheathing" for wall sheathings and wall sheathing joint-and-penetration treatments.
 - 2. Section 072500 "Weather Barriers" for weather barriers

1.2 DEFINITIONS

- A. Air-Barrier Accessory: A transitional component of the air barrier that provides continuity.
- B. Air-Barrier Assembly: The collection of air-barrier materials and accessories applied to an opaque wall, including joints and junctions to abutting construction, to control air movement through the wall.
- C. Air-Barrier Material: A primary element that provides a continuous barrier to the movement of air.

1.3 ACTION SUBMITTALS

- A. Product Data: Self-adhering air barrier. Include manufacturer's written instructions for evaluating, preparing, and treating each substrate; technical data; and tested physical and performance properties of products.
 - 1. Vapor-retarding nonbituminous sheet.
 - 2. Vapor-permeable nonbituminous sheet.
- B. Shop Drawings: For air-barrier assemblies.
 - 1. Show locations and extent of air-barrier materials, accessories, and assemblies specific to Project conditions.
 - 2. Include details for substrate joints and cracks, counterflashing strips, penetrations, inside and outside corners, terminations, and tie-ins with adjoining construction.
 - 3. Include details of interfaces with other materials that form part of air barrier.

1.4 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For Installer.
- B. Product Certificates: From air-barrier manufacturer, certifying compatibility of air barriers and accessory materials with Project materials that connect to or that come in contact with air barrier.
- C. Product Test Reports: For each air-barrier assembly, for tests performed by a qualified testing agency.

1.5 QUALITY ASSURANCE

- A. Installer Qualifications: An entity that employs installers and supervisors who are trained and approved by manufacturer.
 - 1. Installer to be licensed by ABAA in accordance with ABAA's Quality Assurance Program and to employ ABAA-certified installers and supervisors on Project.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Remove and replace liquid materials that cannot be applied within their stated shelf life.
- B. Protect stored materials from direct sunlight.

1.7 FIELD CONDITIONS

- A. Environmental Limitations: Apply air barrier within the range of ambient and substrate temperatures recommended in writing by air-barrier manufacturer.
 - 1. Protect substrates from environmental conditions that affect air-barrier performance.
 - 2. Do not apply air barrier to a damp or wet substrate or during snow, rain, fog, or mist.

PART 2 - PRODUCTS

2.1 SOURCE LIMITATIONS

- A. Obtain primary air-barrier materials and air-barrier accessories from single source from single manufacturer.

2.2 PERFORMANCE REQUIREMENTS

- A. Air-Barrier Performance: Air-barrier assembly and seals with adjacent construction to be capable of performing as a continuous air barrier and as a liquid-water drainage plane flashed to

discharge to the exterior incidental condensation or water penetration. Air-barrier assemblies to be capable of accommodating substrate movement and of sealing substrate expansion and control joints, construction material changes, penetrations[, tie-ins to installed waterproofing, and transitions at perimeter conditions without deterioration and air leakage exceeding specified limits.

- B. Air-Barrier Assembly Air Leakage: Maximum 0.04 cfm/sq. ft. of surface area at 1.57 lbf/sq. ft. (0.2 L/s x sq. m of surface area at 75 Pa)

2.3 NONBITUMINOUS SHEET AIR BARRIER

- A. Vapor-Retarding Nonbituminous Sheet: Minimum 10-mil- (0.25-mm-) thick, self-adhering sheet consisting of 5 mils (0.13 mm) of air-barrier film and a 5-mil- (0.13-mm-) thick, acrylic adhesive with release liner on adhesive side and formulated for application with primer that complies with VOC limits.

1. Physical and Performance Properties:

- a. Air Permeance: Maximum 0.004 cfm/sq. ft. of surface area at 1.57-lbf/sq. ft. (0.02 L/s x sq. m of surface area at 75-Pa) Option in "Puncture Resistance" Subparagraph below is ABAA's requirement for approving a self-adhered air-barrier material; revise to suit Project.
- b. Puncture Resistance: Minimum 40 lbf (180 N) Option in "Vapor Permeance" Subparagraph below is the maximum value of a Class 2 vapor-retarder as defined by the 2012 IBC. Verify available values with manufacturers. 3M Industrial Adhesives and Tapes Division does not offer a Class 1 vapor retarder maximum 0.1 perm (5.8 ng/Pa x s x sq. m) for this product type.
- c. Vapor Permeance: Maximum 1.0 perm (57.5 ng/Pa x s x sq. m) Option in "Adhesion to Substrate" Subparagraph below is ABAA's requirement for approving an air-barrier material's adhesion to concrete, glass-fiber-based gypsum sheathing, and concrete block substrates; revise to suit Project.
- d. Adhesion to Substrate: Minimum 16 lbf/sq. in. (110 kPa) when tested in accordance with ASTM D4541 as modified by ABAA.
- e. Fire Propagation Characteristics: Passes NFPA 285 testing as part of an approved assembly.
- f. UV Resistance: Can be exposed to sunlight in accordance with manufacturer's written instructions.

- B. Vapor-Permeable Nonbituminous Sheet: Minimum 20-mil- (0.5-mm-) thick, self-adhering sheet consisting of a breathable carrier film or fabric and an adhesive with release liner on adhesive side and formulated for application with primer that complies with VOC limits.

1. Physical and Performance Properties:

- a. Air Permeance: Maximum 0.004 cfm/sq. ft. of surface area at 1.57-lbf/sq. ft. (0.02 L/s x sq. m of surface area at 75-Pa) Option in "Puncture Resistance" Subparagraph below is ABAA's requirement for approving a self-adhered air-barrier material; revise to suit Project.
- b. Puncture Resistance: Minimum 40 lbf (180 N) Option in "Vapor Permeance" Subparagraph below is based on some listed products. Verify values with

manufacturers. 10 perms (580 ng/Pa x s x sq. m) is the minimum for a vapor-permeable membrane as defined by the 2012 IBC.

- c. Vapor Permeance: Minimum 15 perms (860 ng/Pa x s x sq. m) Option in "Adhesion to Substrate" Subparagraph below is ABAA's requirement for approving an air-barrier material's adhesion to concrete, glass-fiber-based gypsum sheathing, and concrete block substrates; revise to suit Project.
- d. Adhesion to Substrate: Minimum 16 lbf/sq. in. (110 kPa) Retain "Fire Propagation Characteristics" Subparagraph below if required for the air barrier, such as combustible sheets that also function as water-resistive barriers in buildings of Type I, II, III, or IV construction that are taller than 40 feet (12 192 mm) above grade. Air-barrier materials that pass NFPA 285 testing may be unavailable from some manufacturers or for some wall assemblies; contact manufacturers for test results.
- e. Fire Propagation Characteristics: Passes NFPA 285 testing as part of an approved assembly.
- f. UV Resistance: Can be exposed to sunlight for in accordance with manufacturer's written instructions.

2.4 ACCESSORY MATERIALS

- A. Requirement: Provide primers, transition strips, termination strips, joint sealants, counterflashing strips, flashing sheets and metal termination bars, termination mastic, substrate patching materials, adhesives, tapes, foam sealants, lap sealants, and other accessory materials that are recommended in writing by air-barrier manufacturer to produce a complete air-barrier assembly and that are compatible with primary air-barrier material and adjacent construction to which they may seal.
- B. Primer: Liquid primer recommended for substrate by air-barrier material manufacturer.
- C. Stainless Steel Sheet: ASTM A240/A240M, Type 304, and Series 300 stainless steel fasteners.
- D. Preformed Silicone Extrusion: Manufacturer's standard system consisting of cured low-modulus silicone extrusion, sized to fit opening widths, with a single-component, neutral-curing, Class 100/50 (low-modulus) silicone sealant for bonding extrusions to substrates.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements and other conditions affecting performance of the Work.
 - 1. Verify that substrates are sound and free of oil, grease, dirt, excess mortar, or other contaminants.
 - 2. Verify that substrates have cured and aged for minimum time recommended in writing by air-barrier manufacturer.
 - 3. Verify that substrates are visibly dry and free of moisture. Test concrete substrates for capillary moisture by plastic sheet method in accordance with ASTM D4263.

4. Verify that masonry joints are flush and completely filled with mortar.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 SURFACE PREPARATION

- A. Clean, prepare, treat, fill, and seal substrate and joints and cracks in substrate in accordance with manufacturer's written instructions and details. Provide clean, dust-free, and dry substrate for air-barrier application.
- B. Mask off adjoining surfaces not covered by air barrier to prevent spillage and overspray affecting other construction.
- C. Remove grease, oil, bitumen, form-release agents, paints, curing compounds, and other penetrating contaminants or film-forming coatings from concrete.
- D. Remove fins, ridges, mortar, and other projections and fill honeycomb, aggregate pockets, holes, and other voids in concrete with substrate-patching membrane.
- E. Remove excess mortar from masonry ties, shelf angles, and other obstructions.
- F. At changes in substrate plane, apply sealant or termination mastic beads at sharp corners and edges to form a smooth transition from one plane to another.
- G. Cover gaps in substrate plane and form a smooth transition from one substrate plane to another with stainless steel sheet mechanically fastened to structural framing to provide continuous support for air barrier.
- H. Bridge expansion joints and discontinuous wall-to-wall, deck-to-wall, and deck-to-deck joints with air-barrier accessory material that accommodates joint movement in accordance with manufacturer's written instructions and details.

3.3 INSTALLATION OF NONBITUMINOUS SHEET AIR BARRIER

- A. Install materials in accordance with air-barrier manufacturer's written instructions and details to form a seal with adjacent construction and ensure continuity of air and water barrier.
 1. Unless manufacturer recommends in writing against priming, apply primer to substrates at required rate and allow it to dry.
- B. Prepare, treat, and seal inside and outside corners and vertical and horizontal surfaces at terminations and penetrations with termination mastic.
- C. Apply primer to substrates at required rate and allow it to dry. Limit priming to areas that will be covered by air-barrier sheet on same day. Reprime areas exposed for more than 24 hours.
- D. Apply and firmly adhere air-barrier sheets over area to receive air barrier. Accurately align sheets and maintain uniform 2-1/2-inch- (64-mm-) minimum lap widths and end laps. Overlap and seal seams, and stagger end laps to ensure airtight installation.

1. Apply sheets in a shingled manner to shed water.
 2. Roll sheets firmly to enhance adhesion to substrate.
- E. Apply continuous air-barrier sheets over accessory strips bridging substrate cracks, construction, and contraction joints.
- F. CMU: Install air-barrier sheet horizontally against the CMU beginning at base of wall. Align top edge of air-barrier sheet immediately below protruding masonry ties or joint reinforcement or ties, and firmly adhere in place.
1. Overlap horizontally adjacent sheets a minimum of 2 inches (50 mm) and roll seams.
 2. Apply overlapping sheets with bottom edge slit to fit around masonry reinforcing or ties. Roll firmly into place.
 3. Seal around masonry reinforcing or ties and penetrations with termination mastic.
 4. Continue the sheet into all openings in the wall, such as doors and windows, and terminate at points to maintain an airtight barrier that is not visible from interior.
- G. Seal top of through-wall flashings to air-barrier sheet with an additional 6-inch- (150-mm-) wide, transition strip.
- H. Seal exposed edges of sheet at seams, cuts, penetrations, and terminations not concealed by metal counterflashings or ending in reglets with termination mastic.
- I. Install air-barrier sheet and accessory materials to form a seal with adjacent construction and to maintain a continuous air barrier.
1. Coordinate air-barrier installation with installation of roofing membrane and base flashing to ensure continuity of air barrier with roofing membrane.
 2. Install transition strip on roofing membrane or base flashing so that a minimum of 3 inches (75 mm) of coverage is achieved over each substrate.
- J. Connect and seal exterior wall air-barrier sheet continuously to roofing-membrane air barrier, concrete below-grade structures, floor-to-floor construction, exterior glazing and window systems, glazed curtain-wall systems, storefront systems, exterior louvers, exterior door framing, and other construction used in exterior wall openings, using accessory materials.
- K. At end of each working day, seal top edge of air-barrier material to substrate with termination mastic.
- L. Apply joint sealants forming part of air-barrier assembly within manufacturer's recommended application temperature ranges. Consult manufacturer when sealant cannot be applied within these temperature ranges.
- M. Wall Openings: Prime concealed, perimeter frame surfaces of windows, curtain walls, storefronts, and doors. Apply transition strip so that a minimum of 3 inches (75 mm) of coverage is achieved over each substrate. Maintain 3 inches (75 mm) of contact over firm bearing to perimeter frames, with not less than 1 inch (25 mm) of full contact.
1. Transition Strip: Roll firmly to enhance adhesion.
 2. Preformed Silicone Extrusion: Set in full bed of silicone sealant applied to walls, frame, and air-barrier material.

- N. Fill gaps in perimeter frame surfaces of windows, curtain walls, storefronts, doors, and miscellaneous penetrations of air-barrier material with foam sealant.
- O. Repair punctures, voids, and deficient lapped seams in air barrier. Slit and flatten fishmouths and blisters. Patch with air-barrier sheet extending 6 inches (150 mm) beyond repaired areas in all directions.
- P. Do not cover air barrier until it has been tested and inspected by testing agency.
- Q. Correct deficiencies in or remove air barrier that does not comply with requirements; repair substrates and reapply air-barrier components.

3.4 FIELD QUALITY CONTROL

- A. ABAA Quality Assurance Program: Perform examinations, preparation, installation, testing, and inspections under ABAA's Quality Assurance Program.
- B. Air barriers will be considered defective if they do not pass tests and inspections.
 - 1. Apply additional air-barrier material, in accordance with manufacturer's written instructions, where inspection results indicate insufficient thickness.
 - 2. Remove and replace deficient air-barrier components for retesting as specified above.
- C. Repair damage to air barriers caused by testing; follow manufacturer's written instructions.
- D. Prepare test and inspection reports.

3.5 CLEANING AND PROTECTION

- A. Protect air-barrier system from damage during application and remainder of construction period, in accordance with manufacturer's written instructions.
 - 1. Protect air barrier from exposure to UV light and harmful weather exposure as recommended in writing by manufacturer. If exposed to these conditions for longer than recommended, remove and replace air barrier or install additional, full-thickness, air-barrier application after repairing and preparing the overexposed materials in accordance with air-barrier manufacturer's written instructions.
 - 2. Protect air barrier from contact with incompatible materials and sealants not approved by air-barrier manufacturer.
- B. Clean spills, stains, and soiling from construction that would be exposed in the completed Work, using cleaning agents and procedures recommended in writing by manufacturer of affected construction.

END OF SECTION 072715

SECTION 076200

SHEET METAL FLASHING AND TRIM

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Roof-drainage sheet metal fabrications.
2. Low-slope roof sheet metal fabrications.
3. Steep-slope roof sheet metal fabrications.
4. Wall sheet metal fabrications.
5. Miscellaneous sheet metal fabrications.

B. Related Requirements:

1. Section 077200 "Roof Accessories" for set-on-type curbs, equipment supports, roof hatches, vents, and other manufactured roof accessory units.

1.2 COORDINATION

A. Coordinate sheet metal flashing and trim layout and seams with sizes and locations of penetrations to be flashed, and joints and seams in adjacent materials.

B. Coordinate sheet metal flashing and trim installation with adjoining roofing and wall materials, joints, and seams to provide leakproof, secure, and noncorrosive installation.

1.3 ACTION SUBMITTALS

A. Product Data:

1. Roof-drainage sheet metal fabrications.
2. Low-slope roof sheet metal fabrications.
3. Steep-slope roof sheet metal fabrications.
4. Wall sheet metal fabrications.
5. Miscellaneous sheet metal fabrications.

B. Product Data Submittals:

1. Underlayment materials.
2. Elastomeric sealant.
3. Butyl sealant.
4. Epoxy seam sealer.

C. Shop Drawings: For sheet metal flashing and trim.

1. Include plans, elevations, sections, and attachment details.
2. Detail fabrication and installation layouts, expansion-joint locations, and keyed details. Distinguish between shop- and field-assembled Work.
3. Include identification of material, thickness, weight, and finish for each item and location in Project.
4. Include details for forming, including profiles, shapes, seams, and dimensions.
5. Include details for joining, supporting, and securing, including layout and spacing of fasteners, cleats, clips, and other attachments. Include pattern of seams.
6. Include details of termination points and assemblies.
7. Include details of expansion joints and expansion-joint covers, including showing direction of expansion and contraction from fixed points.
8. Include details of roof-penetration flashing.
9. Include details of edge conditions, including eaves, ridges, valleys, rakes, crickets, flashings, and counterflashings.
10. Include details of special conditions.
11. Include details of connections to adjoining work.
12. Detail formed flashing and trim at scale of not less than 3 inches per 12 inches (1:5)

1.4 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For fabricator.

1.5 CLOSEOUT SUBMITTALS

- A. Maintenance Data: For sheet metal flashing and trim, and its accessories, to include in maintenance manuals.
- B. Special warranty.

1.6 QUALITY ASSURANCE

- A. Fabricator Qualifications: Employs skilled workers who custom fabricate sheet metal flashing and trim similar to that required for this Project and whose products have a record of successful in-service performance.
 1. For copings and roof edge flashings that are ANSI/SPRI/FM 4435/ES-1 tested and FM Approvals approved, shop is to be listed as able to fabricate required details as tested and approved.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Do not store sheet metal flashing and trim materials in contact with other materials that might cause staining, denting, or other surface damage.
 1. Store sheet metal flashing and trim materials away from uncured concrete and masonry.
 2. Protect stored sheet metal flashing and trim from contact with water.

- B. Protect strippable protective covering on sheet metal flashing and trim from exposure to sunlight and high humidity, except to extent necessary for period of sheet metal flashing and trim installation.

1.8 WARRANTY

- A. Special Warranty on Finishes: Manufacturer agrees to repair finish or replace sheet metal flashing and trim that shows evidence of deterioration of factory-applied finishes within specified warranty period.
 - 1. Exposed Panel Finish: Deterioration includes, but is not limited to, the following:
 - a. Color fading more than 5 Delta E units when tested in accordance with ASTM D2244.
 - b. Chalking in excess of a No. 8 rating when tested in accordance with ASTM D4214.
 - c. Cracking, checking, peeling, or failure of paint to adhere to bare metal.
 - 2. Finish Warranty Period: [20] years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Sheet metal flashing and trim assemblies, including cleats, anchors, and fasteners, are to withstand wind loads, structural movement, thermally induced movement, and exposure to weather without failure due to defective manufacture, fabrication, installation, or other defects in construction. Completed sheet metal flashing and trim are not to rattle, leak, or loosen, and are to remain watertight.
- B. Sheet Metal Standard for Flashing and Trim: Comply with NRCA's "The NRCA Roofing Manual: Architectural Metal Flashing, Condensation and Air Leakage Control, and Reroofing" and SMACNA's "Architectural Sheet Metal Manual" requirements for dimensions and profiles shown unless more stringent requirements are indicated.
- C. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes to prevent 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: 120 deg F (67 deg C), ambient; 180 deg F (100 deg C)
- D. Protect mechanical and other finishes on exposed surfaces from damage by applying strippable, temporary protective film before shipping.

2.2 MISCELLANEOUS MATERIALS

- A. Provide materials and types of fasteners, solder, protective coatings, sealants, and other miscellaneous items as required for complete sheet metal flashing and trim installation and as recommended by manufacturer of primary sheet metal or manufactured item unless otherwise indicated.
- B. Fasteners: Self-tapping screws, self-locking rivets and bolts, and other suitable fasteners designed to withstand design loads and recommended by manufacturer of primary sheet metal
 - 1. General: Blind fasteners or self-drilling screws, gasketed, with hex-washer head.
 - a. Exposed Fasteners: Heads matching color of sheet metal using plastic caps or factory-applied coating. Provide metal-backed EPDM or PVC sealing washers under heads of exposed fasteners bearing on weather side of metal.
 - b. Blind Fasteners: High-strength aluminum or stainless steel rivets suitable for metal being fastened.
 - c. Spikes and Ferrules: Same material as gutter; with spike with ferrule matching internal gutter width.
- C. Solder:
 - 1. For Zinc-Coated (Galvanized) Steel: ASTM B32, Grade Sn50, 50 percent tin and 50 percent lead or Grade Sn60, 60 percent tin and 40 percent lead with maximum lead content of 0.2 percent.
- D. Sealant Tape: Pressure-sensitive, 100 percent solids, polyisobutylene compound sealant tape with release-paper backing. Provide permanently elastic, nonsag, nontoxic, nonstaining tape 1/2 inch (13 mm) wide and 1/8 inch (3 mm) thick.
- E. Elastomeric Sealant: ASTM C920, elastomeric, polyurethane, polysulfide, silicone, polymer sealant; of type, grade, class, and use classifications required to seal joints in sheet metal flashing and trim and remain watertight.
- F. Butyl Sealant: ASTM C1311, single-component, solvent-release butyl rubber sealant; polyisobutylene plasticized; heavy bodied for hooked-type expansion joints with limited movement.

2.3 FABRICATION, GENERAL

- A. Custom fabricate sheet metal flashing and trim to comply with details indicated and recommendations in cited sheet metal standard that apply to design, dimensions, geometry, metal thickness, and other characteristics of item required.
 - 1. Fabricate sheet metal flashing and trim in shop to greatest extent possible.
 - 2. Fabricate sheet metal flashing and trim in thickness or weight needed to comply with performance requirements, but not less than that specified for each application and metal.
 - 3. Verify shapes and dimensions of surfaces to be covered and obtain field measurements for accurate fit before shop fabrication.

4. Form sheet metal flashing and trim to fit substrates without excessive oil-canning, buckling, and tool marks; true to line, levels, and slopes; and with exposed edges folded back to form hems.
5. Conceal fasteners and expansion provisions where possible. Do not use exposed fasteners on faces exposed to view.

B. Fabrication Tolerances:

1. Fabricate sheet metal flashing and trim that is capable of installation to a tolerance of 1/4 inch in 20 feet (6 mm in 6 m) on slope and location lines indicated on Drawings and within 1/8-inch (3-mm) offset of adjoining faces and of alignment of matching profiles.
2. Fabricate sheet metal flashing and trim that is capable of installation to tolerances specified.

C. Expansion Provisions: Form metal for thermal expansion of exposed flashing and trim.

1. Form expansion joints of intermeshing hooked flanges, not less than 1 inch (25 mm) deep, filled with butyl sealant concealed within joints.
2. Use lapped expansion joints only where indicated on Drawings.

D. Sealant Joints: Where movable, nonexpansion-type joints are required, form metal in accordance with cited sheet metal standard to provide for proper installation of elastomeric sealant.

E. Fabricate cleats and attachment devices from same material as accessory being anchored or from compatible, noncorrosive metal.

F. Seams:

1. Fabricate nonmoving seams with flat-lock seams. Tin edges to be seamed, form seams, and solder..

G. Do not use graphite pencils to mark metal surfaces.

2.4 LOW-SLOPE ROOF SHEET METAL FABRICATIONS

A. Base Flashing: Shop fabricate interior and exterior corners. Fabricate from the following materials:

1. Galvanized Steel: 0.028 inch (0.71 mm) thick.

B. Counterflashing: Shop fabricate interior and exterior corners. Fabricate from the following materials:

1. Galvanized Steel: 0.022 inch (0.56 mm) thick.

C. Flashing Receivers: Fabricate from the following materials:

1. Galvanized Steel: 0.022 inch (0.56 mm) thick.

D. Roof-Penetration Flashing: Fabricate from the following materials:

1. Galvanized Steel: 0.028 inch (0.71 mm) thick.

2.5 WALL SHEET METAL FABRICATIONS

- A. Through-Wall Flashing: Fabricate continuous flashings in minimum 96-inch- (2400-mm-) long, but not exceeding 12-foot- (3.6-m-) long, sections, under copings, and at shelf angles. Fabricate discontinuous lintel, sill, and similar flashings to extend 6 inches (150 mm) beyond each side of wall openings; and form with 2-inch- (50-mm-) high, end dams. Fabricate from the following materials:
 - 1. Galvanized Steel: [0.022 inch (0.56 mm)
- B. Opening Flashings in Frame Construction: Fabricate head, sill, jamb, and similar flashings to extend 4 inches (100 mm) beyond wall openings. Form head and sill flashing with 2-inch- (50-mm-) high, end dams. Fabricate from the following materials:
 - 1. Galvanized Steel: 0.022 inch (0.56 mm) thick.

2.6 MISCELLANEOUS SHEET METAL FABRICATIONS

- A. Equipment Support Flashing: Fabricate from the following materials:
 - 1. Galvanized Steel: 0.028 inch (0.71 mm) thick.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates, areas, and conditions, with installer present, for compliance with requirements for installation tolerances, substrate, and other conditions affecting performance of the Work.
 - 1. Verify compliance with requirements for installation tolerances of substrates.
 - 2. Verify that substrate is sound, dry, smooth, clean, sloped for drainage, and securely anchored.
 - 3. Verify that air- or water-resistant barriers have been installed over sheathing or backing substrate to prevent air infiltration or water penetration.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION, GENERAL

- A. Install sheet metal flashing and trim to comply with details indicated and recommendations of cited sheet metal standard that apply to installation characteristics required unless otherwise indicated on Drawings.
 - 1. Install fasteners, solder, protective coatings, separators, sealants, and other miscellaneous items as required to complete sheet metal flashing and trim system.
 - 2. Install sheet metal flashing and trim true to line, levels, and slopes. Provide uniform, neat seams with minimum exposure of solder, welds, sealant.
 - 3. Anchor sheet metal flashing and trim and other components of the Work securely in place, with provisions for thermal and structural movement.

4. Install sheet metal flashing and trim to fit substrates and to result in watertight performance.
 5. Install continuous cleats with fasteners spaced not more than 12 inches (300 mm) o.c.
 6. Install exposed sheet metal flashing and trim with limited oil-canning, and free of buckling and tool marks.
 7. Do not field cut sheet metal flashing and trim by torch.
 8. Do not use graphite pencils to mark metal surfaces.
- B. Metal Protection: Where dissimilar metals contact each other, or where metal contacts pressure-treated wood or other corrosive substrates, protect against galvanic action or corrosion by painting contact surfaces with bituminous coating or by other permanent separation as recommended by sheet metal manufacturer or cited sheet metal standard.
1. Coat concealed side of uncoated-aluminum and stainless steel sheet metal flashing and trim with bituminous coating where flashing and trim contact wood, ferrous metal, or cementitious construction.
 2. Underlayment: Where installing sheet metal flashing and trim directly on cementitious or wood substrates, install underlayment and cover with slip sheet.
- C. Expansion Provisions: Provide for thermal expansion of exposed flashing and trim.
1. Space movement joints at maximum of 10 feet (3 m)] with no joints within 24 inches (600 mm) of corner or intersection.
- D. Conceal fasteners and expansion provisions where possible in exposed work and locate to minimize possibility of leakage. Cover and seal fasteners and anchors as required for a tight installation.
- E. Seal joints as required for watertight construction.
1. Use sealant-filled joints unless otherwise indicated.
 - a. Embed hooked flanges of joint members not less than 1 inch (25 mm) into sealant.
 - b. Form joints to completely conceal sealant.
 - c. When ambient temperature at time of installation is between 40 and 70 deg F (4 and 21 deg C), set joint members for 50 percent movement each way.
 - d. Adjust setting proportionately for installation at higher ambient temperatures.
 - 1) Do not install sealant-type joints at temperatures below 40 deg F (4 deg C).
 2. Prepare joints and apply sealants to comply with requirements in Section 079200 "Joint Sealants."
- F. Soldered Joints: Clean surfaces to be soldered, removing oils and foreign matter.
1. Pretin edges of sheets with solder to width of 1-1/2 inches (38 mm); however, reduce pretinning where pretinned surface would show in completed Work.
 2. Do not solder metallic-coated steel and aluminum sheet.
 3. Do not pretin zinc-tin alloy-coated copper.
 4. Do not use torches for soldering.
 5. Heat surfaces to receive solder, and flow solder into joint.

- a. Fill joint completely.
- b. Completely remove flux and spatter from exposed surfaces.

3.3 INSTALLATION OF WALL FLASHINGS

- A. Install sheet metal wall flashing to intercept and exclude penetrating moisture in accordance with cited sheet metal standard unless otherwise indicated. Coordinate installation of wall flashing with installation of wall-opening components such as windows, doors, and louvers.
- B. Opening Flashings in Frame Construction: Install continuous head, sill, jamb, and similar flashings to extend **4 inches (100 mm)** beyond wall openings.

3.4 INSTALLATION OF MISCELLANEOUS FLASHING

- A. Equipment Support Flashing:
 - 1. Coordinate installation of equipment support flashing with installation of roofing and equipment.
 - 2. Weld or seal flashing with elastomeric sealant to equipment support member.

3.5 INSTALLATION TOLERANCES

- A. Installation Tolerances: Shim and align sheet metal flashing and trim within installed tolerance of 1/4 inch in 20 feet (6 mm in 6 m) on slope and location lines indicated on Drawings and within 1/8-inch (3-mm) offset of adjoining faces and of alignment of matching profiles.

3.6 CLEANING

- A. Clean exposed metal surfaces of substances that interfere with uniform oxidation and weathering.
- B. Clean and neutralize flux materials. Clean off excess solder.
- C. Clean off excess sealants.

3.7 PROTECTION

- A. Remove temporary protective coverings and strippable films as sheet metal flashing and trim are installed unless otherwise indicated in manufacturer's written installation instructions.
- B. On completion of sheet metal flashing and trim installation, remove unused materials and clean finished surfaces as recommended in writing by sheet metal flashing and trim manufacturer.
- C. Maintain sheet metal flashing and trim in clean condition during construction.

- D. Replace sheet metal flashing and trim that have been damaged or that have deteriorated beyond successful repair by finish touchup or similar minor repair procedures, as determined by Architect.

END OF SECTION 076200

SECTION 079200

JOINT SEALANTS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Silicone joint sealants.
2. Nonstaining silicone joint sealants.
3. Urethane joint sealants.
4. Mildew-resistant joint sealants.
5. Butyl joint sealants.

1.2 ACTION SUBMITTALS

A. Product Data:

1. Silicone joint sealants.
2. Nonstaining silicone joint sealants.
3. Urethane joint sealants.
4. Mildew-resistant joint sealants.
5. Butyl joint sealants.

B. Samples for Initial Selection: Manufacturer's standard color charts consisting of strips of cured sealants showing the full range of colors available for each product exposed to view.

C. Samples for Verification: For each type and color of joint sealant required, provide Samples with joint sealants in 1/2-inch- (13-mm-) wide joints formed between two 6-inch- (150-mm-) long strips of material matching the appearance of exposed surfaces adjacent to joint sealants.

D. Joint-Sealant Schedule: Include the following information:

1. Joint-sealant application, joint location, and designation.
2. Joint-sealant manufacturer and product name.
3. Joint-sealant formulation.
4. Joint-sealant color.

1.3 INFORMATIONAL SUBMITTALS

A. Preconstruction Laboratory Test Schedule: Include the following information for each joint sealant and substrate material to be tested:

1. Manufacturer and product name.
2. Type of substrate material..

- B. Preconstruction Laboratory Test Reports: For each joint sealant and substrate material to be tested 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 are needed for adhesion.
- C. Sample warranties.

1.4 CLOSEOUT SUBMITTALS

- A. Manufacturers' special warranties.
- B. Installer's special warranties.

1.5 QUALITY ASSURANCE

- A. Installer Qualifications: Authorized representative who is trained and approved by manufacturer.

1.6 FIELD CONDITIONS

- A. Do not proceed with installation of joint sealants under the following conditions:
 - 1. When ambient and substrate temperature conditions are outside limits permitted by joint-sealant manufacturer or are below 40 deg F (5 deg C).
 - 2. When joint substrates are wet.
 - 3. Where joint widths are less than those allowed by joint-sealant manufacturer for applications indicated.
 - 4. Where contaminants capable of interfering with adhesion have not yet been removed from joint substrates.

1.7 WARRANTY

- A. Special Installer's Warranty: Installer agrees to repair or replace joint sealants that do not comply with performance and other requirements specified in this Section within specified warranty period.
 - 1. Warranty Period: Two years from date of Substantial Completion.
- B. Special Manufacturer's Warranty: Manufacturer agrees to furnish joint sealants to repair or replace those joint sealants that do not comply with performance and other requirements specified in this Section within specified warranty period.
 - 1. Warranty Period: Five years from date of Substantial Completion.

- C. Special warranties specified in this article exclude deterioration or failure of joint sealants from the following:
1. Movement of the structure caused by stresses on the sealant exceeding sealant manufacturer's written specifications for sealant elongation and compression.
 2. Disintegration of joint substrates from 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

2.1 JOINT SEALANTS, 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. Colors of Exposed Joint Sealants: Submit color samples for selection

2.2 SILICONE JOINT SEALANTS – Vertical joints in concrete & masonry metal flashing

- A. Silicone, S, NS, 25, NT: Single-component, nonsag, plus 25 percent and minus 25 percent movement capability, nontraffic-use, neutral-curing silicone joint sealant; ASTM C920, Type S, Grade NS, Class 25, Use NT.
1. Dow Corning Corp., Dow Corning 790, 791, 795
 2. Tremco, Inc., Spectrem 1
 3. Pecoca Corp., 864

2.3 URETHANE JOINT SEALANTS – In horizontal surface of concrete; between metal and concrete masonry and mortar

- A. Urethane, S, NS, 25, NT: Single-component, nonsag, plus 25 percent and minus 25 percent movement capability, nontraffic-use, urethane joint sealant; ASTM C920, Type P, Grade P Class 25
1. Tremco, Inc., HPL
 2. Sika Corporation, Sikaflex 2C NS/SL
 3. W.R. Meadows,, Pourthan

2.4 MILDEW-RESISTANT JOINT SEALANTS – At plumbing fixtures

- A. Mildew-Resistant Joint Sealants: Formulated for prolonged exposure to humidity with fungicide to prevent mold and mildew growth.
- B. Silicone, Mildew Resistant, Acid Curing, S, NS, 25, NT: Mildew-resistant, single-component, nonsag, plus 25 percent and minus 25 percent movement capability, nontraffic-use, acid-curing silicone joint sealant; ASTM C920, Type S, Grade NS, Class 25, Use NT.
 - 1. Dow Corning Corp., Dow Corning 786
 - 2. Tremco, Inc., Proglaze White
 - 3. Pecoca Corp., 863 White

2.5 BUTYL JOINT SEALANTS – Under thresholds

- A. Butyl-Rubber-Based Joint Sealants: ASTM C1311.
 - 1. Tremco Inc., Tremco Butyl Sealant
 - 2. Pecora Corp., BC-158
 - 3. Bostik Construction Products Division, Chem-Calk 300

2.6 JOINT-SEALANT BACKING

- A. Sealant Backing Material, General: Nonstaining; compatible with joint substrates, sealants, primers, and other joint fillers; and approved for applications indicated by sealant manufacturer based on field experience and laboratory testing.
- B. 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.

2.7 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

3.1 EXAMINATION

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

3.2 PREPARATION

- A. Surface Cleaning of Joints: Clean out joints immediately before installing joint sealants to comply with joint-sealant manufacturer's written instructions and the following requirements:
 - 1. Remove all foreign material from joint substrates that could interfere with adhesion of joint sealant, including dust, paints (except for permanent, protective coatings tested and approved for sealant adhesion and compatibility by sealant manufacturer), old joint sealants, oil, grease, waterproofing, water repellents, water, surface dirt, and frost.
 - 2. Clean porous joint substrate surfaces by brushing, grinding, mechanical abrading, or a combination of these methods to produce a clean, sound substrate capable of developing optimum bond with joint sealants. Remove loose particles remaining after cleaning operations above by vacuuming or blowing out joints with oil-free compressed air. Porous joint substrates include the following:
 - a. Concrete.
 - b. Masonry.
 - c. Unglazed surfaces of ceramic tile.
 - d. Exterior insulation and finish systems.
 - 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.

3.3 INSTALLATION OF JOINT SEALANTS

- A. General: Comply with joint-sealant manufacturer's written installation instructions for products and applications indicated, unless more stringent requirements apply.
- B. Sealant Installation Standard: Comply with recommendations in ASTM C1193 for use of joint sealants as applicable to materials, applications, and conditions indicated.
- C. Install sealant backings of type 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 in accordance with 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.

3.4 CLEANING

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

3.5 PROTECTION

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

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

END OF SECTION 079200

SECTION 081213
HOLLOW METAL FRAMES

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Interior standard steel frames.
 - 2. Exterior standard steel frames.
- B. Related Requirements:
 - 1. Section 87100 Door Hardware

1.2 DEFINITIONS

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

1.3 COORDINATION

- A. Coordinate anchorage installation for hollow-metal frames. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, and items with integral anchors. Deliver such items to Project site in time for installation.
- B. Coordinate requirements for installation of door hardware, electrified door hardware, and access control and security systems.

1.4 ACTION SUBMITTALS

- A. Product Data Submittals: For each product.
 - 1. Include construction details, material descriptions, fire-resistance ratings, and finishes.
- B. Shop Drawings: Include the following:
 - 1. Details of each different wall opening condition.
 - 2. Details of electrical raceway and preparation for electrified hardware, access control systems, and security systems.
 - 3. Details of anchorages, joints, field splices, and connections.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Deliver hollow-metal frames palletized, packaged, or crated to provide protection during transit and Project-site storage. Do not use nonvented plastic.
 - 1. Provide additional protection to prevent damage to factory-finished units. Damaged doors will be rejected.
- B. Store hollow-metal frames vertically under cover at Project site with head up. Place on minimum 4-inch- (102-mm-) high wood blocking. Provide minimum 1/4-inch (6-mm) space between each stacked door to permit air circulation.

PART 2 - PRODUCTS

2.1 HOLLOW METAL FRAMES

- A. Acceptable Manufactures
 - 1. Security Metal Products Corp.
 - 2. Curries Manufacturing, Inc.
 - 3. Steelcraft
 - 4. Amweld Metal Doors and Frames
 - 5. Stiles Custom Metal, Inc.

2.2 PERFORMANCE REQUIREMENTS

- A. Fire-Rated Assemblies: Assemblies complying with NFPA 80 that are listed and labeled by a qualified testing agency acceptable to authorities having jurisdiction for fire-protection ratings indicated on Drawings, based on testing at positive pressure according to NFPA 252 or UL 10C.
 - 1. Smoke- and Draft-Control Assemblies: Listed and labeled for smoke and draft control by a qualified testing agency acceptable to authorities having jurisdiction, based on testing according to UL 1784 and installed in compliance with NFPA 105.
 - 2. Oversize Fire-Rated Frames: For units exceeding sizes of tested assemblies, provide certification by a qualified testing agency that frames comply with standard construction requirements for tested and labeled fire-rated assemblies except for size.
- B. Fire-Rated, Borrowed-Lite Assemblies: Complying with NFPA 80 and listed and labeled by a qualified testing agency acceptable to authorities having jurisdiction, for fire-protection ratings indicated, based on testing according to NFPA 257 or UL 9.

2.3 STANDARD STEEL FRAMES

- A. Construct hollow-metal frames to comply with standards indicated for materials, fabrication, hardware locations, hardware reinforcement, tolerances, and clearances, and as specified.
- B. Interior Standard Steel Frames: SDI A250.8.
 - 1. Materials: Uncoated] steel sheet, minimum thickness of .067 inch (1.7 mm).

2. Sidelite and Transom Frames: Fabricated from same thickness material as adjacent door frame.
 3. Exposed Finish: Prime
- C. Exterior Standard Steel Frames: SDI A250.8.
1. Materials: Metallic-coated steel sheet, minimum thickness of 0.067 inch (1.7 mm), with minimum A60 (ZF180) coating.
 2. Sidelite and Transom Frames: Fabricated from same thickness material as adjacent door frame.
 3. Exposed Finish: Prime

2.4 FRAME ANCHORS

- A. Jamb Anchors:
1. Type: Anchors of minimum size and type required by applicable door and frame standard, and suitable for performance level indicated.
 2. Quantity: Minimum of three anchors per jamb, with one additional anchor for frames with no floor anchor. Provide one additional anchor for each 24 inches (610 mm) of frame height above 7 feet (2.1 m).
 3. Postinstalled Expansion Anchor: Minimum 3/8-inch- (9.5-mm-) diameter bolts with expansion shields or inserts, with manufacturer's standard pipe spacer.
- B. Material: ASTM A879/A879M, Commercial Steel (CS), 04Z (12G) coating designation; mill phosphatized.
1. For anchors built into exterior walls, steel sheet complying with ASTM A1008/A1008M or ASTM A1011/A1011M; hot-dip galvanized according to ASTM A153/A153M, Class B.

2.5 MATERIALS

- A. Cold-Rolled Steel Sheet: ASTM A1008/A1008M, Commercial Steel (CS), Type B; suitable for exposed applications.
- B. Hot-Rolled Steel Sheet: ASTM A1011/A1011M, Commercial Steel (CS), Type B; free of scale, pitting, or surface defects; pickled and oiled.
- C. Metallic-Coated Steel Sheet: ASTM A653/A653M, Commercial Steel (CS), Type B.
- D. Inserts, Bolts, and Fasteners: Hot-dip galvanized according to ASTM A153/A153M.
- E. Power-Actuated Fasteners in Concrete: Fastener system of type suitable for application indicated, fabricated from corrosion-resistant materials, with clips or other accessory devices for attaching hollow-metal frames of type indicated.
- F. Glazing: Comply with requirements in Section 088000 "Glazing."

2.6 FABRICATION

- A. Hollow-Metal Frames: Fabricate in one piece except where handling and shipping limitations require multiple sections. Where frames are fabricated in sections, provide alignment plates or angles at each joint, fabricated of metal of same or greater thickness as frames.
1. Sidelite and Transom Bar Frames: Provide closed tubular members with no visible face seams or joints, fabricated from same material as door frame. Fasten members at crossings and to jambs by welding
 2. Provide countersunk, flat- or oval-head exposed screws and bolts for exposed fasteners unless otherwise indicated.
 3. Door Silencers: Except on weather-stripped frames, drill stops to receive door silencers as follows. Keep holes clear during construction.
 - a. Single-Door Frames: Drill stop in strike jamb to receive three door silencers.
 - b. Double-Door Frames: Drill stop in head jamb to receive two door silencers.
 4. Terminated Stops: Terminate stops 6 inches (152 mm) above finish floor with a 45 degree angle cut, and close open end of stop with steel sheet closure. Cover opening in extension of frame with welded-steel filler plate, with welds ground smooth and flush with frame.
- B. Hardware Preparation: Factory prepare hollow-metal frames to receive templated mortised hardware, and electrical wiring; include cutouts, reinforcement, mortising, drilling, and tapping according to SDI A250.6, the Door Hardware Schedule on Drawings, and templates.
1. Reinforce frames to receive nontemplated, mortised, and surface-mounted door hardware.
 2. Comply with BHMA A156.115 for preparing hollow-metal frames for hardware.
- C. Glazed Lites: Provide stops and moldings around glazed lites where indicated. Form corners of stops and moldings with mitered hairline joints.
1. Multiple Glazed Lites: Provide fixed and removable stops and moldings so that each glazed lite is capable of being removed independently.
 2. Provide fixed frame moldings on outside of exterior and on secure side of interior frames. Provide loose stops and moldings on inside of hollow-metal frames.
 3. Coordinate rabbet width between fixed and removable stops with glazing and installation types indicated.
 4. Provide stops for installation with countersunk flat- or oval-head machine screws spaced uniformly not more than 9 inches (230 mm) o.c. and not more than 2 inches (51 mm) o.c. from each corner.

2.7 STEEL FINISHES

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

PART 3 - EXECUTION

3.1 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. Touch up factory-applied finishes where spreaders are removed.
- B. Drill and tap frames to receive nontemplated, mortised, and surface-mounted door hardware.

3.2 INSTALLATION

- A. General: Install hollow-metal frames plumb, rigid, properly aligned, and securely fastened in place. Comply with approved Shop Drawings and with manufacturer's written instructions. Comply with SDI A250.11 and NAAMM-HMMA 840.
- B. Set frames accurately in position; plumbed, aligned, and braced securely until permanent anchors are set. After wall construction is complete, remove temporary braces without damage to completed Work.
 - 1. Where frames are fabricated in sections, field splice at approved locations by welding face joint continuously; grind, fill, dress, and make splice smooth, flush, and invisible on exposed faces. Touch-up finishes.
 - 2. Install frames with removable stops located on secure side of opening.
- C. Fire-Rated Openings: Install frames according to NFPA 80.
- D. Solidly pack mineral-fiber insulation inside frames.
- E. In-Place Concrete or Masonry Construction: Secure frames in place with postinstalled expansion anchors. Countersink anchors, and invisible on exposed faces.
- F. Installation Tolerances: Adjust hollow-metal frames to the following tolerances:
 - 1. Squareness: Plus or minus 1/16 inch (1.6 mm), measured at door rabbet on a line 90 degrees from jamb perpendicular to frame head.
 - 2. Alignment: Plus or minus 1/16 inch (1.6 mm), measured at jambs on a horizontal line parallel to plane of wall.
 - 3. Twist: Plus or minus 1/16 inch (1.6 mm), measured at opposite face corners of jambs on parallel lines, and perpendicular to plane of wall.
 - 4. Plumbness: Plus or minus 1/16 inch (1.6 mm), measured at jambs at floor.
- G. Glazing: Comply with hollow-metal manufacturer's written instructions.
- H. Door Louvers: Install according to manufacturers recommendations.

3.3 CLEANING AND TOUCHUP

- A. Prime-Coat Touchup: Immediately after erection, sand smooth rusted or damaged areas of prime coat and apply touchup of compatible air-drying, rust-inhibitive primer.
- B. Metallic-Coated Surface Touchup: Clean abraded areas and repair with galvanizing repair paint according to manufacturer's written instructions.
- C. Factory-Finish Touchup: Clean abraded areas and repair with same material used for factory finish according to manufacturer's written instructions.
- D. Touchup Painting: Cleaning and touchup painting of abraded areas of paint are specified in painting Sections.

END OF SECTION 081213

SECTION 081416
FLUSH WOOD DOORS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Solid-core five-ply flush wood veneer-faced doors and transom panels for transparent finish.
2. Solid-core five-ply flush wood doors and transom panels for opaque finish.

B. Related Requirements:

1. Section 081213: Hollow Metal Frames
2. Section 087100: Door Hardware
3. Section: 099123: Interior Painting

1.2 ACTION SUBMITTALS

A. Product Data:

1. Solid-core five-ply flush wood veneer-faced doors and transom panels for transparent finish.
2. Solid-core five-ply flush wood doors and transom panels for opaque finish.

B. Product Data Submittals: For each product, including the following:

1. Door core materials and construction.
2. Door edge construction
3. Door face type and characteristics.
4. Door louvers.
5. Door trim for openings.
6. Door frame construction.
7. Factory-machining criteria.
8. Factory-[**priming**] specifications.

C. Shop Drawings: Indicate location, size, and hand of each door; elevation of each type of door; construction details not covered in Product Data; and the following:

1. Door schedule indicating door location, type, size, fire protection rating, and swing.
2. Door elevations, dimension and locations of hardware, lite and louver cutouts, and glazing thicknesses.
3. Details of frame for each frame type, including dimensions and profile.
4. Details of electrical raceway and preparation for electrified hardware, access control systems, and security systems.

5. Apply AWI Quality Certification or WI Certified Compliance Program label to Shop Drawings.

1.3 CLOSEOUT SUBMITTALS

- A. Special warranties.
- B. Quality Standard Compliance Certificates: AWI Quality Certification or WI Certified Compliance Program certificates.
- C. Record Documents: For fire-rated doors, list of door numbers and applicable room name and number to which door accesses.

1.4 QUALITY ASSURANCE

- A. Manufacturer's Certification: Licensed participant in AWI's Quality Certification Program or WI's Certified Compliance Program.
- B. Fire-Rated Door Inspector Qualifications: Inspector for field quality-control inspections of fire-rated door assemblies complies with qualifications set forth in NFPA 80, Section 5.2.3.1 and the following:
 1. DHI's Fire and Egress Door Assembly Inspector (FDAI) certification.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Comply with requirements of referenced standard and manufacturer's written instructions.
- B. Package doors individually in cardboard cartons, and wrap bundles of doors in plastic sheeting.
- C. Mark each door on top and bottom rail with opening number used on Shop Drawings.

1.6 FIELD CONDITIONS

- A. Environmental Limitations:
 1. Do not deliver or install doors until building is enclosed and weathertight, wet work is complete, and HVAC system is operating and maintaining temperature between 60 and 90 deg F (16 and 32 deg C) and relative humidity between 25 and 55 percent during remainder of construction period.

1.7 WARRANTY

- A. Special Warranty: Manufacturer agrees to repair or replace doors that fail in materials or workmanship within specified warranty period.
 1. Failures include, but are not limited to, the following:

- a. Delamination of veneer.
 - b. Warping (bow, cup, or twist) more than 1/4 inch (6.4 mm) in a 42-by-84-inch (1067-by-2134-mm) section.
 - c. Telegraphing of core construction in face veneers exceeding 0.01 inch in a 3-inch (0.25 mm in a 76.2-mm) span.
- 2. Warranty also includes installation and finishing that may be required due to repair or replacement of defective doors
 - 3. Warranty Period for Solid-Core Interior Doors: Life of installation.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Fire-Rated Wood Door and Frame Assemblies: Assemblies complying with NFPA 80 that are listed and labeled by a qualified testing agency acceptable to authorities having jurisdiction, for fire-protection ratings indicated on Drawings, based on testing at positive pressure in accordance with UL 10C or NFPA 252.
- B. Smoke- and Draft-Control Door Assemblies: Listed and labeled for smoke and draft control by a qualified testing agency acceptable to authorities having jurisdiction, based on testing in accordance with UL 1784 and installed in compliance with NFPA 105.

2.2 FLUSH WOOD DOORS AND FRAMES, GENERAL

- A. Quality Standard: In addition to requirements specified, comply with AWI/AWMAC/WI's "Architectural Woodwork Standards."
 - 1. y comply with requirements of grades specified.
 - 2. The Contract Documents contain requirements that are more stringent than the referenced quality standard. Comply with the Contract Documents in addition to those of the referenced quality standard.

2.3 PRODUCTS

A. MANUFACTURERS

- 1. Eggers Industries Or Equal

2.4 SOLID-CORE FIVE-PLY FLUSH WOOD VENEER-FACED DOORS AND TRANSOM PANELS FOR TRANSPARENT FINISH

- A. Interior Doors, Solid-Core Five-Ply Veneer-Faced
 - 1. Performance Grade: ANSI/WDMA I.S. 1A
 - 2. Performance Grade by Location:

- a. ANSI/WDMA I.S. 1A Extra Heavy Duty: Classrooms, public toilets, janitor's closets, assembly spaces and exits
 - b. ANSI/WDMA I.S. 1A Standard Duty: Closets (not including janitor's closets) and private toilets
3. ANSI/WDMA I.S. 1A Quality Grade: Premium
 4. Architectural Woodwork Standards Quality Grade: Premium
 5. Faces: Single-ply wood veneer not less than 1/50 inch (0.508 mm) thick.
 - a. Assembly of Veneer Leaves on Door Faces: Center-balance match.
 - b. Pair and Set Match: Provide for doors hung in same opening
 - c. Room Match:
 - 1) Match door faces within each separate room or area of building. Corridor-door faces do not need to match where they are separated by 10 feet (3 m) or more.
 - 2) Provide door faces of compatible color and grain within each separate room or area of building.
 6. Exposed Vertical and Top Edges: Same species as faces or a compatible species - Architectural Woodwork Standards edge Type A.
 - 1) Screw-Holding Capability: 550 lbf (2440 N) in accordance with WDMA T.M. 10.
 7. Core for Non-Fire-Rated Doors:
 - a. ANSI A208.1, [Grade LD-1] particleboard.
 - 1) Blocking: Provide wood blocking in particleboard-core doors as needed to eliminate through-bolting hardware.
 - a) 5-inch (125-mm) top-rail blocking, in doors indicated to have closers.
 - b) 5-inch (125-mm) bottom-rail blocking, in exterior doors and doors indicated to have kick, mop, or armor plates.
 - c) 5-inch (125-mm) midrail blocking, in doors indicated to have exit devices.
 - 2) Provide doors with glued-wood-stave or WDMA I.S. 10 structural-composite-lumber cores instead of particleboard cores for doors scheduled to receive exit devices in Section 087100 "Door Hardware." Section 087111 "Door Hardware (Descriptive Specification."
 - b. Glued wood stave.
 - c. WDMA I.S. 10 structural composite lumber.
 - d. Either glued wood stave or WDMA I.S. 10 structural composite lumber.
 8. Core for Fire-Rated Doors: As required to achieve fire-protection rating indicated on Drawings.

- a. Blocking for Mineral-Core Doors: Provide composite blocking with improved screw-holding capability approved for use in doors of fire-protection ratings indicated on Drawings as needed to eliminate through-bolting hardware.
 - 1) 5-inch (125-mm) top-rail blocking.
 - 2) 5-inch (125-mm) bottom-rail blocking, in doors indicated to have protection plates.
 - 3) 5-inch (125-mm) midrail blocking, in doors indicated to have armor plates.
 - 4) 4-1/2-by-10-inch (114-by-250-mm) lock blocks, 5-inch (125-mm) midrail blocking, in doors indicated to have exit devices.
- 9. Construction: Five plies, hot-pressed bonded (vertical and horizontal edging is bonded to core), with entire unit abrasive planed before veneering.

2.5 SOLID-CORE FIVE-PLY FLUSH WOOD DOORS AND TRANSOM PANELS FOR OPAQUE FINISH

- A. Interior Doors, Solid-Core Five-Ply for Opaque Finish
 - 1. Performance Grade: ANSI/WDMA I.S. 1A
 - 2. Performance Grade by Location:
 - a. ANSI/WDMA I.S. 1A Extra Heavy Duty: Classrooms, public toilets, janitor's closet, assembly spaces, and exits.
 - b. ANSI/WDMA I.S. 1A Standard Duty: Closets (not including janitor's closets) and private toilets.
 - 3. ANSI/WDMA I.S. 1A Quality Grade: Premium
 - 4. Architectural Woodwork Standards Quality Grade: Premium
 - 5. Faces: MDO, Any closed-grain hardwood of mill option, Hardboard or MDF.
 - a. Apply MDO to standard-thickness, closed-grain, hardwood face veneers or directly to high-density hardboard crossbands.
 - b. Hardboard Faces: ANSI A135.4, Class 1 (tempered) or Class 2 (standard).
 - c. MDF Faces: ANSI A208.2, Grade 150 or Grade 160.
 - 6. Core for Non-Fire-Rated Doors:
 - a. ANSI A208.1, Grade LD-1 particleboard.
 - 1) Blocking: Provide wood blocking in particleboard-core doors as follows:
 - a) 5-inch (125-mm) top-rail blocking, in doors indicated to have closers.
 - b) 5-inch (125-mm) bottom-rail blocking, in exterior doors and doors indicated to have kick, mop, or armor plates.
 - c) 5-inch (125-mm) midrail blocking, in doors indicated to have exit devices.
 - b. Glued wood stave.
 - c. WDMA I.S. 10 structural composite lumber.

- 1) Screw Withdrawal, Door Face: 550 lbf (2440 N)]
 - 2) Screw Withdrawal, Vertical Door Edge: 550 lbf (2440 N)
- d. Either glued wood stave or WDMA I.S. 10 structural composite lumber.
7. Core for Fire-Rated Doors: As required to achieve fire-protection rating indicated on Drawings.
- a. Blocking for Mineral-Core Doors: Provide composite blocking with improved screw-holding capability approved for use in doors of fire-protection ratings indicated on Drawings as follows:
 - 1) 5-inch (125-mm) top-rail blocking.
 - 2) 5-inch (125-mm) bottom-rail blocking, in doors indicated to have protection plates.
 - 3) 5-inch (125-mm) midrail blocking, in doors indicated to have armor plates.
 - 4) 4-1/2-by-10-inch (114-by-250-mm) lock blocks, 5-inch (125-mm) midrail blocking, in doors indicated to have exit devices.
8. Construction: Five plies, hot-pressed bonded (vertical and horizontal edging is bonded to core), with entire unit abrasive planed before veneering.

2.6 LIGHT FRAMES AND LOUVERS

- 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: Flush rectangular beads
- B. Wood Louvers: Door manufacturer's standard solid-wood louvers unless otherwise indicated.
1. Wood Species: Same species as door faces
 2. Profile: Flat

2.7 FABRICATION

- A. Factory fit doors to suit frame-opening sizes indicated.
1. Comply with clearance requirements of referenced quality standard for fitting unless otherwise indicated.
 2. Comply with NFPA 80 requirements for fire-rated doors.
- B. Openings: Factory cut and trim openings through doors.
1. Light Openings: Trim openings with moldings of material and profile indicated.
 2. Louvers: Factory install louvers in prepared openings.
 3. Flash top of outswinging doors with manufacturer's standard metal flashing.

2.8 FACTORY PRIMING

- A. Doors for Opaque Finish: Factory prime faces, all four edges, edges of cutouts, and mortises with one coat of wood primer specified in Section 099100" Painting and Coating."

2.9 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.
 - 3. Stains and fillers may be omitted on top and bottom edges, edges of cutouts, and mortises.
- B. Factory finish doors.
- C. Factory finish doors that are indicated on Drawings to receive transparent finish.
- D. Factory finish doors where indicated in schedules or on Drawings as factory finished.
- E. Transparent Finish:
 - 1. Architectural Woodwork Standards Grade: Premium
 - a. System-5, Varnish, Conversion.
 - b. System-9, UV Curable, Acrylated Epoxy, Polyester or Urethane.
 - c. System-10, UV Curable, Water Based.
 - d. System-11, Polyurethane, Catalyzed.
 - 2. ANSI/WDMA I.S. 1A Grade: Premium
 - a. TR-4 Conversion Varnish.
 - b. TR-6 Catalyzed Polyurethane.
 - c. TR-8 UV Cured Acrylated Polyester/Urethane.
 - 3. Staining: Submit for selection
 - 4. Sheen: [Satin]
- F. Opaque Finish:
 - 1. Architectural Woodwork Standards Grade: Premium
 - a. System-5, Varnish, Conversion.
 - b. System-9, UV Curable, Acrylated Epoxy, Polyester, or Urethane.
 - c. System-10, UV Curable, Water Based.
 - d. System-11, Polyurethane, Catalyzed.
 - 2. ANSI/WDMA I.S. 1A Grade: Premium

- a. OP-4 Conversion Varnish.
 - b. OP-6 Catalyzed Polyurethane.
3. Color: Submit for Selection
 4. Sheen: [Semigloss]

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine doors and installed door frames, with Installer present, before hanging doors.
 1. Verify that installed 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.

3.2 INSTALLATION

- A. Hardware: For installation, see Section 087100 "Door Hardware."
- B. Install doors and frames to comply with manufacturer's written instructions and referenced quality standard, and as indicated.
- C. Install frames level, plumb, true, and straight.
 1. Shim as required with concealed shims. Install level and plumb to a tolerance of 1/8 inch in 96 inches (3.2 mm in 2400 mm).
 2. Anchor frames to anchors or blocking built in or directly attached to substrates.
 - a. Secure with countersunk, concealed fasteners and blind nailing.
 - b. Use fine finishing nails or finishing screws for exposed fastening, countersunk and filled flush with woodwork.
 - 1) For factory-finished items, use filler matching finish of items being installed.
- D. Job-Fitted Doors:
 1. Align and fit doors in frames with uniform clearances and bevels as indicated below.
 - a. Do not trim stiles and rails in excess of limits set by manufacturer or permitted for fire-rated doors.
 2. Machine doors for hardware.
 3. Seal edges of doors, edges of cutouts, and mortises after fitting and machining.
 4. Clearances:

- a. Provide 1/8 inch (3.2 mm) at heads, jambs, and between pairs of doors.
 - b. Provide 1/8 inch (3.2 mm) from bottom of door to top of decorative floor finish or covering unless otherwise indicated on Drawings.
 - c. Where threshold is shown or scheduled, provide 1/4 inch (6.4 mm) from bottom of door to top of threshold unless otherwise indicated.
- 5. Bevel non-fire-rated doors 1/8 inch in 2 inches (3-1/2 degrees) at lock and hinge edges.
 - 6. Bevel fire-rated doors 1/8 inch in 2 inches (3-1/2 degrees) at lock edge; trim stiles and rails only to extent permitted by labeling agency.
- E. Factory-Fitted Doors: Align in frames for uniform clearance at each edge.
 - F. Factory-Finished Doors: Restore finish before installation if fitting or machining is required at Project site.

3.3 FIELD QUALITY CONTROL

- A. Repair or remove and replace installations where inspections indicate that they do not comply with specified requirements.
- B. Reinspect repaired or replaced installations to determine if replaced or repaired door assembly installations comply with specified requirements.

3.4 ADJUSTING

- A. Operation: Rehang or replace doors that do not swing or operate freely.
- 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.

END OF SECTION 081416

SECTION 083113

ACCESS DOORS AND FRAMES

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Access doors and frames.

1.2 ALLOWANCES

- A. Access doors and frames are part of an access door and frame allowance.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.
 - 1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes.

1.4 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For testing and inspecting agency.

1.5 CLOSEOUT SUBMITTALS

- A. Record Documents: For fire-rated doors, list of applicable room name and number in which access door is located.

PART 2 - PRODUCTS

2.1 ACCESS DOORS AND FRAMES

- A. Flush Access Doors with Exposed Flanges
 - 1. Description: Face of door flush with frame, with exposed flange and concealed hinge.
 - 2. Metallic-Coated Steel Sheet for Door: Nominal 0.064 inch (1.63 mm), 16 gage factory finished.
 - 3. Frame Material: Same material, thickness, and finish as door

2.2 MATERIALS

- A. Steel Plates, Shapes, and Bars: ASTM A36/A36M.
- B. Steel Sheet: Uncoated or electrolytic zinc coated, ASTM A879/A879M, with cold-rolled steel sheet substrate complying with ASTM A1008/A1008M, Commercial Steel (CS), exposed.
- C. Metallic-Coated Steel Sheet: ASTM A653/A653M, Commercial Steel (CS), Type B; with minimum G60 (Z180) or A60 (ZF180) metallic coating.
- D. Frame Anchors: Same material as door face.
- E. Inserts, Bolts, and Anchor Fasteners: Hot-dip galvanized steel according to ASTM A153/A153M or ASTM F2329.

2.3 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 mounting holes, attachment devices and fasteners of type required to secure access doors to types of supports indicated.
- D. Latch and Lock Hardware:
 - 1. Quantity: Furnish number of latches and locks required to hold doors tightly closed.
 - 2. Keys: Furnish two keys per lock and key all locks alike.

2.4 FINISHES

- A. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.
- B. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.
- C. 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.
- D. Painted Finishes: Comply with coating manufacturer's written instructions for cleaning, conversion coating, and applying and baking finish.
 - 1. Factory Primed: Apply manufacturer's standard, lead- and chromate-free, universal primer immediately after surface preparation and pretreatment.

2. Factory Finished: Apply manufacturer's standard baked-enamel or powder-coat finish immediately after cleaning and pretreating, with minimum dry-film thickness of 1 mil (0.025 mm) for topcoat.

PART 3 - EXECUTION

3.1 EXAMINATION

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

3.2 INSTALLATION

- A. Comply with manufacturer's written instructions for installing access doors and frames.

3.3 FIELD QUALITY CONTROL

- A. Repair or remove and replace installations where inspections indicate that they do not comply with specified requirements.
- B. Reinspect repaired or replaced installations to determine if replaced or repaired door assembly installations comply with specified requirements.

3.4 ADJUSTING

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

END OF SECTION 083113

SECTION 084113

ALUMINUM-FRAMED ENTRANCES AND STOREFRONTS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Aluminum-framed storefront systems.
2. Aluminum-framed entrance door systems.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes.

B. Shop Drawings: For aluminum-framed entrances and 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 type of vertical-to-horizontal intersection of aluminum-framed entrances and storefronts, showing the following:
 - a. Joinery, including concealed welds.
 - b. Anchorage.
 - c. Expansion provisions.
 - d. Glazing.
 - e. Flashing and drainage.

1.3 INFORMATIONAL SUBMITTALS

A. Certificates:

1. Energy Performance Certificates: For aluminum-framed entrances and storefronts, accessories, and components, from manufacturer.
 - a. Basis for Certification: NFRC-certified energy performance values for each aluminum-framed entrance and storefront.

1.4 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For aluminum-framed entrances and storefronts.
- B. Maintenance Data for Structural Sealant: For structural-sealant-glazed storefront. Include ASTM C1401 recommendations for post-installation-phase quality-control program.

1.5 QUALITY ASSURANCE

- A. Qualifications:
 - 1. Installers: An entity that employs installers and supervisors who are trained and approved by manufacturer and that employs a qualified glazing contractor for this Project who is certified under the North American Contractor Certification Program (NACC) for Architectural Glass & Metal (AG&M) contractors and that employs glazing technicians certified under the Architectural Glass and Metal Technician (AGMT) certification program.
- B. Product Options: Information on Drawings and in Specifications establishes requirements for aesthetic effects and performance characteristics of assemblies. Aesthetic effects are indicated by dimensions, arrangements, alignment, and profiles of components and assemblies as they relate to sightlines, to one another, and to adjoining construction.
 - 1. Do not change intended aesthetic effects, as judged solely by Architect, except with Architect's approval. If changes are proposed, submit comprehensive explanatory data to Architect for review.

1.6 WARRANTY

- A. Special Warranty: Manufacturer and Installer agrees to repair or replace components of aluminum-framed entrances and 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. Failure of operating components.
 - 2. Warranty Period: Two years from date of Substantial Completion.
- B. Special Finish Warranty, Anodized Finishes: Standard form in which manufacturer agrees to repair finishes or replace aluminum that shows evidence of deterioration of anodized finishes within specified warranty period.
 - 1. Deterioration includes, but is not limited to, the following:
 - a. Color fading more than 5 Delta E units when tested in accordance with ASTM D 2244.

- b. Chalking in excess of a No. 8 rating when tested in accordance with ASTM D 4214.
 - c. Cracking, peeling, or chipping.
2. Warranty Period: 10 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Framing system shall be as manufactured by Efco, Or Equal Framing sections shall be as shown on Drawings.

2.2 PERFORMANCE REQUIREMENTS

- A. General Performance: Comply with performance requirements specified, as determined by testing of aluminum-framed entrances and storefronts representing those indicated for this Project without failure due to defective manufacture, fabrication, installation, or other defects in construction.
 - 1. Aluminum-framed entrances and storefronts shall withstand movements of supporting structure, including, but not limited to, 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. Noise Reduction: Test in accordance with ASTM E90, with ratings determined by ASTM E1332, as follows.

2.3 STOREFRONT SYSTEMS

- A. Framing Members: Manufacturer's extruded- or formed-aluminum framing members of thickness required and reinforced as required to support imposed loads.
 - 1. Interior Vestibule Framing Construction
 - 2. Glazing System: Retained mechanically with gaskets on four sides
 - 3. Glazing Plane: Front
 - 4. Finish: Clear anodic finish
 - 5. Fabrication Method: Field-fabricated stick system.
 - 6. Aluminum: Alloy and temper recommended by manufacturer for type of use and finish indicated.
 - 7. Steel Reinforcement: As required by manufacturer.

- B. Backer Plates: Manufacturer's standard, continuous backer plates for framing members, if not integral, where framing abuts adjacent construction.
- C. Brackets and Reinforcements: Manufacturer's standard high-strength aluminum with nonstaining, nonferrous shims for aligning system components.

2.4 ENTRANCE DOOR SYSTEMS

- A. Entrance Doors: Manufacturer's standard glazed entrance doors for manual-swing
 - 1. Door Construction: 2- to 2-1/4-inch (50.8- to 57.2-mm) overall thickness, with minimum 0.125-inch- (3.2-mm-) thick, extruded-aluminum tubular rail and stile members. Mechanically fasten corners with reinforcing brackets that are deeply penetrated and fillet welded or that incorporate concealed tie rods.
 - 2. Door Design: As indicated
 - 3. Glazing Stops and Gaskets: Beveled snap-on, extruded-aluminum stops and preformed gaskets.
 - 4. Finish: Match adjacent storefront framing finish.

2.5 ENTRANCE DOOR HARDWARE

- A. Entrance Door Hardware: Hardware not specified in this Section is specified in Section 087100 "Door Hardware."
 - 1. Entrance Door Hardware Sets: Provide quantity, item, size, finish or color indicated, and products complying with BHMA standard referenced.
 - 2. Opening-Force Requirements:
 - a. Accessible Interior Doors: Not more than 5 lbf (22.2 N) to fully open door.
- B. Butt Hinges: BHMA A156.1, Grade 1, radius corner.
 - 1. Nonremovable Pins: Provide setscrew in hinge barrel that, when tightened into a groove in hinge pin, prevents removal of pin while entrance door is closed.
- C. Continuous-Gear Hinges: BHMA A156.26.
- D. Mortise Auxiliary Locks: BHMA A156.5, Grade 1.
- E. Manual Flush Bolts: BHMA A156.16, Grade 1.
- F. Automatic and Self-Latching Flush Bolts: BHMA A156.3, Grade 1.
- G. Cylinders:
 - 1. As specified in Section 087100 "Door Hardware."
 - 2. BHMA A156.5, Grade 1.

- a. Keying: Master key system. Permanently inscribe each key with a visual key control number and include notation "DO NOT DUPLICATE"
- H. Strikes: Provide strike with black-plastic dust box for each latch or lock bolt; fabricated for aluminum framing.
- I. Operating Trim: BHMA A156.6.
- J. Removable Mullions: BHMA A156.3 extruded aluminum.
 - 1. When used with panic exit devices, provide keyed removable mullions listed and labeled by a testing and inspecting agency acceptable to authorities having jurisdiction, for panic protection, based on testing in accordance with UL 305. Use only mullions that have been tested with exit devices to be used.
- K. Closers: BHMA A156.4, Grade 1, with accessories required for a complete installation, sized as required by door size, exposure to weather, and anticipated frequency of use; adjustable to comply with field conditions and requirements for opening force.
- L. Concealed Overhead Holders and Stops: BHMA A156.8, Grade 1.
- M. Door Stops: BHMA A156.16, Grade 1, floor or wall mounted, as appropriate for door location indicated, with integral rubber bumper.

2.6 GLAZING

- A. Glazing: Comply with Section 088000 "Glazing."
- B. Glazing Gaskets: Manufacturer's standard sealed-corner pressure-glazing system of black, resilient elastomeric glazing gaskets, setting blocks, and shims or spacers. Comply with Section 088000 "Glazing."
- C. Glazing Sealants: As recommended by manufacturer. Comply with Section 088000 "Glazing."
- D. Structural Glazing Sealants: ASTM C1184 chemically 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 structural-sealant manufacturer for use in storefront system indicated.
 - 1. Color: Black

2.7 MATERIALS

- A. Sheet and Plate: **ASTM B209** (**ASTM B209M**).
- B. Extruded Bars, Rods, Profiles, and Tubes: **ASTM B221** (**ASTM B221M**).
- C. Structural Profiles: ASTM B308/B308M.
- D. Steel Reinforcement:

1. Structural Shapes, Plates, and Bars: ASTM A36/A36M.
 2. Cold-Rolled Sheet and Strip: ASTM A1008/A1008M.
 3. Hot-Rolled Sheet and Strip: ASTM A1011/A1011M.
- E. Steel Reinforcement Primer: Manufacturer's standard zinc-rich, corrosion-resistant primer complying with SSPC-PS Guide No. 12.00; applied immediately after surface preparation and pretreatment. Select surface preparation methods in accordance with recommendations in SSPC-SP COM, and prepare surfaces in accordance with applicable SSPC standard.

2.8 ACCESSORIES

- A. Fasteners and Accessories: Manufacturer's standard corrosion-resistant, nonstaining, nonbleeding fasteners and accessories compatible with adjacent materials.
1. Use self-locking devices where fasteners are subject to loosening or turning out from thermal and structural movements, wind loads, or vibration.
 2. Reinforce members as required to receive fastener threads.
 3. Use exposed fasteners with countersunk Phillips screw heads, finished to match framing system
 4. Concrete and Masonry Inserts: Hot-dip galvanized cast-iron, malleable-iron, or steel inserts complying with ASTM A123/A123M or ASTM A153/A153M requirements.

2.9 FABRICATION

- A. Form or extrude aluminum shapes before finishing.
- B. Fabricate components that, when assembled, have the following characteristics:
1. Profiles that are sharp, straight, and free of defects or deformations.
 2. Accurately fitted joints with ends coped or mitered.
 3. Physical and thermal isolation of glazing from framing members.
 4. Accommodations for thermal and mechanical movements of glazing and framing to maintain required glazing edge clearances.
 5. Fasteners, anchors, and connection devices that are concealed from view to greatest extent possible.
- C. Mechanically Glazed Framing Members: Fabricate for flush glazing without projecting stops.
- D. Structural-Sealant-Glazed Framing Members: Include accommodations for using temporary support device to retain glazing in place while structural sealant cures.
- E. Entrance Door Frames: Reinforce as required to support loads imposed by door operation and for installing entrance door hardware.
- F. Entrance Doors: Reinforce doors as required for installing entrance door hardware.
1. At pairs of exterior doors, provide sliding-type weather stripping retained in adjustable strip and mortised into door edge.

- G. Entrance Door Hardware Installation: Factory install entrance door hardware to the greatest extent possible. Cut, drill, and tap for factory-installed entrance door hardware before applying finishes.
- H. After fabrication, clearly mark components to identify their locations in Project in accordance with Shop Drawings.

2.10 ALUMINUM FINISHES

- A. Clear Anodic Finish: AAMA 611, AA-M12C22A41, Class I, 0.018 mm
- B. Color Anodic Finish: AAMA 611, AA-M12C22A42/A44, Class I, 0.018 mm or thicker.
 - 1. Color: Dark bronze

PART 3 - EXECUTION

3.1 EXAMINATION

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

3.2 INSTALLATION, GENERAL

- A. Comply with manufacturer's written instructions.
- B. Do not install damaged components.
- C. Fit joints to produce hairline joints free of burrs and distortion.
- D. Rigidly secure nonmovement joints.
- E. Install anchors with separators and isolators to prevent metal corrosion and electrolytic deterioration and to prevent impeding movement of moving joints.
- F. Seal perimeter and other joints watertight unless otherwise indicated.
- G. Metal Protection:
 - 1. Where aluminum is in contact with dissimilar metals, protect against galvanic action by painting contact surfaces with materials recommended by manufacturer for this purpose or by installing nonconductive spacers.
 - 2. Where aluminum is in contact with concrete or masonry, protect against corrosion by painting contact surfaces with bituminous paint.
- H. Install joint filler behind sealant as recommended by sealant manufacturer.

- I. Install components plumb and true in alignment with established lines and grades.

3.3 INSTALLATION OF OPERABLE UNITS

- A. Install operable units level and plumb, securely anchored, and without distortion. Adjust hardware movement to produce proper operation.

3.4 INSTALLATION OF GLAZING

- A. Install glazing as specified in Section 088000 "Glazing."

3.5 INSTALLATION OF ALUMINUM-FRAMED ENTRANCE DOORS

- A. Install entrance doors to produce smooth operation and tight fit at contact points.
 - 1. Exterior Doors: Install to produce weathertight enclosure and tight fit at weather stripping.
 - 2. Field-Installed Entrance Door Hardware: Install surface-mounted entrance door hardware in accordance with entrance door hardware manufacturers' written instructions using concealed fasteners to greatest extent possible.

3.6 ERECTION TOLERANCES

- A. Install aluminum-framed entrances and 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.

3.7 MAINTENANCE SERVICE

- A. Entrance Door Hardware Maintenance:
 - 1. Maintenance Tools and Instructions: Furnish a complete set of specialized tools and maintenance instructions as needed for Owner's continued adjustment, maintenance, and removal and replacement of entrance door hardware.

2. Initial Maintenance Service: Beginning at Substantial Completion, provide six months' full maintenance by skilled employees of entrance door hardware Installer. Include quarterly preventive maintenance, repair or replacement of worn or defective components, lubrication, cleaning, and adjusting as required for proper entrance door hardware operation at rated speed and capacity. Use parts and supplies that are the same as those used in the manufacture and installation of original equipment.

END OF SECTION 084113

SECTION 087100
DOOR HARDWARE

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Mechanical door hardware for the following:
 - a. Swinging doors.
 - b. Sliding doors.
 - c. Folding doors.
2. Cylinders for door hardware specified in other Sections.
3. Electrified door hardware.

B. Related Requirements:

1. Section 081213 "Hollow Metal Frames"
2. Section 081416 "Flush Wood Doors"
3. Section 084113 "Aluminum-Framed Entrances and Storefronts"

1.2 COORDINATION

- A. Installation Templates: Distribute for doors, frames, and other work specified to be factory 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.
- B. Security: Coordinate installation of door hardware, keying, and access control with Owner
- C. Existing Openings: Where hardware components are scheduled for application to existing construction or where modifications to existing door hardware are required, field verify existing conditions and coordinate installation of door hardware to suit opening conditions and to provide proper door operation.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes.

B. Door Hardware Schedule: Coordinate door hardware schedule with doors, frames, and related work to ensure proper size, thickness, hand, function, and finish of door hardware.

1. Submittal Sequence: Submit door hardware schedule concurrent with submissions of Product Data, Samples, and Shop Drawings. Coordinate submission of door hardware schedule with scheduling requirements of other work to facilitate the fabrication of other work that is critical in Project construction schedule.
2. Format: Use same scheduling sequence and format and use same door numbers as in door hardware schedule in the Contract Documents.
3. Content: Include the following information:
 - a. Identification number, location, hand, fire rating, size, and material of each door and frame.
 - b. Locations of each door hardware set, cross-referenced to Drawings on floor plans and to door and frame schedule.
 - c. Complete designations, including name and manufacturer, type, style, function, size, quantity, function, and finish of each door hardware product.
 - d. Fastenings and other installation information.
 - e. Explanation of abbreviations, symbols, and designations contained in door hardware schedule.
 - f. Mounting locations for door hardware.
 - g. List of related door devices specified in other Sections for each door and frame.

1.4 WARRANTY

- A. Manufacturer shall provide a minimum 2 year material warranty except as follows:
 1. 10 year manufacturer's material warranty for door closers.
 2. Provide a 5 year manufacturer's material warranty for locksets and exit devices.

1.5 MAINTENANCE MATERIAL SUBMITTALS

- A. Furnish extra materials:
 1. Provide 5 percent or a minimum of one, whichever is greater, of the following hardware: locksets, exit devices, closers, and electric or electronic hardware. Transmit to OAR before Substantial Completion.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Inventory door hardware on receipt and provide secure lock-up for door hardware delivered to Project site.
- B. Tag each item or package separately with identification coordinated with the final door hardware schedule, and include installation instructions, templates, and necessary fasteners with each item or package.
- C. Deliver keys to Owner by registered mail or overnight package service.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Accessibility Requirements: For door hardware on doors in an accessible route, comply with the USDOJ's "2010 ADA Standards for Accessible Design" and 2019 CBC Chapter 11B
1. Provide operating devices that do not require tight grasping, pinching, or twisting of the wrist and that operate with a force of not more than 5 lbf (22.2 N).
 2. Comply with the following maximum opening-force requirements:
 - a. Interior, Non-Fire-Rated Hinged Doors: 5 lbf (22.2 N) applied perpendicular to door.
 - b. Sliding or Folding Doors: 5 lbf (22.2 N) applied parallel to door at latch.
 - c. Fire Doors: Minimum opening force allowable by authorities having jurisdiction.
 3. Bevel raised thresholds with a slope of not more than 1:2. Provide thresholds not more than 1/2 inch (13 mm) high.
 4. Adjust door closer sweep periods so that, from an open position of 90 degrees, the door will take at least 5 seconds to move to a position of 12 degrees from the latch.
 5. Adjust spring hinges so that, from an open position of 70 degrees, the door will take at least 1.5 seconds to move to the closed position.
- B. Code Compliance: All requirements below shall apply to gates as well
1. Doors/doorways as part of an accessible route shall comply with CBC Sections 11B-404
 2. The clear opening width for a door shall be 32" minimum. For a swinging door it shall be measured between the face of the door and the stop, with the door open 90 degrees. There shall be no projections into it below 34" up to 4" maximum projections are allowed between 34" and 80" above the finish floor or ground. Door closers and stops shall be permitted to be 78" minimum above the finish floor or ground. CBC Section 11B-404.2.3
 3. Handles, pulls, latches, locks, and other operable parts on accessible doors shall comply with CBC Section 11B-309.4 and shall be operable with one hand and shall not require tight grasping, pinching, or twisting of the wrist. Operable parts of such hardware shall be 34" minimum and 44" maximum above finish floor or ground. Where sliding doors are in the fully open position, operating hardware shall be exposed and usable from both sides. CBC Section 11B-404.2.7
 4. The force for pushing or pulling open a door shall be as follows, per CBC Section 11B-404.2.9:
 - Interior hinged doors, sliding or folding doors, and exterior hinged doors: 5 pounds (22.2N) maximum. Case-by-case exceptions may be allowed for required fire doors when specifically allowed by DSA (the appropriate administrative authority), but not to exceed 15 pounds (66.7N). These forces do not apply to the force required to retract latch bolts or disengage other devices that hold the door in a closed position.
 - The force required for activating any operable parts, such as lever hardware, or disengaging other devices shall be 5 pounds (22.2N) maximum to comply with CBC Section 11B-309.4
 5. Door closing speed shall be as follows per CBC Section 11B-404.2.8:

- Closer shall be adjusted so that the required time to move a door from an open position of 90 degrees to a position of 12 degrees from the latch is 5 seconds minimum.
 - Spring hinges shall be adjusted so that the required time to move a door from an open position of 70 degrees to the closed position is 1.5 seconds minimum.
6. Thresholds shall comply with CBC Section 11B-404.2.5
 7. Floor stops shall not be located in the path of travel and 4” maximum from walls.
 8. Hardware (including panic hardware) shall not be provided with “Night Latch” (NL) function for any accessible doors or gates

2.2 HINGES

- A. Hinges: BHMA A156.1. Provide template-produced hinges for hinges installed on hollow-metal doors and hollow-metal frames.
- B. Manufactures:
 1. Hager Companies (HA) – CB Series.
 2. McKinney Products; ASSA Abloy Architectural Door Accessories (MK) – TA Series.
 3. Stanley Hardware (ST) – CB Series

2.3 MECHANICAL LOCKS AND LATCHES

- A. Mortise Locksets, Grade 1 (Heavy Duty): ANSI/BHMA A156.13, Series 1000, Operational Grade 1 certified. Locksets are to be manufactured with a corrosion resistant steel case and be field-reversible for handing without disassembly of the lock body.
 1. Manufactures:
 - a. Corbin Russwin Hardware (RU) – ML2000 Series.
- B. Cylindrical Lockset, Grade 1 (Heavy Duty): ANSI/BHMA A156.13, Series 4000, Grade 1 certified.
 1. Furnish with solid cast levers, standard 2 ¾” backset, and ½” (¾” at rated paired openings) throw brass or stainless steel latchbolt.
 2. Locks are to be non-handed and fully field reversible.
 3. Manufactures:
 - a. Corbin Russwin Hardware (RU) – ML3300 Series.

2.4 KEYING

- A. Keying System: Factory registered, complying with guidelines in BHMA A156.28, appendix. Provide one extra key blank for each lock.
 1. Conduct specified “Keying Conference” to define and document keying system instructions and requirements.

2. Furnish factory cut, nickel-silver large bow permanently inscribed with a visual key control number as directed by Owner
 3. Existing System: Field verify and key locks to match Owner's existing system.
- B. Key Quantity: Provide the following minimum number of keys
1. Change Keys per Cylinder: Two
 2. Master Keys (per Master Key Level/Group): Five
 3. Construction Keys: Ten
- C. Construction Keying: Provide construction master keyed cylinders.
- D. Key Registration List (Bitting List):
1. Provide keying transcript list to OAR in the proper format for importing into key control software
 2. Provide transcript list in writing or electronic file as directed by the Owner
- E. Key Control Cabinet: Provide a key control system including envelopes, labels, and tags with self-locking key clips, receipt forms 3-way visible card index, temporary markers, permanent markers, and standard metal cabinet. Key control cabinet shall have expansion capacity of 150% of the number of locks required for the project.
1. Manufacturers:
 - a. Lund Equipment (LU)
 - b. Telkee (TK)

2.5 ACCESSORIES FOR PAIRS OF DOORS

- A. Coordinators: BHMA A156.3; consisting of active-leaf, hold-open lever and inactive-leaf release trigger; fabricated from steel with nylon-coated strike plates; with built-in, adjustable safety release.
- B. Astragals: BHMA A156.22.
- C. Manufacturer:
 1. Rockwood Products: ASSA Abloy Architectural Door Accessories (RO)

2.6 DOOR CLOSERS

- A. Surface Closers: BHMA A156.4; rack-and-pinion hydraulic type with adjustable sweep and latch speeds controlled by key-operated valves and forged-steel main arm. Comply with manufacturer's written instructions for size of door closers depending on size of door, exposure to weather, and anticipated frequency of use. Provide factory-sized closers, adjustable to meet field conditions and requirements for opening force.
- B. MANUFACTURERS

1. Corbin Russwin Hardware (RU) – DC600 Series
2. LCN Closers (LC) – 4040 Series.

2.7 MECHANICAL STOPS AND HOLDERS

A. Wall- and Floor-Mounted Stops: BHMA A156.16.

B. MANUFACTURERS

1. Hager Companies (HA)
2. Rockwood Products; ASSA Abloy Architectural Door Accessories (RO).

2.8 DOOR GASKETING

A. Door Gasketing: BHMA A156.22; with resilient or flexible seal strips that are easily replaceable and readily available from stocks maintained by manufacturer.

B. Maximum Air Leakage: When tested in accordance with ASTM E283 with tested pressure differential of 0.3-inch wg (75 Pa), as follows:

1. Gasketing on Single Doors: 0.3 cfm/sq. ft. (3 cu. m per minute/sq. m) of door opening.
2. Gasketing on Double Doors: 0.50 cfm per ft. (0.000774 cu. m/s per m) of door opening.

C. MANUFACTURERS

1. National Guard Products (NG)
2. Pemko Products: ASSA Abloy Architectural Door Accessories (RO).
3. Reese Enterprises, Inc. (RE)

2.9 FABRICATION

A. Base Metals: Produce door hardware units of base metal indicated, fabricated by forming method indicated, using manufacturer's standard metal alloy, composition, temper, and hardness. Furnish metals of a quality equal to or greater than that of specified door hardware units and BHMA A156.18.

B. Fasteners: Provide door hardware manufactured to comply with published templates prepared for machine, wood, and sheet metal screws. Provide screws that comply with commercially recognized industry standards for application intended, except aluminum fasteners are not permitted. Provide Phillips flat-head screws with finished heads to match surface of door hardware unless otherwise indicated.

1. Concealed Fasteners: For door hardware units that are exposed when door is closed, except for units already specified with concealed fasteners. Do not use through bolts for installation where bolt head or nut on opposite face is exposed unless it is the only means of securely attaching the door hardware. Where through bolts are used on hollow door and frame construction, provide sleeves for each through bolt.
2. Gasketing Fasteners: Provide noncorrosive fasteners for exterior applications and elsewhere as indicated.

2.10 FINISHES

- A. Provide finishes complying with BHMA A156.18 as indicated in door hardware schedule.
- B. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.
- C. 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

3.1 EXAMINATION

- A. 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 of the Work.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Wood Doors: Comply with door and hardware manufacturers' written instructions.

3.3 INSTALLATION

- A. Mounting Heights: Mount door hardware units at heights indicated on Drawings unless otherwise indicated or required to comply with governing regulations.
 - 1. Standard Steel Doors and Frames: ANSI/SDI A250.8.
 - 2. Wood Doors: DHI's "Recommended Locations for Architectural Hardware for Wood Flush Doors."
- B. Install each door hardware item to comply with manufacturer's written instructions. Where cutting and fitting are required to install door hardware onto or into surfaces that are later to be painted or finished in another way, coordinate removal, storage, and reinstallation of surface protective trim units with finishing work. Do not install surface-mounted items until finishes have been completed on substrates involved.
 - 1. Set units level, plumb, and true to line and location. Adjust and reinforce attachment substrates as necessary for proper installation and operation.
 - 2. Drill and countersink units that are not factory prepared for anchorage fasteners. Space fasteners and anchors according to industry standards.

- C. Hinges: Install types and in quantities indicated in door hardware schedule, but not fewer than the number recommended by manufacturer for application indicated or one hinge for every 30 inches (750 mm) of door height, whichever is more stringent, unless other equivalent means of support for door, such as spring hinges or pivots, are provided.
- D. Intermediate Offset Pivots: Where offset pivots are indicated, provide intermediate offset pivots in quantities indicated in door hardware schedule, but not fewer than one intermediate offset pivot per door and one additional intermediate offset pivot for every 30 inches (750 mm) of door height greater than 90 inches (2286 mm).
- E. Lock Cylinders: Install construction cores to secure building and areas during construction period.
 - 1. Replace construction cores with permanent cores
- F. Key Control System:
 - 1. Key Control Cabinet: Tag keys and place them on markers and hooks in key control system cabinet, as determined by final keying schedule.
 - 2. Key Lock Boxes: Install where indicated or approved by Architect to provide controlled access for fire and medical emergency personnel.
 - 3. Key Control System Software: Set up multiple-index system based on final keying schedule.
- G. Perimeter Gasketing: Apply to head and jamb, forming seal between door and frame.
 - 1. Do not notch perimeter gasketing to install other surface-applied hardware.
- H. Meeting Stile Gasketing: Fasten to meeting stiles, forming seal when doors are closed.
- I. Door Bottoms: Apply to bottom of door, forming seal with threshold when door is closed.

3.4 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. Door Closers: Adjust sweep period to comply with accessibility requirements and requirements of authorities having jurisdiction.
 - 2. Spring Hinges: Adjust to achieve positive latching when door is allowed to close freely from an open position of 70 degrees and so that closing time complies with accessibility requirements of authorities having jurisdiction.
 - 3. Electric Strikes: Adjust horizontal and vertical alignment of keeper to properly engage lock bolt.

3.5 CLEANING AND PROTECTION

- A. Clean adjacent surfaces soiled by door hardware installation.

- B. Clean operating items as necessary to restore proper function and finish.
- C. Provide final protection and maintain conditions that ensure that door hardware is without damage or deterioration at time of Substantial Completion.

3.6 MAINTENANCE SERVICE

- A. Maintenance Tools and Instructions: Furnish a complete set of specialized tools and maintenance instructions for Owner's continued adjustment, maintenance, and removal and replacement of door hardware.

3.7 DOOR HARDWARE SCHEDULE

- A. **Hardware Set 1:** Doors: 9, 22

3 Hinge, Full Mortise	TA2714 (NRP)	US26D	MK
1 Classroom Intruder Lock	CL3352 NZD 67B1	626	RU
1 Surface Closer	DC6200 A4	689	RU
1 Mop Plate	K1050 6" high CSK BEV	US32D	RO
1 Kick Plate	K1050 10" high CSK BEV	US32D	RO
3 Silencer	608-RKW		RO

- B. **Hardware Set 2:** Doors: 8, 24

3 Hinge, Full Mortise	TA2714 (NRP)	US26D	MK
1 Classroom Lock	CL3355 NZD 67B1	626	RU
1 Surface Closer	DC6200 A3	689	RU
3 Silencer	608-RKW		RO

- C. **Hardware Set 3:** Each door to have the following: Doors: 23

6 Hinge, Full Mortise	TA2714 (NRP)	US26D	MK
1 Classroom Lock	CL3355 NZD 67B1	626	RU
1 Coordinator	2600 series x Brkts as req'd	Black	RO
2 Surface Closer	DC6200 A4	689	RU
1 Gasketing (Head)	2891AS		PE
1 Gasketing (Jambs)	2891AS		PE

- D. **Hardware Set 4:** Each door to have the following: Doors: E1A, E1B, E1C, E1D

1 Nightlatch	CDSI PA AX 99NL-OP 110MD-NL	US26D	VD
1 Exit Only	CDSI PA AX 99EO 990EO(Std)	US26D	VD
3 Mortise Cylinder	CR1000 67B1	626	RU
1 Rim Cylinder	CR1000 67B1	626	RU
1 Vandal Resistant Trim	VRT26	US32D	RO
1 Vandal Resistant Trim	VRT26 C	US32D	RO

END OF SECTION 087100

SECTION 088000

GLAZING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Glass products.
2. Laminated glass.
3. Glazing sealants.
4. Glazing tapes.
5. Miscellaneous glazing materials.

B. Related Requirements:

1. Section 084113 "Aluminum-Framed Entrances and Storefronts."

1.2 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 in accordance with ASTM C1036.

1.3 COORDINATION

- A. Coordinate glazing channel dimensions to provide necessary bite on glass, minimum edge and face clearances, and adequate sealant thicknesses, with reasonable tolerances to achieve proper safety margins for glazing retention under each design load case, load case combination, and service condition.

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Glass Samples: For each type of glass product other than clear monolithic vision: 12 inches (300 mm) square.
 1. Laminated glass.
- C. Glazing Accessory Samples: For sealants and colored spacers, in 12-inch (300-mm) lengths. Install sealant Samples between two strips of material representative in color of adjoining framing system.

- D. Glazing Schedule: List glass types and thicknesses for each size opening and location. Use same designations indicated on Drawings.

1.5 INFORMATIONAL SUBMITTALS

- A. Product Certificates: For glass.
- B. Product Test Reports: For fabricated glass and glazing sealants, for tests performed by a qualified testing agency.
 - 1. For glazing sealants, provide test reports based on testing current sealant formulations within previous 36-month period.
- C. Qualification of Installer: Minimum 10 years experience installing glass in project of similar scope and complexity

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Protect glazing materials in accordance with manufacturer's written instructions. Prevent damage to glass and glazing materials from condensation, temperature changes, direct exposure to sun, or other causes.

1.7 FIELD 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 are below 40 deg F (4.4 deg C).

1.8 WARRANTY

- A. Manufacturer's Special Warranty for 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: 10 years from date of Substantial Completion.
 - 2. Installer shall provide a 10 year labor warranty.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Type of glass specified or indicated shall be manufactured or fabricated by one of the following:
 - 1. PPG Glass Technology
 - 2. Viracon
 - 3. Southwest Technologies

2.2 PERFORMANCE REQUIREMENTS

- A. Safety Glazing: Where safety glazing is indicated, provide glazing that complies with 16 CFR 1201, Category II.
- B. Acoustic Performance:
 - 1. Interior Glazing: [41] STC.

2.3 GLASS PRODUCTS, GENERAL

- A. Glazing Publications: Comply with published recommendations of glass product manufacturers and organizations below unless more stringent requirements are indicated. See these publications for glazing terms not otherwise defined in this Section or in referenced standards.
 - 1. NGA Publications: "Laminated Glazing Reference Manual" and "Glazing Manual."
- B. Safety Glazing Labeling: Where safety glazing 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.
- C. Strength: Where annealed float glass is indicated, provide annealed float glass, heat-strengthened float glass, or fully tempered float glass as needed to comply with "Performance Requirements" Article. Where heat-strengthened float glass is indicated, provide heat-strengthened float glass or fully tempered float glass as needed to comply with "Performance Requirements" Article. Where fully tempered float glass is indicated, provide fully tempered float glass.

2.4 GLASS PRODUCTS

- A. Clear Annealed Float Glass: ASTM C1036, Type I, Class 1 (clear), Quality-Q3.
- B. Fully Tempered Float Glass: ASTM C1048, Kind FT (fully tempered), Condition A (uncoated) unless otherwise indicated, Type I, Class 1 (clear) or Class 2 (tinted) as indicated, Quality-Q3.

2.5 LAMINATED GLASS

- A. Laminated Glass: ASTM C1172. Use materials that have a proven record of no tendency to bubble, discolor, or lose physical and mechanical properties after fabrication and installation.
 - 1. Construction: Laminate glass with [polyvinyl butyral interlayer to comply with interlayer manufacturer's written instructions.
 - 2. Interlayer Color: Clear unless otherwise indicated.

2.6 GLAZING SEALANTS

- A. General:
 - 1. Compatibility: Compatible with one another and with other materials they 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. Colors of Exposed Glazing Sealants: Submit for selection from manufacturer's full range of industry colors.

2.7 GLAZING TAPES

- A. 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 C1281 and AAMA 800 for products indicated below:
 - 1. AAMA 804.1

2.8 MISCELLANEOUS GLAZING MATERIALS

- A. General: Provide products of material, size, and shape complying with referenced glazing standard, recommended in writing by 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:
 - 1. Type recommended in writing by sealant or glass manufacturer.
- D. Spacers:
 - 1. Neoprene blocks or continuous extrusions of hardness required by glass manufacturer to maintain glass lites in place for installation indicated.

2. Type recommended in writing by sealant or glass manufacturer.

PART 3 - EXECUTION

3.1 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.

3.2 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 leave visible marks in the completed Work.

3.3 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. Protect glass edges from damage during handling and installation. Remove damaged glass from Project site and legally dispose of off Project site. Damaged glass includes glass with edge damage or other imperfections that, when installed, could weaken glass, impair performance, or impair appearance.
- C. Apply primers to joint surfaces where required for adhesion of sealants, as determined by preconstruction testing.
- D. 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.

3.4 TAPE GLAZING

- A. Position tapes on fixed stops so that, when compressed by glass, their exposed edges are flush with or protrude slightly above sightline of stops.
- B. Install tapes continuously, but not necessarily in one continuous length. Do not stretch tapes to make them fit opening.
- C. Cover vertical framing joints by applying tapes to heads and sills first, then to jambs. Cover horizontal framing joints by applying tapes to jambs, then to heads and sills.
- D. Place joints in tapes at corners of opening with adjoining lengths butted together, not lapped. Seal joints in tapes with compatible sealant approved by tape manufacturer.
- E. Do not remove release paper from tape until right before each glazing unit is installed.

3.5 CLEANING AND PROTECTION

- A. Immediately after installation, remove nonpermanent labels and clean surfaces.
- B. Protect glass from contact with contaminating substances resulting from construction operations. 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.
 - 1. If, despite such protection, contaminating substances do contact with glass, remove substances immediately as recommended in writing by glass manufacturer. Remove and replace glass that cannot be cleaned without damage to coatings.
- C. Remove and replace glass that is damaged during construction period.
- D. Wash glass on both exposed surfaces 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.

3.6 MONOLITHIC GLASS SCHEDULE

- A. Clear Glass Type Fully tempered float glass.
 - 1. Minimum Thickness: 1”
 - 2. Safety glazing required.

3.7 LAMINATED GLASS SCHEDULE

- A. Clear Laminated Glass Type Two plies of fully tempered float glass.
 - 1. Safety glazing required.
- B. Tinted Interlayer Laminated Glass Type Two plies of clear annealed, heat-strengthened, fully tempered float glass and tinted interlayer.

END OF SECTION 088000

SECTION 092216

NON-STRUCTURAL METAL FRAMING

PART 1 - GENERAL

1.1 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.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

1.3 INFORMATIONAL SUBMITTALS

A. Product Certificates: For each type of code-compliance certification for studs and tracks.

1.4 QUALITY ASSURANCE

A. Code-Compliance Certification of Studs and Tracks: Provide documentation that framing members are certified according to the product-certification program of the Certified Steel Stud Association, the Steel Framing Industry Association, the Steel Stud Manufacturers Association or the Supreme Steel Framing System Association.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Notify manufacturer of damaged materials received prior to installation.

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

C. Protect cold-formed metal framing from corrosion, deformation, and other damage during delivery, storage, and handling as required by AISI S202, "Code of Standard Practice for Cold-Formed Steel Structural Framing."

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Horizontal Deflection: For non-composite wall assemblies, limited to 1/360 of the wall height based on horizontal loading of 10 lbf/sq. ft. (480 Pa)
- B. Design framing systems in accordance with AISI S220, "North American Specification for the Design of Cold-Formed Steel Framing - Nonstructural Members," unless otherwise indicated.
- C. Design Loads: minimum 5 lbf/sq. ft. (239 Pa) minimum applied perpendicular to the walls.
- D. Design framing systems to accommodate deflection of primary building structure and construction tolerances and to withstand design load. Deflection shall not exceed 1/240 under the design load.

2.2 FRAMING SYSTEMS

- A. Framing Members, General: Comply with ASTM C645, AISI S220 and ASTM C645, Section 10, AISI S220 for conditions indicated.
 - 1. Steel Sheet Components: Comply with ASTM C645, AISI S220 and ASTM C645, Section 10, AISI S220 requirements for metal unless otherwise indicated
 - 2. Protective Coating: Comply with ASTM C645, AISI S220; ASTM A653/A653M, G40 (Z120); or coating with equivalent corrosion resistance. Galvannealed products are unacceptable.
 - a. Coating demonstrates equivalent corrosion resistance with an evaluation report acceptable to authorities having jurisdiction.
- B. Studs and Track: ASTM C645, AISI S220 and ASTM C645, Section 10, AISI S220.
 - 1. Minimum Base-Steel Thickness: As required by performance requirements for horizontal deflection 0.0329 inch (0.836 mm).
 - 2. Depth: As indicated on Drawings
- C. Slip-Type Head Joints: Where indicated, provide one of the following:
 - 1. Clip System: Clips designed for use in head-of-wall deflection conditions that provide a positive attachment of studs to tracks while allowing 1-1/2-inch (38-mm) minimum vertical movement.
 - 2. Double-Track System: ASTM C645 top outer tracks, inside track with 2-inch- (51-mm-) deep flanges in thickness not less than indicated for studs and fastened to studs, and outer track sized to friction-fit over inner track.
- D. Hat-Shaped, Rigid Furring Channels: ASTM C645.
 - 1. Minimum Base-Steel Thickness: As indicated on Drawings
 - 2. Depth: As indicated on
- E. Resilient Furring Channels: 1/2-inch- (13-mm-) deep, steel sheet members designed to reduce sound transmission.

1. Configuration: hat shaped

2.3 SUSPENSION SYSTEMS

- A. Tie Wire: ASTM A641/A641M, Class 1 zinc coating, soft temper, 0.062-inch- (1.59-mm-) diameter wire, or double strand of 0.048-inch- (1.21-mm-) diameter wire.
- B. Hanger Attachments to Concrete:
 1. Post-Installed Anchors: Fastener systems with an evaluation report acceptable to authorities having jurisdiction, based on ICC-ES [AC01] [AC193] [AC58] [or] [AC308] as appropriate for the substrate.
 - a. Uses: Securing hangers to structure.
 2. Power-Actuated Anchors: Fastener systems with an evaluation report acceptable to authorities having jurisdiction, based on ICC-ES AC70.
- C. Wire Hangers: ASTM A641/A641M, Class 1 zinc coating, soft temper, 0.16 inch (4.12 mm) in diameter.
- D. Flat Hangers: Steel sheet, in size indicated on Drawings
- E. Carrying Channels (Main Runners): Cold-rolled, commercial-steel sheet with a base-steel thickness of 0.0538 inch (1.367 mm) and minimum 1/2-inch- (13-mm-) wide flanges.
 1. Depth: As indicated on Drawings
- F. Furring Channels (Furring Members):
 1. Cold-Rolled Channels: 0.0538-inch (1.367-mm) uncoated-steel thickness, with minimum 1/2-inch- (13-mm-) wide flanges, 3/4 inch (19 mm) deep.
 2. Steel Studs and Tracks: ASTM C645.
 - a. Minimum Base-Steel Thickness: As indicated on Drawings
 - b. Depth: As indicated on Drawings
 3. Resilient Furring Channels: 1/2-inch- (13-mm-) deep members designed to reduce sound transmission.
 - a. Configuration: hat shaped.
- G. Grid Suspension System for Gypsum Board Ceilings: ASTM C645, direct-hung system composed of main beams and cross-furring members that interlock.

PART 3 - EXECUTION

3.1 EXAMINATION

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

3.2 PREPARATION

- A. Suspended Assemblies: Coordinate installation of suspension systems with installation of overhead structure to ensure that inserts and other provisions for anchorages to building structure have been installed to receive hangers at spacing required to support the Work and that hangers will develop their full strength.
 - 1. Furnish concrete inserts and other devices indicated to other trades for installation in advance of time needed for coordination and construction.

3.3 INSTALLATION, GENERAL

- A. Installation Standard: ASTM C754.
 - 1. Gypsum Plaster Assemblies: Also comply with requirements in ASTM C841 that apply to framing installation.
 - 2. Portland Cement Plaster Assemblies: Also comply with requirements in ASTM C1063 that apply to framing installation.
 - 3. Gypsum Veneer Plaster Assemblies: Also comply with requirements in ASTM C844 that apply to framing installation.
 - 4. Gypsum Board Assemblies: Also comply with requirements in ASTM C840 that apply to framing installation.
- B. Install framing and accessories plumb, square, and true to line, with connections securely fastened.
- C. Install supplementary framing, and blocking to support fixtures, equipment services, heavy trim, grab bars, toilet accessories, furnishings, or similar construction.
- D. Install bracing at terminations in assemblies.
- E. Do not bridge building control and expansion joints with non-load-bearing steel framing members. Frame both sides of joints independently.

3.4 INSTALLING FRAMED ASSEMBLIES

- A. Install framing system components according to spacings indicated, but not greater than spacings required by referenced installation standards for assembly types.

1. Single-Layer Application: As required by horizontal deflection performance requirements unless otherwise indicated.
 2. Multilayer Application: As required by horizontal deflection performance requirements unless otherwise indicated.
 3. Tile Backing Panels: As required by horizontal deflection performance requirements unless otherwise indicated.
- B. Where studs are installed directly against exterior masonry walls or dissimilar metals at exterior walls, install isolation strip between studs and exterior wall.
- C. Install studs so flanges within framing system point in same direction.
- D. Install tracks at floors and overhead supports. Extend framing full height to structural supports or substrates above suspended ceilings except where partitions are indicated to terminate at suspended ceilings. Continue framing around ducts that penetrate partitions above ceiling.
1. Slip-Type Head Joints: Where framing extends to overhead structural supports, install to produce joints at tops of framing systems that prevent axial loading of finished assemblies.
 2. Door Openings: Screw vertical studs at jambs to jamb anchor clips on door frames; install track section (for cripple studs) at head and secure to jamb studs.
 - a. Install two studs at each jamb unless otherwise indicated.
 - b. Install cripple studs at head adjacent to each jamb stud, with a minimum 1/2-inch (13-mm) clearance from jamb stud to allow for installation of control joint in finished assembly.
 - c. Extend jamb studs through suspended ceilings and attach to underside of overhead structure.
 3. Other Framed Openings: Frame openings other than door openings the same as required for door openings unless otherwise indicated. Install framing below sills of openings to match framing required above door heads.
 4. Sound-Rated Partitions: Install framing to comply with sound-rated assembly indicated.
- E. 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 (610 mm) o.c.
- F. Installation Tolerance: Install each framing member so fastening surfaces vary not more than 1/8 inch (3 mm) from the plane formed by faces of adjacent framing.

3.5 INSTALLING CEILING SUSPENSION SYSTEMS

- A. Install suspension system components according to spacings indicated, but not greater than spacings required by referenced installation standards for assembly types.
1. Hangers: 48 inches (1219 mm) o.c.

2. Carrying Channels (Main Runners): 48 inches (1219 mm) o.c.
 3. Furring Channels (Furring Members): 16 inches (406 mm) o.c.
- B. Isolate suspension systems from building structure where they abut or are penetrated by building structure to prevent transfer of loading imposed by structural movement.
- C. Suspend 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 suspension system.
 - a. Splay hangers only where required to miss obstructions and offset resulting horizontal forces by bracing, countersplaying, or other equally effective means.
 2. Where width of ducts and other construction within ceiling plenum produces hanger spacings that interfere with locations of hangers required to support standard suspension system members, install supplemental suspension members and hangers in the form of trapezes or equivalent devices.
 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. Flat Hangers: Secure to structure, including intermediate framing members, by attaching to inserts, eye screws, or other devices and fasteners that are secure and appropriate for structure and hanger, and in a manner that will not cause hangers to deteriorate or otherwise fail.
 5. Do not attach hangers to steel roof deck.
 6. Do not attach hangers to permanent metal forms. Furnish cast-in-place hanger inserts that extend through forms.
 7. Do not attach hangers to rolled-in hanger tabs of composite steel floor deck.
 8. Do not connect or suspend steel framing from ducts, pipes, or conduit.
- D. Seismic Bracing: Sway-brace suspension systems with hangers used for support as required.
- E. Grid Suspension Systems: Attach perimeter wall track or angle where grid suspension systems meet vertical surfaces. Mechanically join main beam and cross-furring members to each other and butt-cut to fit into wall track.
- F. Installation Tolerances: Install suspension systems that are level to within 1/8 inch in 12 feet (3 mm in 3.6 m)] measured lengthwise on each member that will receive finishes and transversely between parallel members that will receive finishes.

END OF SECTION 092216

SECTION 092400

CEMENT PLASTERING

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Metal lath.
 - 2. Base-coat cement plaster.
 - 3. Cement plaster finish coats.
 - 4. Accessories.

1.2 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Shop Drawings: Show locations and installation of control and expansion joints, including plans, elevations, sections, details of components, and attachments to other work.
- C. Samples: For each type of factory-prepared finish coat and for each color and texture specified.
- D. Samples for Verification: For each type of factory-prepared finish coat and for each color and texture specified, 12 by 12 inches (305 by 305 mm), and prepared on rigid backing.

1.3 MOCKUPS

- A. Build mockups to verify selections made under Sample submittals, to demonstrate aesthetic effects, and to set quality standards for materials and execution.
 - 1. Build mockups for each substrate and finish texture indicated for cement plastering, including accessories.
 - a. Size: 10 sq. ft. (9 sq. m) in surface area.
 - 2. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.

1.4 DELIVERY, STORAGE AND HANDLING

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

1.5 FIELD CONDITIONS

- A. Comply with ASTM C926 requirements.
- B. Exterior Plasterwork:
 - 1. Apply and cure plaster to prevent plaster drying out during curing period. Use procedures required by climatic conditions, including moist curing, providing coverings, and providing barriers to deflect sunlight and wind.
 - 2. Apply plaster when ambient temperature is greater than 40 deg F (4.4 deg C).
 - 3. Protect plaster coats from freezing for not less than 48 hours after set of plaster coat has occurred.

PART 2 - PRODUCTS

2.1 SOURCE LIMITATIONS

- A. Obtain plaster materials from single source from single manufacturer.

2.2 METAL LATH

- A. Expanded-Metal Lath: ASTM C847, cold-rolled carbon-steel sheet with ASTM A653/A653M, G60 (Z180), hot-dip galvanized-zinc coating.
 - 1. Diamond-Mesh Lath: Self-furring 3.4 lb/sq. yd. (1.8 kg/sq. m).
 - 2. 3/8-Inch (10-mm) Rib Lath: 3.4 lb/sq. yd. (1.8 kg/sq. m)
- B. Paper Backing: FS UU-B-790a, Type I, [Grade D, Style 2 vapor-permeable paper]
 - 1. Provide paper-backed lath at exterior locations

2.3 BASE-COAT CEMENT PLASTER

- A. General: Comply with ASTM C926 for applications indicated.
 - 1. Fiber Content: Add fiber to base-coat mixes after ingredients have mixed at least two minutes. Comply with fiber manufacturer's written instructions for fiber quantities in mixes, but do not exceed 1 lb of fiber/cu. yd. (0.6 kg of fiber/cu. m) of cementitious materials.
- B. Base-Coat Mixes for Use over Metal Lath: Scratch and brown coats for three-coat plasterwork as follows:
 - 1. Portland Cement Mixes:
 - a. Scratch Coat: For cementitious material, mix 1 part portland cement and 3/4 to 1-1/2 parts lime. Use 2-1/2 to 4 parts aggregate per part of cementitious material.

- b. Brown Coat: For cementitious material, mix 1 part portland cement and 3/4 to 1-1/2 parts lime. Use 3 to 5 parts aggregate per part of cementitious material, but not less than volume of aggregate used in scratch coat.
- 2. Portland Cement Mix: For cementitious material, mix 1 part portland cement and 3/4 to 1-1/2 parts lime. Use 2-1/2 to 4 parts aggregate per part of cementitious material.
- 3. Masonry Cement Mix: Use 1 part masonry cement and 2-1/2 to 4 parts aggregate.
- 4. Portland and Masonry Cement Mix: For cementitious material, mix 1 part portland cement and 1 part masonry cement. Use 2-1/2 to 4 parts aggregate per part of cementitious material.
- 5. Plastic Cement Mix: Use 1 part plastic cement and 2-1/2 to 4 parts aggregate.

2.4 CEMENT PLASTER FINISH COATS

A. Job-Mixed Finish-Coat Mixes:

- 1. Portland Cement Mix: For cementitious materials, mix 1 part portland cement and 3/4 to 1-1/2 parts lime. Use 1-1/2 to 3 parts aggregate per part of cementitious material.

2.5 ACCESSORIES

A. General: Comply with ASTM C1063, and coordinate depth of trim and accessories with thicknesses and number of plaster coats required.

B. Metal Accessories:

- 1. Foundation Weep Screenshot: Fabricated from hot-dip galvanized-steel sheet, ASTM A653/A653M, G60 (Z180) zinc coating.
- 2. Cornerite: Fabricated from metal lath with ASTM A653/A653M, G60 (Z180), hot-dip galvanized-zinc coating.
- 3. External- (Outside-) Corner Reinforcement: Fabricated from metal lath with ASTM A653/A653M, G60 (Z180), hot-dip galvanized-zinc coating.
- 4. Cornerbeads: Fabricated from zinc-coated (galvanized) steel
- 5. Casing Beads: Fabricated from [zinc] [zinc-coated (galvanized) steel]; square-edged style; with expanded flanges.
- 6. Control Joints: Fabricated from zinc-coated (galvanized) steel; one-piece-type, folded pair of unperforated screeds in M-shaped configuration; with perforated flanges and removable protective tape on plaster face of control joint.
- 7. Expansion Joints: Fabricated from zinc-coated (galvanized) steel; folded pair of unperforated screeds in M-shaped configuration; with expanded flanges.
- 8. Two-Piece Expansion Joints: Fabricated from zinc-coated (galvanized) steel formed to produce slip-joint and square-edged reveal that is adjustable from 1/4 to 5/8 inch (6 to 16 mm) wide; with perforated flanges.

2.6 PLASTER MATERIALS

A. Cement Plaster: As manufactured by California Stucco, LaHabra, Highland Stucco, or Merlex Stucco, Inc. Furnish formulations requiring only addition of water for installation.

Sand shall pass the No. 20 sieve. Mix and sand shall provide the specified finish. Furnish integral colored stucco in colors as selected by Architect.

- B. Portland Cement: ASTM C150/C150M, Type II.
- C. Lime: ASTM C206, Type S; or ASTM C207, Type S.
- D. Sand Aggregate: ASTM C897.

2.7 MISCELLANEOUS MATERIALS

- A. Water for Mixing and Finishing Plaster: Potable and free of substances capable of affecting plaster set or of damaging plaster, lath, or accessories.
- B. Fiber for Base Coat: Alkaline-resistant glass or polypropylene fibers, 1/2 inch (13 mm) long, free of contaminants, manufactured for use in cement plaster.
- C. Fasteners for Attaching Metal Lath to Substrates: ASTM C1063.
- D. Wire: ASTM A641/A641M, Class 1 zinc coating, soft temper, not less than 0.0475-inch (1.21-mm) diameter unless otherwise indicated.
- E. Acoustical Sealant: As specified in Section 079219 "Acoustical Joint Sealants."

PART 3 - EXECUTION

3.1 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.

3.2 PREPARATION

- A. Protect adjacent work from soiling, spattering, moisture deterioration, and other harmful effects caused by plastering.
- B. Prepare smooth, solid substrates for plaster according to ASTM C926.

3.3 INSTALLATION OF METAL LATH

- A. Metal Lath: Install according to ASTM C1063.

3.4 INSTALLATION OF ACCESSORIES

- A. Install according to ASTM C1063 and at locations indicated on Drawings.
- B. Reinforcement for External (Outside) Corners:
 - 1. Install cornerbead at exterior locations.
- C. Control Joints: Locate as approved by Architect for visual effect and as follows:
 - 1. As required to delineate plasterwork into areas (panels) of the following maximum sizes:
 - a. Vertical Surfaces: 144 sq. ft. (13.4 sq. m).
 - b. Horizontal and Other Nonvertical Surfaces: 100 sq. ft. (9.3 sq. m).
 - 2. At distances between control joints of not greater than 18 feet (5.5 m) o.c.
 - 3. As required to delineate plasterwork into areas (panels) with length-to-width ratios of not greater than 2-1/2:1.
 - 4. Where control joints occur in surface of construction directly behind plaster.
 - 5. Where plasterwork areas change dimensions, to delineate rectangular-shaped areas (panels) and to relieve the stress that occurs at the corner formed by the dimension change.

3.5 APPLICATION OF BASE-COAT CEMENT PLASTER

- A. General: Comply with ASTM C926.
 - 1. Do not deviate more than plus or minus 1/4 inch in 10 feet (6 mm in 3 m) from a true plane in finished plaster surfaces when measured by a 10-foot (3-m) straightedge placed on surface.
 - 2. Finish plaster flush with metal frames and other built-in metal items or accessories that act as a plaster ground unless otherwise indicated. Where casing bead does not terminate plaster at metal frame, cut base coat free from metal frame before plaster sets and groove finish coat at junctures with metal.
- B. Walls; Base-Coat Mixes for Use over Metal Lath: For scratch and brown coats, for three-coat plasterwork with 3/4-inch (19-mm) total thickness, as follows:
 - 1. Portland cement mixes.
- C. Ceilings; Base-Coat Mixes for Use over Metal Lath: For scratch and brown coats, for three-coat plasterwork and having 3/4-inch (19-mm) total thickness for metal lath on concrete, as follows:
 - 1. Portland cement mixes.
- D. Ceilings; Base-Coat Mix: For base (scratch) coat, for two-coat plasterwork and having 1/4-inch (6-mm) thickness on concrete, as follows:
 - 1. Portland cement mix.

3.6 APPLICATION OF CEMENT PLASTER FINISH COATS

- A. Plaster Finish Coats: Apply to provide steel trowel finish to match Architect's sample.
- B. Acrylic-Based Finish Coatings: Apply coating system, including primers, finish coats, and sealing topcoats, according to manufacturer's written instructions.
- C. Concealed Exterior Plasterwork: Where plaster application is used as a base for adhered finishes, omit finish coat.

3.7 REPAIR

- A. Repair or replace work to eliminate cracks, dents, blisters, buckles, crazing and check cracking, dry outs, efflorescence, sweat outs, and similar defects and where bond to substrate has failed.

3.8 CLEANING

- A. Remove temporary protection and enclosure of other work after plastering is complete.
- B. Promptly remove plaster from door frames, windows, and other surfaces not indicated to be plastered.
- C. Repair floors, walls, and other surfaces stained, marred, or otherwise damaged during plastering.

END OF SECTION 092400

SECTION 092900
GYPSUM BOARD

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Interior gypsum board.

B. Related Requirements:

1. Section 061600 "Sheathing" for gypsum sheathing for exterior walls..
2. Section 092216 "Non-Structural Metal Framing" for non-structural steel framing and suspension systems that support gypsum board panels.

1.2 ACTION SUBMITTALS

A. Product Data: For the following:

1. Gypsum wallboard.
2. Abuse-resistant gypsum board.
3. Mold-resistant gypsum board.
4. Glass-mat gypsum sheathing board.
5. Interior trim.
6. Exterior trim.
7. Joint treatment materials.
8. Acoustical sealant.

B. Shop Drawings: Show locations and installation of control and expansion joints, including plans, elevations, sections, details of components, and attachments to other work.

1. Trim Accessories: Full-size Sample in 12-inch- (300-mm-) long length for each trim accessory indicated.

1.3 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.

1.4 FIELD CONDITIONS

- A. Environmental Limitations: Comply with ASTM C840 requirements or gypsum board manufacturer's written instructions, 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, 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.

PART 2 - PRODUCTS

2.1 SOURCE LIMITATIONS

- A. Obtain each type of gypsum panel and joint finishing material from single source with resources to provide products of consistent quality in appearance and physical properties.

2.2 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.

2.3 INTERIOR GYPSUM BOARD

- A. Gypsum Wallboard: ASTM C1396/C1396M.
 - 1. Thickness: 5/8 inch (15.9 mm).
 - 2. Long Edges: Tapered
- B. Gypsum Board, Type X: ASTM C1396/C1396M.
 - 1. Thickness: 5/8 inch (15.9 mm).
 - 2. Long Edges: Tapered
- C. Abuse-Resistant Gypsum Board: ASTM C1396/C1396M gypsum board, tested according to ASTM C1629/C1629M.
- D. Mold-Resistant Gypsum Board: ASTM C1396/C1396M. With moisture- and mold-resistant core and paper surfaces.
 - 1. Core: 5/8 inch (15.9 mm)
 - 2. Long Edges: Tapered.
 - 3. Mold Resistance: ASTM D3273, score of 10 as rated according to ASTM D3274.

2.4 TRIM ACCESSORIES

A. Interior Trim: ASTM C1047.

1. Material: Galvanized.
2. Shapes:
 - a. Cornerbead.
 - b. Bullnose bead.
 - c. LC-Bead: J-shaped; exposed long flange receives joint compound.
 - d. L-Bead: L-shaped; exposed long flange receives joint compound.
 - e. U-Bead: J-shaped; exposed short flange does not receive joint compound.
 - f. Expansion (control) joint.
 - g. Curved-Edge Cornerbead: With notched or flexible flanges.
 - h. Base-of-Wall Galvanized Moisture Barrier Trim: Galvanized-steel sheet, 2 inches (50 mm) high.

B. Exterior Trim: ASTM C1047.

1. Material: Hot-dip galvanized-steel sheet
2. Shapes:
 - a. Cornerbead.
 - b. LC-Bead: J-shaped; exposed long flange receives joint compound.
 - c. Expansion (Control) Joint: One-piece, rolled zinc with V-shaped slot and removable strip covering slot opening.

2.5 JOINT TREATMENT MATERIALS

A. General: Comply with ASTM C475/C475M.

B. Joint Tape:

1. Interior Gypsum Board: Paper.
2. Exterior Gypsum Soffit Board: Paper.
3. Glass-Mat Gypsum Sheathing Board: 10-by-10 glass mesh.
4. Tile Backing Panels: As recommended by panel manufacturer.

C. Joint Compound for Interior Gypsum Board: For each coat, use formulation that is compatible with other compounds applied on previous or for successive coats.

1. Prefilling: At open joints, rounded , and damaged surface areas, use setting-type taping compound.
2. Embedding and First Coat: For embedding tape and first coat on joints, fasteners, and trim flanges, use setting-type taping compound.
 - a. Use setting-type compound for installing paper-faced metal trim accessories.
3. Fill Coat: For second coat, use all-purpose compound.
4. Finish Coat: For third coat, use all-purpose compound.

5. Skim Coat: For final coat of Level 5 finish, use high-build interior coating product designed for application by airless sprayer and to be used instead of skim coat to produce Level 5 finish.

D. Joint Compound for Exterior Applications:

1. Glass-Mat Gypsum Sheathing Board: As recommended by sheathing board manufacturer.

E. Joint Compound for Tile Backing Panels:

1. Cementitious Backer Units: As recommended by backer unit manufacturer.

2.6 AUXILIARY MATERIALS

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

B. Steel Drill Screws: ASTM C1002 unless otherwise indicated.

1. Use screws complying with ASTM C954 for fastening panels to steel members from 0.033 to 0.112 inch (0.84 to 2.84 mm) thick.

C. Thermal Insulation: As specified in Section 072100 "Thermal Insulation."

D. Vapor Retarder: As specified in Section 072500 "Weather Barriers."

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine areas and substrates including welded hollow-metal frames and support framing, with Installer present, for compliance with requirements and other conditions affecting performance of the Work.

- B. Examine panels before installation. Reject panels that are wet, moisture damaged, and mold damaged.

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

3.2 INSTALLATION AND FINISHING OF PANELS, GENERAL

- A. Comply with ASTM C840.

- 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 (1.5 mm) 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. (0.7 sq. m) 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- (6.4- to 9.5-mm-) wide joints to install sealant.
- G. Isolate perimeter of gypsum board applied to non-load-bearing partitions at structural abutments. Provide 1/4- to 1/2-inch- (6.4- to 12.7-mm-) 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 C919 and with manufacturer's written instructions 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.

3.3 INSTALLATION OF INTERIOR GYPSUM BOARD

- A. Install interior gypsum board in the following locations:
 - 1. Wallboard Type: Vertical surfaces unless otherwise indicated.
 - 2. Ceiling Type: Ceiling surfaces.
 - 3. Abuse-Resistant Type: MPR 10' from finish floor
 - 4. Mold-Resistant Type: Restroom
- 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) 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.

3.4 INSTALLATION OF TILE BACKING PANELS

- A. Cementitious Backer Units: ANSI A108.11, at locations indicated to receive tile.
- B. Where tile backing panels abut other types of panels in same plane, shim surfaces to produce a uniform plane across panel surfaces.

3.5 INSTALLATION OF 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 C840 and in specific locations approved by Architect for visual effect.
- C. Interior Trim: Install in the following locations:
 1. Cornerbead: Use at outside corners unless otherwise indicated.
 2. Bullnose Bead: Use at outside corners
 3. LC-Bead: Use at exposed panel edges
 4. L-Bead: Use where indicated on Drawings
 5. U-Bead: Use at exposed panel edges

3.6 FINISHING OF 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, rounded or beveled edges, 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 C840:

1. Level 1: Ceiling plenum areas, concealed areas, and where indicated.
 2. Level 2: Panels that are substrate for tile, Panels that are substrate for acoustical tile
 3. Level 3: Where indicated on Drawings
 4. Level 4: Where indicated on Drawings
 - a. Primer and its application to surfaces are specified in Section 099123 "Interior Painting."
 5. Level 5: At panel surfaces that will be exposed to view unless otherwise indicated
 - a. Primer and its application to surfaces are specified in Section 099123 "Interior Painting."
- E. Cementitious Backer Units: Finish according to manufacturer's written instructions.

3.7 APPLICATION OF TEXTURE FINISHES

- A. Surface Preparation and Primer: Prepare and apply primer to gypsum panels and other surfaces receiving texture finishes. Apply primer to surfaces that are clean, dry, and smooth.

3.8 PROTECTION

- A. Protect adjacent surfaces from drywall compound and promptly remove from floors and other non-drywall surfaces. Repair surfaces stained, marred, or otherwise damaged during drywall application.
- B. Protect installed products from damage from weather, condensation, direct sunlight, construction, and other causes during remainder of the construction period.
- C. 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 092900

SECTION 095123

ACOUSTICAL TILE CEILINGS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Acoustical tiles for interior ceilings.
2. Fully concealed, direct-hung, suspension systems.

B. Products furnished, but not installed under this Section, include anchors, clips, and other ceiling attachment devices to be cast in concrete.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Samples: For each exposed product and for each color and texture specified, 6 inches (150 mm) in size.

C. Samples for Initial Selection: For components with factory-applied finishes.

D. Samples for Verification: For each component indicated and for each exposed finish required, prepared on Samples of sizes indicated below:

1. Acoustical Tiles: Set of full-size Samples of each type, color, pattern, and texture.
2. Concealed Suspension-System Members: 6-inch- (150-mm-) long Sample of each type.

1.3 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Reflected ceiling plans, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of the items involved:

1. Ceiling suspension-system members.
2. Structural members to which suspension systems will be attached.
3. Method of attaching hangers to building structure.
4. Carrying channels or other supplemental support for hanger-wire attachment where conditions do not permit installation of hanger wires at required spacing.
5. Size and location of initial access modules for acoustical tile.
6. Items penetrating finished ceiling and ceiling-mounted items including the following:
 - a. Lighting fixtures.
 - b. Diffusers.
 - c. Grilles.

- d. Speakers.
 - e. Sprinklers.
 - f. Access panels.
7. Minimum Drawing Scale: 1/4 inch = 1 foot (1:48)

1.4 CLOSEOUT SUBMITTALS

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

1.5 MAINTENANCE MATERIAL SUBMITTALS

- A. Furnish extra materials from the same product run that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 - 1. Acoustical Ceiling Units: Full-size tiles
 - 2. Suspension-System Components: Quantity of each concealed grid and exposed component

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Deliver acoustical tiles, suspension-system components, and accessories to Project site 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 tiles, permit them to reach room temperature and a stabilized moisture content.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Source Limitations:
 - 1. Suspended Acoustical Tile Ceilings: Obtain each type of acoustical ceiling tile and its suspension system from single source from single manufacturer.
 - 2. Directly Attached Acoustical Tile Ceilings: Obtain each type of acoustical ceiling tile from single source from single manufacturer.
- B. Acceptable Manufactures
 - 1. USG Corporation
 - 2. Armstrong World Industries
 - 3. Celotex Corporation

2.2 PERFORMANCE REQUIREMENTS

- A. Seismic Performance: Suspended ceilings shall withstand the effects of earthquake motions determined according to ASCE/SEI 7
- B. Surface-Burning Characteristics: Comply with ASTM E84; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.
 - 1. Flame-Spread Index: Class A according to ASTM E1264.
 - 2. Smoke-Developed Index: 50 or less.

2.3 ACOUSTICAL TILES

- A. Acoustical Tile Standard: Provide manufacturer's standard tiles of configuration indicated that comply with ASTM E1264 classifications as designated by type, form, pattern, acoustical rating, and light reflectance unless otherwise indicated.
- B. Color: White
- C. Light Reflectance (LR): Not less than 0.80
- D. Ceiling Attenuation Class (CAC): Not less than 30
- E. Noise Reduction Coefficient (NRC): Not less than 0.50
- F. Edge/Joint Detail: As indicated by manufacturer's designation
- G. Thickness: 5/8 inch (15 mm)
- H. Modular Size: As indicated on Drawings
- I. Antimicrobial Treatment: Manufacturer's standard broad spectrum, 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, ASTM D3274, or ASTM G21 and evaluated according to ASTM D3274 or ASTM G21.
- J. Label/mark ceiling panels where valves, dampers, equipment, V.A.V boxes, etc., are located above. Provide the label, colored dot, or other demarcation located on the T-bar grid for approval

2.4 METAL SUSPENSION SYSTEM

- A. Metal Suspension-System Standard: Provide manufacturer's standard, direct-hung, fully concealed, metal suspension system and accessories of type, structural classification, and finish indicated that complies with applicable requirements in ASTM C635/C635M.
 - 1. Structural Classification: Heavy-duty system.
 - a. Chicago Metallic
 - b. USG Interior Systems (Donn)
 - c. Armstrong Ceiling System (Donn)

2.5 ACCESSORIES

- A. Attachment Devices: Size for five times the design load indicated in ASTM C635/C635M, Table 1, "Direct Hung," unless otherwise indicated. Comply with seismic design requirements.
1. Anchors in Concrete: Anchors of type and material indicated below, with holes or loops for attaching hangers of type indicated and with capability to sustain, without failure, a load equal to five times that imposed by ceiling construction, as determined by testing according to ASTM E488/E488M or ASTM E1512 as applicable, conducted by a qualified testing and inspecting agency.
 - a. Type: Cast-in-place anchors.
 - b. Corrosion Protection: Carbon-steel components zinc plated according to ASTM B633, Class SC 1 (mild) service condition.
 - c. Corrosion Protection: Stainless-steel components complying with ASTM F593 and ASTM F594, Group 1 Alloy 304 or 316.
 2. Power-Actuated Fasteners in Concrete: Fastener system of type suitable for application indicated, fabricated from corrosion-resistant materials, with clips or other accessory devices for attaching hangers of type indicated, and with capability to sustain, without failure, a load equal to 10 times that imposed by ceiling construction, as determined by testing according to ASTM E1190, conducted by a qualified testing and inspecting agency.
- B. Wire Hangers, Braces, and Ties: Provide wires as follows:
1. Zinc-Coated, Carbon-Steel Wire: ASTM A641/A641M, Class 1 zinc coating, soft temper.
 2. Size: Wire diameter sufficient for its stress at three times hanger design load (ASTM C635/C635M, Table 1, "Direct Hung") will be less than yield stress of wire, but not less than 12 gage
- C. Hanger Rods: Mild steel, zinc coated or protected with rust-inhibitive paint.
- D. Flat Hangers: Mild steel, zinc coated or protected with rust-inhibitive paint.
- E. Angle Hangers: Angles with legs not less than 7/8 inch (22 mm) wide; formed with 0.04-inch- (1-mm-) thick, galvanized-steel sheet complying with ASTM A653/A653M, G90 (Z275) coating designation; with bolted connections and 5/16-inch- (8-mm-) diameter bolts.
- F. Seismic Stabilizer Bars: Manufacturer's standard perimeter stabilizers designed to accommodate seismic forces.
- G. Seismic Struts: Manufacturer's standard compression struts designed to accommodate lateral forces.
- H. Seismic Clips: Manufacturer's standard seismic clips designed to secure acoustical tiles in-place during a seismic event.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates, areas, and conditions, including structural framing and substrates to which acoustical tile ceilings attach or abut, with Installer present, for compliance with requirements specified in this and other Sections that affect ceiling installation and anchorage and for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
- B. Examine acoustical tiles before installation. Reject acoustical tiles that are wet, moisture damaged, or mold damaged.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Measure each ceiling area and establish layout of acoustical tiles to balance border widths at opposite edges of each ceiling. Avoid using less-than-half-width tiles at borders unless otherwise indicated, and comply with layout shown on reflected ceiling plans.
- B. Layout openings for penetrations centered on the penetrating items.

3.3 INSTALLATION OF SUSPENDED ACOUSTICAL TILE CEILINGS

- A. Install suspended acoustical tile ceilings according to ASTM C636/C636M, seismic design requirements, and manufacturer's written instructions.
- 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. 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.
 - 3. Secure wire hangers to ceiling suspension members and to supports above with a minimum of three tight turns. Connect hangers directly to structure 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.
 - 4. Secure flat, angle, channel, and rod hangers to structure, including intermediate framing members, by attaching to inserts, eye screws, or other devices that are secure and appropriate for both the structure to which hangers are attached and the type of hanger involved. Install hangers in a manner that will not cause them to deteriorate or 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, postinstalled 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 (1200 mm) o.c. along each member supported directly from hangers unless otherwise indicated; provide hangers not more than 8 inches (200 mm) from ends of each member.
 10. Size supplemental suspension members and hangers to support ceiling loads within performance limits established by referenced standards.
- 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 postinstalled anchors.
- D. Install edge moldings and trim of type indicated at perimeter of acoustical ceiling area and where necessary to conceal edges of acoustical tiles.
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 (400 mm) o.c. and not more than 3 inches (75 mm) from ends. 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 tiles in coordination with suspension system and exposed moldings and trim. Place splines or suspension-system flanges into kerfed edges of tiles so tile-to-tile joints are interlocked.
1. Fit adjoining tiles to form flush, tight joints. Scribe and cut tiles for accurate fit at borders and around penetrations through ceiling.
 2. Hold tile field in compression by inserting leaf-type, spring-steel spacers between tiles and moldings, spaced 12 inches (305 mm) o.c.

3.4 INSTALLATION OF DIRECTLY ATTACHED ACOUSTICAL TILE CEILINGS

- A. Install edge moldings and trim of type indicated at perimeter of acoustical tile ceiling area and where necessary to conceal edges of acoustical units.

3.5 ERECTION TOLERANCES

- A. Suspended Ceilings: Install main and cross runners level to a tolerance of 1/8 inch in 12 feet (3 mm in 3.6 m) , non-cumulative.
- B. Moldings and Trim: Install moldings and trim to substrate and level with ceiling suspension system to a tolerance of 1/8 inch in 12 feet (3 mm in 3.6 m), non-cumulative.

3.6 FIELD QUALITY CONTROL

- A. Acoustical tile ceiling hangers, anchors, and fasteners will be considered defective if they do not pass tests and inspections.

3.7 ADJUSTING

- A. Clean exposed surfaces of acoustical tile ceilings, including trim and edge moldings. Comply with manufacturer's written instructions for cleaning and touchup of minor finish damage.
- B. Remove and replace tiles and other ceiling components that cannot be successfully cleaned and repaired to permanently eliminate evidence of damage.

END OF SECTION 095123

SECTION 096813

TILE CARPETING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Modular carpet tile.

B. Related Requirements:

1. Section 024119 "Selective Demolition" for removing existing floor coverings.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Include manufacturer's written data on physical characteristics, durability, and fade resistance.
2. Include manufacturer's written installation recommendations for each type of substrate.

B. Samples: For each of the following products and for each color and texture required. Label each Sample with manufacturer's name, material description, color, pattern, and designation indicated on Drawings and in schedules.

1. Carpet Tile: Full-size Sample.
2. Exposed Edge, Transition, and Other Accessory Stripping: 12-inch- (300-mm-) long Samples.

C. Certificate: Submit a certificate from carpet manufacturer that materials supplied comply with fire hazard resistance standards specified.

1.3 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Installer.

B. Product Test Reports: For carpet tile, for tests performed by a qualified testing agency.

1.4 CLOSEOUT SUBMITTALS

A. Maintenance Data: For carpet tiles to include in maintenance manuals. Include the following:

1. Methods for maintaining carpet tile, including cleaning and stain-removal products and procedures and manufacturer's recommended maintenance schedule.
2. Precautions for cleaning materials and methods that could be detrimental to carpet tile.

1.5 QUALITY ASSURANCE

- A. Installer Qualifications: An experienced installer who is certified by the International Certified Floorcovering Installers Association at the Commercial II certification level.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Comply with the Carpet and Rug Institute's CRI 104.

1.7 FIELD CONDITIONS

- A. Comply with the Carpet and Rug Institute's CRI 104 for temperature, humidity, and ventilation limitations.
- B. Environmental Limitations: Do not deliver or install carpet tiles until spaces are enclosed and weathertight, wet-work in spaces is complete and dry, and ambient temperature and humidity conditions are maintained at levels planned for building occupants during the remainder of the construction period.
- C. Do not install carpet tiles over concrete slabs until slabs have cured and are sufficiently dry to bond with adhesive and concrete slabs have pH range recommended by carpet tile manufacturer.
- D. Where demountable partitions or other items are indicated for installation on top of carpet tiles, install carpet tiles before installing these items.
- E. Code Compliance: CBC Section 11B-302.2
 1. Carpet shall be securely attached and shall have a firm cushion, pad, or backing or no cushion or pad. It shall have a level loop, textured loop, level cut pile, or level cut/uncut pile texture. Pile height shall be ½" maximum.
 2. Exposed edges shall be fastened to floor surfaces and shall have trim on the entire length. Carpet edges shall comply with CBC Section 11B-303.

1.8 WARRANTY

- A. Special Warranty for Carpet Tiles: Manufacturer agrees to repair or replace components of carpet tile installation that fail in materials or workmanship within specified warranty period.
 1. Warranty does not include deterioration or failure of carpet tile due to unusual traffic, failure of substrate, vandalism, or abuse.
 2. Failures include, but are not limited to, the following:

- a. More than 10 percent edge raveling, snags, and runs.
 - b. Dimensional instability.
 - c. Excess static discharge.
 - d. Loss of tuft-bind strength.
 - e. Loss of face fiber.
 - f. Delamination.
3. Manufacturer Warranty Period: 10 years from date of Substantial Completion.
 4. Installer shall provide a 2 year labor warranty.

PART 2 - PRODUCTS

2.1 CARPET TILE

- A. Manufacturer
Mohawk Group – 955 Denim Quickship Available OR EQUAL
- B. Pattern: Repeat
- C. Fiber Type: Duracolor Tricolor Premium Nylon
- D. Pile Thickness: 0.110”
- E. Gage: 1/12”
- F. Tufted Pile Weight: 28 oz/yd²
- G. Primary Backing/Backcoating: Manufacturer's standard composite materials
- H. Size: 18 by 18.4 inches
- I. Applied Treatments:
 1. Soil-Resistance Treatment: Manufacturer's standard treatment
 2. Antimicrobial Treatment: Manufacturer's standard treatment that protects carpet tiles as follows:
 - a. Antimicrobial Activity: Not less than 2-mm halo of inhibition for gram-positive bacteria, not less than 1-mm halo of inhibition for gram-negative bacteria, and no fungal growth, according to AATCC 174.
- J. Performance Characteristics:
 1. Appearance Retention Rating: Heavy traffic, 3.0 minimum according to ASTM D7330.
 2. Dry Breaking Strength: Not less than 100 lbf (445 N) according to ASTM D2646.
 3. Electrostatic Propensity: Less than 3.5 kV according to AATCC 134.

2.2 INSTALLATION ACCESSORIES

- A. Trowelable Leveling and Patching Compounds: Per recommenddation by carpet tile manufacturer.
- B. Adhesives: Water-resistant, mildew-resistant, nonstaining, pressure-sensitive type to suit products and subfloor conditions indicated, that comply with flammability requirements for installed carpet tile, and are recommended by carpet tile manufacturer for releasable installation.
- C. Metal Edge/Transition Strips: Extruded aluminum with mill finish of profile and width shown, of height required to protect exposed edge of carpet, and of maximum lengths to minimize running joints.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for maximum moisture content, alkalinity range, installation tolerances, and other conditions affecting carpet tile performance.
- B. Examine carpet tile for type, color, pattern, and potential defects.
- C. Concrete Slabs: Verify that finishes comply with requirements specified in Section 033000 "Cast-in-Place Concrete" and that surfaces are free of cracks, ridges, depressions, scale, and foreign deposits.
 - 1. Moisture Testing: Perform tests so that each test area does not exceed 200 sq. ft. (18.6 sq. m) and perform no fewer than three tests in each installation area and with test areas evenly spaced in installation areas.
 - a. Anhydrous Calcium Chloride Test: ASTM F1869. Proceed with installation only after substrates have maximum moisture-vapor-emission rate of 3 lb of water/1000 sq. ft. (1.36 kg of water/92.9 sq. m) in 24 hours.
 - b. Relative Humidity Test: Using in situ probes, ASTM F2170. Proceed with installation only after substrates have a maximum 75 percent relative humidity level measurement.
 - c. Perform additional moisture tests recommended in writing by adhesive and carpet tile manufacturers. Proceed with installation only after substrates pass testing.
- D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. General: Comply with the Carpet and Rug Institute's CRI 104 and with carpet tile manufacturer's written installation instructions for preparing substrates indicated to receive carpet tile.

- B. Use trowelable leveling and patching compounds, according to manufacturer's written instructions, to fill cracks, holes, depressions, and protrusions in substrates. Fill or level cracks, holes and depressions 1/8 inch (3 mm) wide or wider, and protrusions more than 1/32 inch (0.8 mm) unless more stringent requirements are required by manufacturer's written instructions.
- C. Concrete Substrates: Remove coatings, including curing compounds, and other substances that are incompatible with adhesives and that contain soap, wax, oil, or silicone, without using solvents. Use mechanical methods recommended in writing by adhesive and carpet tile manufacturers.
- D. Metal Substrates: Clean grease, oil, soil and rust, and prime if recommended in writing by adhesive manufacturer. Rough sand painted metal surfaces and remove loose paint. Sand aluminum surfaces, to remove metal oxides, immediately before applying adhesive.
- E. Broom and vacuum clean substrates to be covered immediately before installing carpet tile.

3.3 INSTALLATION

- A. General: Comply with the Carpet and Rug Institute's CRI 104, Section 10, "Carpet Tile," and with carpet tile manufacturer's written installation instructions.
- B. Installation Method: As recommended in writing by carpet tile manufacturer
- C. Maintain dye-lot integrity. Do not mix dye lots in same area.
- D. Cut and fit carpet tile to butt tightly to vertical surfaces, permanent fixtures, and built-in furniture including cabinets, pipes, outlets, edgings, thresholds, and nosings. Bind or seal cut edges as recommended by carpet tile manufacturer.
- E. Extend carpet tile into toe spaces, door reveals, closets, open-bottomed obstructions, removable flanges, alcoves, and similar openings.
- F. Maintain reference markers, holes, and openings that are in place or marked for future cutting by repeating on carpet tile as marked on subfloor. Use nonpermanent, nonstaining marking device.
- G. Install pattern parallel to walls and borders.

3.4 CLEANING AND PROTECTION

- A. Perform the following operations immediately after installing carpet tile:
 - 1. Remove excess adhesive and other surface blemishes using cleaner recommended by carpet tile manufacturer.
 - 2. Remove yarns that protrude from carpet tile surface.
 - 3. Vacuum carpet tile using commercial machine with face-beater element.
- B. Protect installed carpet tile to comply with the Carpet and Rug Institute's CRI 104, Section 13.7.

- C. Protect carpet tile against damage from construction operations and placement of equipment and fixtures during the remainder of construction period. Use protection methods indicated or recommended in writing by carpet tile manufacturer.

END OF SECTION 096813

SECTION 099100

PAINTING AND COATINGS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

1.2 SUMMARY

A. Section Includes:

1. Primers.
2. Finish coatings.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Include preparation requirements and application instructions.
2. Indicate VOC content.

B. Samples: For each type of topcoat product.

1. Submit Samples on rigid backing, 8 inches (200 mm) square.
2. Apply coats on Samples in steps to show each coat required for system.
3. Label each coat of each Sample.
4. Label each Sample for location and application area.

C. Product Schedule: Use same designations indicated on Drawings and in the Exterior Painting Schedule to cross-reference paint systems specified in this Section. Include color designations.

1.4 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. Paint Products: 5 percent, but not less than 1 gal. (3.8 L) of each material and color applied.

1.5 QUALITY ASSURANCE

A. Mockups: Apply mockups of each paint system indicated and each color and finish selected to verify selections made under Sample submittals, to demonstrate aesthetic effects, and to set quality standards for materials and execution.

1. Architect will select one surface to represent surfaces and conditions for application of each paint system.
 - a. Vertical and Horizontal Surfaces: Provide samples of at least 100 sq. ft. (9 sq. m).
 - b. Other Items: Architect will designate items or areas required.
2. Final approval of color selections will be based on mockups.
 - a. If preliminary color selections are not approved, apply additional mockups of additional colors selected by Architect at no added cost to Owner.
3. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.
4. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Store materials not in use in tightly covered containers in well-ventilated areas with ambient temperatures continuously maintained at not less than 45 deg F (7 deg C).
 1. Maintain containers in clean condition, free of foreign materials and residue.
 2. Remove rags and waste from storage areas daily.

1.7 FIELD CONDITIONS

- A. Apply paints only when temperature of surfaces to be painted and ambient air temperatures are between 50 and 95 deg F (10 and 35 deg C).
- B. Do not apply paints in snow, rain, fog, or mist; when relative humidity exceeds 85 percent; at temperatures less than 5 deg F (3 deg C) above the dew point; or to damp or wet surfaces.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Acceptable Manufacturers:
 - a. Vista Frazee
 - b. Dunn Edwards
- B. Source Limitations: Obtain each paint product from single source from single manufacturer.

2.2 PAINT PRODUCTS, GENERAL

- A. Material Compatibility:

1. Provide materials for use within each paint system that are compatible with one another and substrates indicated, under conditions of service and application as demonstrated by manufacturer based on testing and field experience.
2. For each coat in a paint system, provide products recommended in writing by topcoat manufacturer for use in paint system and on substrate indicated.

B. Colors: As selected by Architect from manufacturer's full range

2.3 PRIMERS

- A. Exterior, Alkali-Resistant, Water-Based Primer: Pigmented, water-based primer formulated for use on alkaline surfaces, such as exterior plaster, vertical concrete, and masonry.
- B. Water-Based Bonding Primer: Pigmented, water-based-emulsion primer formulated for exterior use and to promote adhesion of subsequent specified coatings.
- C. Solvent-Based Bonding Primer: Pigmented, solvent-based primer formulated for exterior use and to seal substrates and promote adhesion of specified subsequent coatings.
- D. Water-Based, Galvanized-Metal Primer: Corrosion-resistant, pigmented, acrylic primer; formulated for use on cleaned/etched, exterior, galvanized metal to prepare it for subsequent water-based coatings.
- E. Interior, Institutional Low-Odor/VOC Primer Sealer: Water-based primer sealer with low-odor characteristics and a VOC of less than 10 grams per liter for use on new interior plaster, concrete, and gypsum wallboard surfaces that are subsequently to be painted with latex finish coats.
- F. Interior Latex Primer for Wood: Waterborne-emulsion primer formulated for resistance to extractive bleeding, mold, and microbials; for hiding stains; and for use on interior wood subject to extractive bleeding.

2.4 FINISH COATINGS

- A. Exterior:
 1. Plaster and Stucco: 2 coats
 - a. 100% Semi-gloss acrylic paint
 2. Metal: 3 coats. Shall be cleaned and pre-treated.
 - a. First Coat: Factory prime or As specified in this Section under Primers
 - b. Second and Third Coats: Exterior Semi-gloss acrylic
- B. Interior:
 1. Gypsum Board Walls: 4 coats
 - a. First Coat: Drywall sealer
 - b. Second Coat: Enamel undercoater
 - c. Third and Fourth: semi-gloss acrylic paint
 2. Wood Doors: 4 coats
 - a. As specified in this section under Primers
 - b. Second, Third, and Fourth Coats: Varnish, gloss

3. Metal: 3 coats. Shall be cleaned and pre-treated.
 - a. First Coat: Metal primer
 - b. Second and Third Coats: Interior gloss enamel, except metal door frame which shall be semi-gloss or gloss to match adjacent wall

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates and conditions, with Applicator present, for compliance with requirements for maximum moisture content and other conditions affecting performance of the Work.
- B. Maximum Moisture Content of Substrates: When measured with an electronic moisture meter as follows:
 1. Concrete: 12 percent.
 2. Masonry (Clay and Concrete Masonry Units): 12 percent.
 3. Wood: 15 percent.
 4. Portland Cement Plaster: 12 percent.
 5. Gypsum Board: 12 percent.
- C. Portland Cement Plaster Substrates: Verify that plaster is fully cured.
- D. Exterior Gypsum Board Substrates: Verify that finishing compound is dry and sanded smooth.
- E. Verify suitability of substrates, including surface conditions and compatibility, with finishes and primers.
- F. Proceed with coating application only after unsatisfactory conditions have been corrected.
 1. Application of coating indicates acceptance of surfaces and conditions.

3.2 PREPARATION

- A. Comply with manufacturer's written instructions applicable to substrates and paint systems indicated.
- B. Remove hardware, covers, plates, and similar items already in place that are removable and are not to be painted. If removal is impractical or impossible because of size or weight of item, provide surface-applied protection before surface preparation and painting.
 1. After completing painting operations, use workers skilled in the trades involved to reinstall items that were removed. Remove surface-applied protection.
- C. Clean substrates of substances that could impair bond of paints, including dust, dirt, oil, grease, and incompatible paints and encapsulants.
 1. Remove incompatible primers and reprime substrate with compatible primers or apply tie coat as required to produce paint systems specified in this Section.

- D. Concrete Substrates: Remove release agents, curing compounds, efflorescence, and chalk. Do not paint surfaces if moisture content or alkalinity of surfaces to be painted exceeds that permitted in manufacturer's written instructions.
- E. Steel Substrates: Remove rust, loose mill scale, and shop primer if any. Clean using methods recommended in writing by paint manufacturer
- F. Shop-Primed Steel Substrates: Clean field welds, bolted connections, and areas where shop paint is abraded. Paint exposed areas with the same material as used for shop priming to comply with SSPC-PA 1 for touching up shop-primed surfaces.
- G. Galvanized-Metal Substrates: Remove grease and oil residue from galvanized sheet metal by mechanical methods to produce clean, lightly etched surfaces that promote adhesion of subsequently applied paints.
 - 1. Scrape and clean knots. Before applying primer, apply coat of knot sealer recommended in writing by topcoat manufacturer for exterior use in paint system indicated.
 - 2. Sand surfaces that will be exposed to view, and remove sanding dust.
 - 3. Prime edges, ends, faces, undersides, and backsides of wood.
 - 4. After priming, fill holes and imperfections in the finish surfaces with putty or plastic wood filler. Sand smooth when dried.
- H. Plastic Trim Fabrication Substrates: Remove dust, dirt, and other foreign material that might impair bond of paints to substrates.

3.3 INSTALLATION

- A. Apply paints in accordance with manufacturer's written instructions.
 - 1. Use applicators and techniques suited for paint and substrate indicated.
 - 2. Paint surfaces behind movable items same as similar exposed surfaces. Before final installation, paint surfaces behind permanently fixed items with prime coat only.
 - 3. Do not paint over labels of independent testing agencies or equipment name, identification, performance rating, or nomenclature plates.
 - 4. Primers specified in the Exterior Painting Schedule may be omitted on items that are factory primed or factory finished if compatible with intermediate and topcoat coatings and acceptable to intermediate and topcoat paint manufacturers.
- B. If undercoats or other conditions show through topcoat, apply additional coats until cured film has a uniform paint finish, color, and appearance.
- C. Apply paints to produce surface films without cloudiness, spotting, holidays, laps, brush marks, roller tracking, runs, sags, ropiness, or other surface imperfections. Cut in sharp lines and color breaks.

3.4 FIELD QUALITY CONTROL

- A. Dry Film Thickness Testing: Owner may engage the services of a qualified testing and inspecting agency to inspect and test paint for dry film thickness.

1. Contractor shall touch up and restore painted surfaces damaged by testing.
2. If test results show that dry film thickness of applied paint does not comply with paint manufacturer's written instructions, Contractor shall pay for testing and apply additional coats as needed to provide dry film thickness that complies with paint manufacturer's written instructions.

3.5 CLEANING AND PROTECTION

- A. At end of each workday, remove rubbish, empty cans, rags, and other discarded materials from Project site.
 1. Do not clean equipment with free-draining water and prevent solvents, thinners, cleaners, and other contaminants from entering into waterways, sanitary and storm drain systems, and ground.
 2. Dispose of contaminants in accordance with requirements of authorities having jurisdiction.
 3. Allow empty paint cans to dry before disposal.
 4. Collect waste paint by type and deliver to recycling or collection facility.
- B. After completing paint application, clean spattered surfaces. Remove spattered paints by washing, scraping, or other methods. Do not scratch or damage adjacent finished surfaces.
- C. Protect work of other trades against damage from paint application. Correct damage to work of other trades by cleaning, repairing, replacing, and refinishing, as approved by Architect, and leave in an undamaged condition.
- D. At completion of construction activities of other trades, touch up and restore damaged or defaced painted surfaces.

END OF SECTION 099100

SECTION 101100
VISUAL DISPLAY UNITS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Markerboards.
- B. Related Requirements:

1.2 ACTION SUBMITTALS

- A. Product Data:
 - 1. Include construction details, material descriptions, dimensions of individual components and profiles, finishes, and accessories for visual display units.
 - 2. Include electrical characteristics for motorized units.
- B. Shop Drawings: For visual display units.
 - 1. Include plans, elevations, sections, details, and attachment to other work.
 - 2. Include sections of typical trim members.

1.3 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For Installer.
- B. Sample Warranties: For manufacturer's special warranties.

1.4 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Deliver factory-fabricated visual display units completely assembled in one piece. If dimensions exceed maximum manufactured unit size, or if unit size is impracticable to ship in one piece, provide two or more pieces with joints in locations indicated on approved Shop Drawings.

1.6 WARRANTY

- A. Special Warranty for Porcelain-Enamel Face Sheets: Manufacturer agrees to repair or replace porcelain-enamel face sheets that fail in materials or workmanship within specified warranty period.
 - 1. Failures include, but are not limited to, the following:
 - a. Surfaces lose original writing and erasing qualities.
 - b. Surfaces exhibit crazing, cracking, or flaking.
 - 2. Warranty Period:
 - a. 50 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Surface-Burning Characteristics: Comply with ASTM E84; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.
 - 1. Flame-Spread Index: 25 or less.
 - 2. Smoke-Developed Index: 450 or less.

2.2 VISUAL DISPLAY BOARD ASSEMBLIES

- A. Markerboard Panel: Magnetic ceramic coated steel
 - 1. Color: White

2.3 MARKERBOARD PANELS

- A. Porcelain-Enamel Markerboard Panels: Balanced, high-pressure, factory-laminated markerboard assembly of three-ply construction, consisting of moisture-barrier backing, core material, and porcelain-enamel face sheet with low gloss finish. Laminate panels under heat and pressure with manufacturer's standard, flexible waterproof adhesive.
 - 1. Manufacturer: Tri-Best OR Equal
- B. High-Pressure Markerboard Laminate Panels: Factory-laminated markerboard panel of three-ply construction, consisting of backing, fiberboard core material, and high-pressure markerboard laminate writing surface.
- C. Melamine Markerboard Panels: Fabricated from 1/4-inch- (6-mm-) thick, sealed and primed hardboard panels permanently bonded with thermally fused, melamine-impregnated decorative paper writing surface.

2.4 MATERIALS

- A. Porcelain-Enamel Face Sheet: PEI-1002, with face sheet manufacturer's standard two- or three-coat process.
- B. High-Pressure Markerboard Laminate: Complying with physical testing requirements of ISO 4586-3.
- C. Fiberboard: ASTM C208 cellulosic fiber insulating board.
- D. Extruded Aluminum: ASTM B221 (ASTM B221M), Alloy 6063.
- E. Adhesives for Field Application: Mildew-resistant, nonstaining adhesive for use with specific type of panels, sheets, or assemblies; and for substrate application; as recommended in writing by visual display unit manufacturer.
- F. Primer/Sealer: Mildew-resistant primer/sealer complying with requirements recommended in writing by visual display unit manufacturer for intended substrate.

2.5 GENERAL FINISH REQUIREMENTS

- A. Comply with NAAMM/NOMMA AMP 500 for recommendations for applying and designating finishes.
- B. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.
- C. Appearance of Finished Work: Noticeable variations in same piece are unacceptable. 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.

2.6 ALUMINUM FINISHES

- A. Alloy 6063-T5, extruded, anodized satin finish aluminum

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates and conditions, with Installer present, for compliance with requirements for installation tolerances, surface conditions of wall, and other conditions affecting performance of the Work.
- B. Examine roughing-in for electrical power systems to verify actual locations of connections before installation of motorized, sliding visual display units.
- C. Examine walls and partitions for proper preparation and backing for visual display units.

- D. Examine walls and partitions for suitable framing depth where sliding visual display units will be installed.
- E. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Comply with manufacturer's written instructions for surface preparation.
- B. Clean substrates of substances, such as dirt, mold, and mildew, that could impair the performance of and affect the smooth, finished surfaces of visual display boards.
- C. Prepare surfaces to achieve a smooth, dry, clean surface free of flaking, unsound coatings, cracks, defects, projections, depressions, and substances that will impair bond between visual display units and wall surfaces.
- D. Prime wall surfaces indicated to receive visual display units and as recommended in writing by primer/sealer manufacturer and visual display unit manufacturer.
- E. Prepare recesses for sliding visual display units as required by type and size of unit.

3.3 INSTALLATION

- A. General: Install visual display surfaces in locations and at mounting heights indicated on Drawings, or if not indicated, at heights indicated below. Keep perimeter lines straight, level, and plumb. Provide grounds, clips, backing materials, adhesives, brackets, anchors, trim, and accessories necessary for complete installation.
- B. Field-Assembled Visual Display Board Assemblies: Coordinate field-assembled units with grounds, trim, and accessories indicated. Join parts with a neat, precision fit.
 - 1. Make joints only where total length exceeds maximum manufactured length. Fabricate with minimum number of joints, balanced around center of board, as acceptable to Architect
 - 2. Where size of visual display board assemblies or other conditions require support in addition to normal trim, provide structural supports or modify trim as indicated or as selected by Architect from manufacturer's standard structural support accessories to suit conditions indicated.
- C. Factory-Fabricated Visual Display Board Assemblies:
 - 1. Attach concealed clips, hangers, and grounds to wall surfaces and to visual display board assemblies with fasteners at not more than 16 inches (400 mm) o.c. Secure tops and bottoms of boards to walls.
- D. Display Rails: Install rails at mounting heights indicated on Drawings, or if not indicated, at height indicated below. Attach to wall surface with fasteners at not more than 16 inches (400 mm) o.c.

3.4 CLEANING AND PROTECTION

- A. Clean visual display units in accordance with manufacturer's written instructions. Attach one removable cleaning instructions label to visual display unit in each room.
- B. Touch up factory-applied finishes to restore damaged or soiled areas.
- C. Cover and protect visual display units after installation and cleaning.

END OF SECTION 101100

SECTION 101400

IDENTIFICATION DEVICES

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes signs that are directly attached to the building.
 - 1. Room-Identification Signs
 - 2. Restroom identification signs
 - 3. Geometric signs
 - 4. Exits
 - 5. Informational and Directional Signags
- B. Related Requirements:
 - 1. Section 101300 "Directories" for building directories.
 - 2. Section 101416 "Plaques" for one-piece, solid metal signs, with or without frames, that are used for high-end room-identification.

1.2 DEFINITIONS

- A. Accessible: In accordance with the accessibility standard.

1.3 COORDINATION

- A. Furnish templates for placement of sign-anchorage devices embedded in permanent construction by other installers.
- B. Furnish templates for placement of electrical service embedded in permanent construction by other installers.

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Shop Drawings: For room-identification signs.
 - 1. Include fabrication and installation details and attachments to other work.
 - 2. Show sign mounting heights, locations of supplementary supports to be provided by other installers, and accessories.
 - 3. Show message list, typestyles, graphic elements, including raised characters and Braille, and layout for each sign at least half size
- C. Material Samples: Submit colors and textures samples of materials to be furnished for signs

1.5 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For Installer and manufacturer.

1.6 MAINTENANCE MATERIAL SUBMITTALS

- A. Furnish extra materials, from the same product run, that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 - 1. Variable Component Materials: 12 replaceable text inserts and interchangeable characters (letters, numbers, and graphic elements) of each type.
 - 2. Tools: One set(s) of specialty tools for assembling signs and replacing variable sign components.

1.7 QUALITY ASSURANCE

- A. Installer Qualifications: An entity that employs installers and supervisors who are trained and approved by manufacturer.

1.8 FIELD CONDITIONS

- A. Field Measurements: Verify locations of anchorage devices and electrical service embedded in permanent construction by other installers by field measurements before fabrication, and indicate measurements on Shop Drawings.

1.9 WARRANTY

- A. Special Warranty: Manufacturer agrees to repair or replace components of signs that fail in materials or workmanship within specified warranty period.
 - 1. Failures include, but are not limited to, the following:
 - a. Deterioration of finishes beyond normal weathering.
 - b. Deterioration of embedded graphic image.
 - c. Separation or delamination of sheet materials and components.
 - 2. Warranty Period: Five years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Accessibility Standard: Comply with applicable provisions in the USDOJ's "2010 ADA Standards for Accessible Design" and CBC chapter 11B .

2.2 ROOM-IDENTIFICATION SIGNS AND WALL SIGNS

- A. 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. Laminated-Sheet Sign: Photopolymer face sheet with raised graphics laminated over subsurface graphics to acrylic or phenolic backing sheet to produce composite sheet.
 - a. Composite-Sheet Thickness: 1/8"
 - b. Surface-Applied Graphics: Applied vinyl film
 - c. Subsurface Graphics: Reverse halftone or dot-screen image
 - d. Color(s): As indicated on Drawings
 2. Sign-Panel Perimeter: Finish edges smooth.
 - a. Edge Condition As indicated on Drawings
 - b. Corner Condition in Elevation: As indicated on Drawings
 3. Mounting: Surface mounted to wall with concealed anchors
 4. Text and Typeface: Accessible raised characters and Braille 1/32" minimum and Sans Serif numbers and sans serif uppercase letters accompanied by Grade 2 Braille as specified herein.
 - a. Character Size: Raised characters shall be a minimum of 5/8" high and a maximum of 2" high
 - b. Finish and Contrast: Contrast between characters, symbols, and their background shall be a minimum of 70% with a non-glare finish (CBC 1117B.5.2).
 - c. Proportions: Characters on signs shall have a width-to height ratio of between 3:5 and 1:1 and shall have a stroke width-to-height ratio of between 1:5 and 1:10, per CBC 1117B.5.3. To test a typestyle for proportions, print the sans serif uppercase letters I, X, and O at a height of 1 inch. Place a 1-inch-square template over the X or O, whichever is narrower; if the character is not wider than 1 inch, nor narrower than the 3:5 rectangle, the proportions are correct. Use a 1:5 rectangle to determine whether the stroke of the I is too broad, and a 1:10 rectangle to determine whether the stroke is too narrow. Only typestyles with the correct proportions may be used.
 - d. Braille: California Contracted Grade 2 Braille shall be used wherever Braille is required elsewhere in the CBC standards. Dots shall be spaced 1/10 inch (2.54 mm) on center in each cell, with 2/10 inch (5.08 mm) space between cells, measured from the second column of dots in the first cell to the first column of dots in the second cell. Dots shall be raised a minimum of 1/40 inch (0.636 mm) above background per CBC 1117B.5.6. Use rounded or domed California Braille dots, each distinct and separate. Dots with straight sides and flat tops are not acceptable.

2.3 SIGN MATERIALS

- A. Aluminum Sheet and Plate: ASTM B209 (ASTM B209M), alloy and temper recommended by aluminum producer and finisher for type of use and finish indicated.

- B. Aluminum Extrusions: ASTM B221 (ASTM B221M), alloy and temper recommended by aluminum producer and finisher for type of use and finish indicated.
- C. Acrylic Sheet: ASTM D4802, category as standard with manufacturer for each sign, Type UVF (UV filtering).
- D. Paints and Coatings for Sheet Materials: Inks, dyes, and paints that are recommended by manufacturer for optimum adherence to surface and are UV and water resistant for colors and exposure indicated.

2.4 ACCESSORIES

- A. Fasteners and Anchors: Manufacturer's standard as required for secure anchorage of signs, noncorrosive and compatible with each material joined, and complying with the following:
 - 1. Use concealed fasteners and anchors unless indicated to be exposed.
 - 2. Exposed Metal-Fastener Components, General:
 - a. Fabricated from same basic metal and finish of fastened sign unless otherwise indicated.
 - 3. Sign Mounting Fasteners:
 - a. Concealed Studs: Concealed (blind), threaded studs welded or brazed to back of sign material or screwed into back of sign assembly unless otherwise indicated.
 - b. Through Fasteners: Exposed metal fasteners matching sign finish, with type of head indicated, and installed in predrilled holes.

2.5 FABRICATION

- A. General: Provide manufacturer's standard sign assemblies according to requirements indicated.
 - 1. Preassemble signs and assemblies in the shop to greatest extent possible. Disassemble signs and assemblies only as necessary for shipping and handling limitations. Clearly mark units for reassembly and installation; apply markings in locations concealed from view after final assembly.
 - 2. Mill joints to a tight, hairline fit. Form assemblies and joints exposed to weather to resist water penetration and retention.
 - 3. Conceal connections if possible; otherwise, locate connections where they are inconspicuous.
 - 4. Provide rabbets, lugs, and tabs 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.

2.6 GENERAL FINISH REQUIREMENTS

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

PART 3 - EXECUTION

3.1 INSTALLATION

- A. General: Install signs using mounting methods indicated and according to manufacturer's written instructions.
 - 1. Install signs level, plumb, true to line, and at locations and heights indicated, with sign surfaces free of distortion and other defects in appearance.
 - 2. Install signs so they do not protrude or obstruct according to the accessibility standard.
 - 3. Before installation, verify that sign surfaces are clean and free of materials or debris that would impair installation.
- B. Accessibility: Install signs in locations on walls as indicated on Drawings and according to the accessibility standard
- C. Mounting Methods:
 - 1. Concealed Studs: Using a template, drill holes in substrate aligning with studs on back of sign. Remove loose debris from hole and substrate surface.
 - a. 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.
 - b. 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.
 - 2. 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.

3.2 ADJUSTING AND CLEANING

- A. Remove and replace damaged or deformed signs and signs that do not comply with specified requirements. Replace signs with damaged or deteriorated finishes or components that cannot be successfully repaired by finish touchup or similar minor repair procedures.
- B. Remove temporary protective coverings and strippable films as signs are installed.

- C. On completion of installation, clean exposed surfaces of signs according to manufacturer's written instructions, and touch up minor nicks and abrasions in finish. Maintain signs in a clean condition during construction and protect from damage until acceptance by Owner.

END OF SECTION 101423.16

SECTION 102113

PHENOLIC-CORE TOILET COMPARTMENTS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Phenolic-core toilet compartments.

B. Related Requirements:

1. Section 102800 "Toilet, Bath, and Laundry Accessories" for accessories mounted on toilet compartments.

1.2 COORDINATION

- A. Coordinate requirements for overhead supports blocking, reinforcing, and other supports concealed within wall and ceiling to ensure that toilet compartments can be supported and installed as indicated.

1.3 ACTION SUBMITTALS

A. Product Data.

1. Phenolic-core toilet compartments.
 - a. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for toilet compartments.

B. Shop Drawings:

1. Include plans, elevations, sections, details, and attachment details.
2. Show locations of cutouts for compartment-mounted toilet accessories.
3. Show locations of centerlines of toilet fixtures.
4. Show ceiling grid, ceiling-mounted items, and overhead support or bracing locations.

C. Samples for Initial Selection: Manufacturer's standard color sheets, showing full range of available colors for each type of toilet compartment.

1. Include Samples of hardware and accessories involving material and color selection.
2. Size: Manufacturers' standard size

1.4 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For toilet compartments.

1.5 FIELD CONDITIONS

- A. Field Measurements: Verify actual locations of toilet fixtures, walls, columns, ceilings, and other construction contiguous with toilet compartments by field measurements, and coordinate before fabrication.
- B. Code Compliance:
 - 1. Wheelchair accessible compartment shall comply with CBC Section 11B-604.8.1
 - 2. Toe clearance for at least one side partition of a wheelchair accessible compartment shall comply with CBC Section and Figure 11B-604.8.1.4. Toe clearance shall be 9" high minimum above the finish floor and 6" deep minimum beyond the compartment side face of the partition, exclusive of partition support members. It shall be 12" high minimum above the finish floor for children's use. Partition components at toe clearances shall be smooth without sharp edges or abrasive surfaces. Toe clearance at the side partition is not required in a compartment greater than 66" wide.
 - 3. Ambulatory accessible compartments shall be provided where there are six or more toilet compartments, or where the combination of urinals and water closets totals six or more fixtures. Such compartments shall be provided in the same quality as wheelchair accessible compartments per CBC Section 11B-213.3.1 and shall comply with CBC Section 11B-604.8.2
 - 4. Door and door hardware for accessible compartments shall be self-closing and shall comply with CBC Section 11B-404 except that if the approach is to the latch side of an ambulatory compartment door, clearance between the door side of the compartment and any obstruction shall be 44" minimum. CBC Figure 11B-604.8.2
 - 5. A door pull complying with CBC Section 11B-404.2.7 shall be placed on both sides of the accessible compartment door near the latch.
 - 6. Ambulatory Accessible Toilet Compartment doors shall not swing into the clear floor space or clearance required for any fixture or into the minimum required compartment area. CBC Section 11B-604.8.2.2
 - 7. Elements of Sanitary facilities shall be mounted at locations in compliance with CBC Sections 11B-602 through 11B-612
 - 8. Grab bars in toilet facilities and bathing facilities shall comply with CBC Section 11B-609. Grab bars and any wall or other surfaces adjacent to grab bar shall be free of sharp or abrasive elements and shall have rounded edges. The space around the grab bars shall be as follows:
 - 1 ½" between the grab bar and the wall.
 - 1 ½" minimum between the grab bar and projecting objects below and at the ends.
 - 12" minimum between the grab bar and projecting objects above.

PART 2 - PRODUCTS

2.1 SOURCE LIMITATIONS

- A. Obtain phenolic-core toilet compartments from single source from single manufacturer.
- B. Surface-Burning Characteristics: Comply with ASTM E84; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.
 - 1. Flame-Spread Index: [25] or less.
 - 2. Smoke-Developed Index: 450 or less.
- C. Structural Performance: Where grab bars are mounted on toilet compartments, design panels to comply with the following requirements:
 - 1. Panels are able to withstand a concentrated load on grab bar of at least 250 lbf (1112 N) applied at any direction and at any point, without deformation of panel.
- D. Regulatory Requirements: Comply with applicable provisions in the USDOJ's "2010 ADA Standards for Accessible Design" and CBC 2019 chapter 11B for toilet compartments designated as accessible.

2.2 PHENOLIC-CORE TOILET COMPARTMENTS

- A. Manufacturers
 - 1. Trespa Athlon DSQ panels, Trespa North America Ltd. [Represented locally by W.H. Steele Co., 626-303-3831].
 - 2. Pionite Phenolic Panels, [Represented locally by Panolam Inc., 562-498-3222].
 - 3. Or equal.
- B. Approved Fabricators:
 - 1. Allen Lewis Partitions, Santa Ana, CA, 714-479-0277.
 - 2. Partition Systems Inc., South Carolina, 803-252-3020.
 - 3. Lam-Tec Industries, Placentia, CA, 714-632-8696.
- C. Toilet-Enclosure Style: Floor anchored
- D. Entrance-Screen Style: Floor anchored
- E. Urinal-Screen Style: Wall hung

Before retaining option in "Door, Panel, and Pilaster Construction" Paragraph below, verify availability with manufacturers. See the Evaluations.

- F. Door, Panel, and Pilaster Construction: Solid phenolic-core material with melamine facing on both sides fused to substrate during manufacture (not separately laminated), and with eased and polished edges. Provide minimum 3/4-inch- (19-mm-) thick doors and pilasters and minimum 1/2-inch- (13-mm-) thick panels. Provide with no-sightline system consisting of door and pilaster lapped edges on strike side of door and door and pilaster lapped edges on hinge side of door (unless continuous hinge is used).
- G. Entrance-Screen Construction: Matching panel construction.
- H. Urinal-Screen Construction: Matching panel construction.
- I. Pilaster Shoes: Formed from stainless steel sheet, not less than 0.031-inch (0.79-mm) nominal thickness and 3 inches (76 mm) high, finished to match hardware.
- J. Pilaster Sleeves (Caps): Formed from stainless steel sheet, not less than 0.031-inch (0.79-mm) nominal thickness and 3 inches (76 mm) high, finished to match hardware.
- K. Urinal-Screen Post: Manufacturer's standard post design of monolithic phenolic-core urinal screen cutout at bottom to form a post, material matching the thickness and construction of pilasters or 1-3/4-inch- (44-mm-) square, aluminum tube with satin finish with shoe and sleeve (cap)] matching that on the pilaster.
- L. Brackets (Fittings):
 - 1. Stirrup Type: Ear or U-brackets, stainless steel.
 - 2. Full-Height (Continuous) Type: Manufacturer's standard design, stainless steel.
- M. Phenolic Compartment Finish: One color in each room.
 - 1. Through-Color Phenolic: Manufacturer's standard solid through-color.
 - a. Color: To match with Existing

2.3 HARDWARE AND ACCESSORIES

- A. Door Hardware and Accessories, Heavy Duty: Manufacturer's heavy-duty institutional operating hardware and accessories.
 - 1. Hinges: Manufacturer's minimum 0.062-inch- (1.59-mm-) thick, stainless steel surface-mounted, paired, self-closing type that can be adjusted to hold doors open at any angle up to 90 degrees, continuous, continuous, spring-loaded type, allowing emergency access by lifting door. Mount with through bolts.
 - 2. Latch and Keeper: Manufacturer's heavy-duty, surface-mounted, cast stainless steel latch unit designed to resist damage due to slamming, with combination rubber-faced door strike and keeper, and with provision for emergency access. Provide units that comply with regulatory requirements for accessibility at toilet enclosures designated as accessible. Mount with through bolts.
 - 3. Coat Hook: Manufacturer's heavy-duty, combination cast stainless steel hook and rubber-tipped bumper, sized to prevent inswinging door from hitting compartment-mounted accessories. Mount with through bolts.

4. Door Bumper: Manufacturer's heavy-duty, rubber-tipped, cast stainless steel bumper at outswinging doors. Mount with through bolts.
 5. Door Pull: Manufacturer's heavy-duty, cast stainless steel pull at outswinging doors that complies with regulatory requirements for accessibility. Provide units on both sides of doors at toilet enclosures designated as accessible. Mount with through bolts.
- B. Overhead Bracing: Manufacturer's standard continuous, extruded-aluminum head rail with antigrip profile and in manufacturer's standard finish.

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- C. Anchorages and Fasteners: Manufacturer's standard exposed fasteners of stainless steel, finished to match items they are securing, with theft-resistant-type heads. Provide sex-type bolts for through-bolt applications. For concealed anchors, use stainless steel, hot-dip galvanized-steel, or other rust-resistant, protective-coated steel compatible with related materials.

2.4 MATERIALS

- A. Stainless Steel Sheet: ASTM A240/A240M or ASTM A666, Type 304, stretcher-leveled standard of flatness.
- B. Stainless Steel Castings: ASTM A743/A743M.

2.5 FABRICATION

- A. Fabricate toilet compartment components to sizes indicated. Coordinate requirements and provide cutouts for through-partition toilet accessories where required for attachment of toilet accessories.
- B. Overhead-Braced Units: Manufacturer's standard corrosion-resistant supports, leveling mechanism, and anchors at pilasters and walls to suit floor and wall conditions. Provide shoes at pilasters to conceal supports and leveling mechanism.
- C. Floor-Anchored Units: Manufacturer's standard corrosion-resistant anchoring assemblies at pilasters and walls, with leveling adjustment nuts at pilasters for structural connection to floor. Provide shoes at pilasters to conceal anchorage.
- D. Urinal-Screen Posts: Manufacturer's standard corrosion-resistant anchoring assemblies at posts and walls, with leveling adjustment nuts at tops and bottoms of posts. Provide shoes and sleeves (caps)] at posts to conceal anchorage.
- E. Door Size and Swings: Unless otherwise indicated on the plans, provide 24-inch- (610-mm-) wide, inswinging doors for standard toilet enclosures and 36-inch- (914-mm-) wide, outswinging doors with a minimum 32-inch- (813-mm-) wide, clear opening for toilet enclosures designated as accessible.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine areas and conditions, with Installer present, for compliance with requirements for fastening, support, alignment, operating clearances, and other conditions affecting performance of the Work.
 - 1. Confirm location and adequacy of blocking and supports required for installation.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. General: Comply with manufacturer's written installation instructions. Install units rigid, straight, level, and plumb. Secure units in position with manufacturer's recommended anchoring devices.
 - 1. Maximum Clearances:
 - a. Pilasters and Panels or Screens: 1/2 inch (13 mm).
 - b. Panels or Screens and Walls: 1 inch (25 mm).
 - 2. Stirrup Brackets: Secure panels or screens to walls and to pilasters with no fewer than three brackets attached at midpoint and near top and bottom of panel.
 - a. Locate wall brackets so holes for wall anchors occur in masonry or tile joints.
 - b. Align brackets at pilasters with brackets at walls.
 - 3. Full-Height (Continuous) Brackets: Secure panels or screens to walls and to pilasters with full-height brackets.
 - a. Locate bracket fasteners so holes for wall anchors occur in masonry or tile joints.
 - b. Align brackets at pilasters with brackets at walls.
- B. Overhead-Braced Units: Secure pilasters to floor and level, plumb, and tighten. Set pilasters with anchors penetrating not less than 1-3/4 inches (44 mm) into structural floor unless otherwise indicated in manufacturer's written instructions. Secure continuous head rail to each pilaster with no fewer than two fasteners. Hang doors to align tops of doors with tops of panels, and adjust so tops of doors are parallel with overhead brace when doors are in closed position.
- C. Floor-Anchored Units: Set pilasters with anchors penetrating not less than 2 inches (51 mm) into structural floor unless otherwise indicated in manufacturer's written instructions. Level, plumb, and tighten pilasters. Hang doors and adjust so tops of doors are level with tops of pilasters when doors are in closed position.
- D. Urinal Screens: Attach with anchoring devices to suit supporting structure. Set units level and plumb, rigid, and secured to resist lateral impact.

3.3 ADJUSTING.

- A. Hardware Adjustment: Adjust and lubricate hardware in accordance with hardware manufacturer's written instructions for proper operation. Set hinges on in-swinging doors to hold doors open approximately 30 degrees from closed position when unlatched. Set hinges on out-swinging doors to return doors to fully closed position.

END OF SECTION 102113.17

SECTION 102800

TOILET, BATH, AND LAUNDRY ACCESSORIES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Public-use washroom accessories.
2. Hand dryers.

B. Related Requirements

1. Section 102113.17 Phenolic-Core Toilet Compartments

1.2 SYSTEM DESCRIPTION

A. Regulatory Requirements: Comply with CBC requirements and ADA recommendations for accessibility.

B. Code Compliance:

1. Plumbing fixtures and accessories provided in a toilet room or bathing room required to comply with CBC Section 11B-213.2 shall comply with CBC Section 11B-213.3
2. Effective March 1, 2017, all single-user toilet facilities shall be identified as Gender Neutral facilities by a door symbol that complies with CBC Sections 11B-216.8 and 11B-703.7.2.6.3. No pictogram, text or braille is required on the symbol. If tactile jambe signage is provided, the signage shall comply with the appropriate technical requirements of CBC Section 11B-703. Examples of appropriate designations are "ALL GENDER RESTROOM", "RESTROOM" or "UNISEX RESTROOM". DSA BU 17-01
3. Accessible plumbing fixtures shall comply with all the requirements in CBC Chapter 11B, Division 6.
4. Clearance around accessible water closets and in toilet compartments shall be 60 inches minimum measured perpendicular from the side wall and 56 inches minimum measured perpendicular from the rear wall per CBC Section 11B-604.3.1
5. Heights and location of all accessible plumbing fixtures and components shall be mounted according to CBC Sections 11B-602 through 11B-612
6. Accessible fixture controls shall comply with CBC Sections 11B-602.3 for drinking fountains, 11B-604.6 for water closets, 11B-604.5 for children's water closets, 11B-605.4 for urinals, 11B-606.4 for lavatories and sinks. 11B-607.5 for bathtubs, 11B-608.5 for showers, and 11B-611.3 for washing machines and clothes dryers.
7. Accessible lavatories and sinks shall be mounted with the front of the higher of the rim or counter surfaces 34" maximum above the finish floor or ground. Depth of lavatories or sinks shall not interfere with knee and toe clearance provided in accordance with CBC

Section 11B-306 when a forward approach is required. CBC Sections 11B-606.3 and 11B-606.7

8. Water supply and drainpipes under accessible lavatories and sinks shall be insulated or otherwise configured to protect against contact. There shall be no sharp or abrasive surface under accessible lavatories and sinks. CBC Section 11B-606.5

1.3 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.

1.4 ACTION SUBMITTALS

- A. Product Data:
 1. Public-use washroom accessories.
 2. Hand dryers.
- B. Product Data Submittals: For each product.
 1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes.
 2. Include anchoring and mounting requirements, including requirements for cutouts in other work and substrate preparation.
 3. Include electrical characteristics as required.

1.5 WARRANTY

- A. Manufacturer's Special Warranty for Hand Dryers: Manufacturer agrees to repair or replace hand dryers that fail in materials or workmanship within specified warranty period.
 1. Warranty Period: [10] years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- B. Structural Performance: Design accessories and fasteners to comply with the following requirements:

1. Grab Bars: Installed units are able to resist 250 lbf (1112 N) concentrated load applied in any direction and at any point.

2.2 PUBLIC-USE WASHROOM ACCESSORIES

A. Acceptable Manufacturers:

1. Bobrick Washroom Equipment
2. A & J Washroom Accessories
3. American Specialties
4. Bradley Corp
5. General Accessory Manufacturing Co

B. Toilet Tissue Dispenser – Accessible toilet stalls (OFCI)

1. Mounting: Semi-recessed
2. Model No: Bobrick B-3888, ASI-0031, Bradley 5412 (double roll tissue holder without paper roll spindle stops), or equal

C. Grab Bar: Accessible Toilet Stalls

1. Size/Finish: 42" x 1 1/2" and 36" x 1 1/2" diameter satin stainless steel
2. Clearance: 1 1/2" between rail and wall
3. Model No: B-6806
4. Mounting: Attached with concealed mounting kit. Mount parallel to floor

2.3 HAND DRYERS

A. Warm-Air Dryer :

1. Mounting: Semi-recessed, maximum 4" projection from wall surface.
2. Model No: World Dryer – Slim Dry
3. Voltage: 120 volt, single phase

2.4 MATERIALS

- A. Stainless Steel: ASTM A240/A240M or ASTM A666, Type 304, 0.031-inch- (0.8-mm-) minimum nominal thickness unless otherwise indicated.
- B. Brass: ASTM B19, flat products; ASTM B16/B16M, rods, shapes, forgings, and flat products with finished edges; or ASTM B30, castings.
- C. Steel Sheet: ASTM A1008/A1008M, Designation CS (cold rolled, commercial steel), 0.036-inch- (0.9-mm-) minimum nominal thickness.
- D. Fasteners: Screws, bolts, and other devices of same material as accessory unit, unless otherwise recommended by manufacturer or specified in this Section, and tamper and theft resistant where exposed, and of stainless or galvanized steel where concealed.

2.5 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

3.1 INSTALLATION

- A. Install accessories in accordance with 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.
 - 1. Remove temporary labels and protective coatings.
- B. Grab Bars: Install to comply with specified structural-performance requirements.
- C. Shower Seats: Install to comply with specified structural-performance requirements.

3.2 ADJUSTING AND CLEANING

- A. Adjust accessories for unencumbered, smooth operation. Replace damaged or defective items.
- B. Clean and polish exposed surfaces in accordance with manufacturer's written instructions.

END OF SECTION 102800

SECTION 115213

PROJECTION SCREENS AND PROJECTORS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Manually operated, front-projection screens.
 - 2. Electrically operated, front-projection screens.

1.2 DEFINITIONS

- A. ALR: Ambient-light rejection; for specular reflective viewing surfaces, measured as the percentage of ambient light striking the viewing surface that has equal angles of incidence and reflection.
- B. Gain: Ratio of light reflected from viewing-surface material to that reflected perpendicularly from a magnesium carbonate surface as determined in accordance with SMPTE RP 94.
- C. Half-Gain Angle: The angle, measured from the axis of the viewing surface to the most central position on a perpendicular plane through the horizontal centerline of the viewing surface, where the gain is half of the peak gain.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Shop Drawings: Show layouts and types of front-projection screens. Include the following:
 - 1. Drop heights.
 - 2. For end-mounted motors, location of screen centerline relative to ends of screen case.
 - 3. Anchorage details, including connection to supporting structure for suspended units.
 - 4. Details of juncture of screen case or trim with adjacent finishes.
 - 5. For electrically operated units, wiring diagrams and location of wiring connections.
 - 6. Accessories.
- C. Samples: For each type of exposed finish and for each color and finish specified, in manufacturer's standard sizes.

1.4 CLOSEOUT SUBMITTALS

- A. Maintenance Data: For front-projection screens to include in maintenance manuals.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Environmental Limitations: Do not deliver front-projection screens until spaces are enclosed and weathertight, wet-work in installation spaces is complete and dry, and temporary or permanent HVAC system is operating and maintaining ambient temperature and humidity conditions planned for building occupants during the remainder of the construction period.
- B. Store front-projection screens in manufacturer's protective packaging and according to manufacturer's written instructions.

1.6 COORDINATION

- A. Coordinate layout and installation of front-projection screens with adjacent construction, including ceiling suspension systems, light fixtures, HVAC system components, and partitions.

PART 2 - PRODUCTS

2.1 SOURCE LIMITATIONS

- A. Source Limitations for Projection Screens: Obtain from single manufacturer. Obtain viewing surfaces and accessories, including mounting hardware, from screen manufacturer.

2.2 PERFORMANCE REQUIREMENTS

- A. Viewing-Surface and Masking Materials:
 - 1. Mildew-Resistance Rating: Zero or 1 when tested in accordance with ASTM G21.
 - 2. Flame Resistance: Passes NFPA 701.
 - 3. Flame-Spread Index: Not greater than 75 when tested in accordance with ASTM E84.

2.3 MANUALLY OPERATED, FRONT-PROJECTION SCREENS

- A. General Requirements: Manufacturer's standard spring-roller-operated units, consisting of case, flexible screen, mounting accessories, and other components necessary for a complete installation.
 - 1. Screen Mounting: Top edge securely anchored to a rigid steel roller; bottom edge formed into a pocket holding a tubular metal slat, with ends of slat protected by plastic caps, and with a saddle and pull attached to slat by screws.
- B. Metal-Encased, Manually Operated Screen Unit with free-hanging screen; with screen case fabricated from formed-steel sheet or aluminum extrusions with manufacturer's standard finish and matching end caps.
 - 1. Surface-Mounting Configuration: [Mounted using manufacturer's standard projecting wall brackets]
 - 2. Screen Case Color: Submit for Selection

3. Matte Viewing Surface: White, 1.0 minimum peak gain and 60-degree minimum half-gain angle
4. Seams: Where height of viewing surface exceeds maximum height without seams, locate horizontal seam with full-width material at bottom of viewing surface.
5. Size of Viewing Surface: As indicated in schedule on Drawings
6. Extra Drop Height: As indicated in schedule on Drawings
 - a. Color: Same as viewing surface

2.4 ELECTRICALLY OPERATED, FRONT-PROJECTION SCREENS - MPR

- A. General Requirements: Manufacturer's standard units, consisting of case, screen, motor, controls, mounting accessories, and other components necessary for a complete installation. Provide units that are listed and labeled as an assembly by Underwriters Laboratories Inc. (UL) or another testing and inspecting agency acceptable to authorities having jurisdiction.
 1. 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. Screen Mounting: Top edge securely anchored to rigid metal roller and bottom edge formed into a pocket holding a metal rod, with ends of rod protected by plastic caps.
- B. Surface-Mounted, Metal-Encased, Electrically Operated Screen: Motor-in-roller unit with screen case fabricated from formed-steel sheet or from aluminum extrusions with manufacturer's standard finish and matching end caps.
 1. Motor in Roller: Instant-reversing motor of size and capacity recommended in writing by screen manufacturer; with permanently lubricated ball bearings, automatic thermal-overload protection, preset limit switches to automatically stop screen in up and down positions, and positive-stop action to prevent coasting. Mount motor inside roller with vibration isolators to reduce noise transmission.
 2. Controls: Remote, three-position control switch installed in recessed device box with flush cover plate matching other electrical device cover plates in room where switch is installed.
 - a. Provide with two control switches
 - b. Provide power supply for low-voltage systems if required.
 - c. Provide locking cover plates for switches.
 - d. Provide power-supply switch.
 - e. Provide video interface control for connecting to projector. Projector provides signal to raise or lower screen.
 3. Surface-Mounting Configuration: Mounted using manufacturer's standard projecting wall brackets
 4. Screen-Case Color: Submit for Selection
 5. Free-Hanging, Matte Viewing Surface: White, 1.0 minimum peak gain and 60-degree minimum half-gain angle.

- a. Seams: Where height of viewing surface exceeds maximum height without seams, locate horizontal seam with full-width material at top of viewing surface.
6. Tab-Tensioned, High-Contrast-Gray Viewing Surface: Minimum peak gain of 0.8 and 45-degree minimum half-gain angle
 - a. Tab Tensioning: Durable low-stretch cord, such as braided polyester, on each side of screen that is connected to edge of entire height of screen by tabs, to pull viewing surface flat horizontally.
 - b. Seams: Where height of viewing surface exceeds maximum height without seams, locate horizontal seam with full-width material at top of viewing surface.
 7. Tab-Tensioned, Gain-White Viewing Surface: Minimum peak gain of 1.3 and 75-degree minimum half-gain angle. Provide viewing surface with black backing and without seams.
 - a. Tab Tensioning: Durable low-stretch cord, such as braided polyester, on each side of screen that is connected to edge of entire height of screen by tabs, to pull viewing surface flat horizontally.
 8. Tab-Tensioned, ALR Viewing Surface: Minimum peak gain of 0.8, 57 percent ALR, and 50-degree minimum half-gain angle. Provide viewing surface without seams.
 - a. Tab Tensioning: Durable low-stretch cord, such as braided polyester, on each side of screen that is connected to edge of entire height of screen by tabs, to pull viewing surface flat horizontally.
 9. Size of Viewing Surface: As indicated in schedule on Drawings
 10. Extra Drop Height: As indicated in schedule on Drawings
 - a. Color: Same as viewing surface
- C. Suspended, Electrically Operated Screen Unit designed and fabricated for suspended mounting.
1. Motor in Roller: Instant-reversing motor of size and capacity recommended in writing by screen manufacturer; with permanently lubricated ball bearings, automatic thermal-overload protection, preset limit switches to automatically stop screen in up and down positions, and positive-stop action to prevent coasting. Mount motor inside roller with vibration isolators to reduce noise transmission.
 2. End-Mounted Motor: Instant-reversing, gear-drive motor of size and capacity recommended in writing by screen manufacturer; with permanently lubricated ball bearings, automatic thermal-overload protection, preset limit switches to automatically stop screen in up and down positions, and positive-stop action to prevent coasting. Locate motor in its own compartment on right end of screen. Support roller with self-aligning bearings in brackets.
 3. Wiring Compartment: Metal or metal lined.
 4. Controls: Remote, key-operated, three-position control switch installed in recessed device box with flush cover plate matching other electrical device cover plates in room where switch is installed.
 - a. Provide with one control switch

- b. Provide power supply for low-voltage systems if required.
 - c. Provide locking cover plates for switches.
 - d. Provide key-operated, power-supply switch.
 - e. Provide video interface control for connecting to projector. Projector provides signal to raise or lower screen.
5. Screen Case: Metal
6. Free-Hanging, Matte Viewing Surface: White, 1.0 minimum peak gain and 60-degree minimum half-gain angle Retain "Seams" Subparagraph below if seams are necessary for viewing-surface sizes required for Project. Verify maximum sizes with manufacturers.
- a. Seams: Where height of viewing surface exceeds maximum height without seams, locate horizontal seam with full-width material at top of viewing surface.
 - b. Edge Treatment: Without black masking borders.
7. Tab-Tensioned, High-Contrast-Gray Viewing Surface: Minimum peak gain of 0.6 and 60-degree minimum half-gain angle, with black backing.
- a. Tab Tensioning: Durable low-stretch cord, such as braided polyester, on each side of screen that is connected to edge of entire height of screen by tabs, to pull viewing surface flat horizontally.
 - b. Seams: Where height of viewing surface exceeds maximum height without seams, locate horizontal seam with full-width material at top of viewing surface.
8. Tab-Tensioned, Gain-White Viewing Surface: Minimum peak gain of 1.3 and 75-degree minimum half-gain angle. Provide viewing surface with black backing and without seams.
- a. Tab Tensioning: Durable low-stretch cord, such as braided polyester, on each side of screen that is connected to edge of entire height of screen by tabs, to pull viewing surface flat horizontally.
9. Tab-Tensioned, ALR Viewing Surface: Minimum peak gain of 0.8, 57 percent ALR, and 50-degree minimum half-gain angle. Provide viewing surface without seams.
- a. Tab Tensioning: Durable low-stretch cord, such as braided polyester, on each side of screen that is connected to edge of entire height of screen by tabs, to pull viewing surface flat horizontally.
10. Size of Viewing Surface: As indicated in schedule on Drawings
11. Extra Drop Height: As indicated in schedule on Drawings
- a. Color: Same as viewing surface

2.5 PROJECTORS

A. Epson

- 1. Model: PowerLite L520W WXGA Long-throw Laser Projector OR Equal
Location: Classroom

2. Model: PowerLite L630U Full HD WUXGA Long-throw Laser Projector OR Equal
Location: MPR

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install front-projection screens at locations indicated on Drawings to comply with screen manufacturer's written instructions.
- B. Install front-projection screens with screen cases in position and in relation to adjoining construction indicated. Securely anchor them to supporting substrate in a manner that produces a smoothly operating screen that, when lowered, has flat viewing surface and plumb vertical edges.
 1. Install low-voltage controls in accordance with NFPA 70 and complying with manufacturer's written instructions.
 - a. Wiring Method: Install wiring in raceway, except in accessible ceiling spaces and in gypsum board partitions, where unenclosed wiring method may be used. Use UL-listed plenum cable in environmental air spaces, including plenum ceilings. Conceal raceway and cables, except in unfinished spaces.
 2. Test electrically operated units to verify that screen controls, limit switches, closures, and other operating components are in optimum functioning condition.
 3. Test manually operated units to verify that screen-operating components are in optimum functioning condition.

END OF SECTION 115213

SECTION 12640

BOOTHS AND TABLES

PART 1 - GENERAL

1.1 ACTION SUBMITTALS

- A. Product Data: Product data and installation instructions.
 - 1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for each type of unit and their various assembly configurations.
- B. Shop Drawings:
 - 1. Show fabrication and installation of built-in table/seating, including plans, elevations, sections, details of components, profiles and finishes.
- C. Samples:
 - 1. For initial selection in the form of manufacturer's color charts consisting of actual units or sections of the units showing the full range of colors, textures and patterns available for each exposed material involving color selection.

1.2 INFORMATIONAL SUBMITTALS

- A. Certificates: Manufacturer certification of qualifications of firms or persons specified in the "Quality Assurance" article to demonstrate their capabilities and experience. Include lists of completed projects with project names and addresses of Architects and Owners as well as other information specified.
- B. Installer Qualifications: Engage an experienced installer who has specialized in installing built-in tables and seating similar to those required for this project and who is acceptable to and certified by the manufacturer of the built-in table/seating system to perform the work of this section.

1.3 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For folding and portable stages to include in operation and maintenance manuals.
- B. Sample of Warranty

1.4 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 not a limitation of, other rights Owner may have under contract documents.
1. Warranty Coverage: To include replacement or repair of any defect in the original material and workmanship, including welds, pockets, tables and benches.
 2. Manufacturer's Warranty: 15 years from the date of Substantial completion

PART 2 - PRODUCTS

2.1 Wall-Mounted Pocket Table and Bench

A. Table and Bench

1. Tabletop frame shall consist of dual 1.25" x 2.125" (32 x 54 mm) 18-gauge steel box channels; bench frame shall consist of dual 1.5" (38 mm) 16-gauge steel angle with returned edges rolled to 11-gauge.
2. Tubular Members: Stretcher bar shall be 16-gauge, 1 " (25.4 mm) diameter steel tubing
3. Finish: Epoxy powder coat.
4. Finish Color: Submit Color Samples for Selection
5. Laminate Surface: [Wilsonart Color: Submit for Selection]
6. Bench: [Length: Per Plan Height: 15" (381 mm) Width: 11.5" (292 mm), Model
7. Table Length: Per Plan

B. Wall-Storage Pockets

1. Material: All welded construction of 16-gauge steel with 11-gauge sill and top plates, without partial back or open studs.
2. Finish: Phosphate coated for rust prevention.
3. Coating: Sprayed-on epoxy paint with hardener.
4. Color: Submit Samples Color Samples for Selection
5. On-Wall Table Products - Mounted on Wall Surface
6. Facing: Provide 2" (51 mm) side facing to overlap walls in recessed installation.
7. Head Panel: Provide custom head panel with 2.5" (64 mm) vertical facing to cover masonry opening of 86.5" (2197 mm).
8. Lock and Retainer:
9. Table and bench have self-actuating safety latch which engages automatically when the table/bench is closed.
10. Pockets, tables, and benches are provided with key operated mullion locks to prevent unauthorized use.
11. Strap Anchors: Provide for pockets built into masonry walls.
12. Anchor Holes: Provide at base and back of pocket for fastening unit to floors and walls.

PART 3 - EXECUTION

3.1 DEMONSTRATION

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain folding and portable stages.
- B. Comply with the instructions and recommendations of the bench and table manufacturer.
- C. Adjust hardware, moving parts, and safety devices to function smoothly, and lubricate as recommended by manufacturer.
- D. Site Verification of Conditions:
 - 1. With general contractor present, examine area where built-in tables and seating are to be installed.
 - 2. Ensure compliance with installation tolerance requirements and other conditions affecting

END OF SECTION 12640

SECTION 22 0500
COMMON WORK RESULTS FOR PLUMBING

PART 1 – GENERAL

1.1 SUMMARY

A. Section Includes:

1. This Section provides the basic plumbing requirements that apply to the Work of Division 22.

B. Related Requirements:

1. Division 01: General Requirements.
2. Division 22: Plumbing
3. Division 23: HVAC
4. Division 26: Electrical.

1.2 REGULATORY REQUIREMENTS

- A. Current federal Safe Drinking Water Act (SDWA) regulations require the furnishing of lead-free pipe, solder, and flux in the installation or repair of plumbing in non-residential facilities connected to public drinking water systems. Under this regulation, solders and flux are considered lead-free when they contain 0.2 percent lead or less. Under California regulations pipes and pipe fittings are considered lead-free when they contain 0.25 percent lead or less as defined in California Assembly Bill 1953 (AB 1953). No pipe, pipe fittings, or any other fitting or fixture intended to convey or dispense water for human consumption by drinking or cooking is allowed in the domestic plumbing system, if they do not meet the low lead definition of AB 1953. Weighted average lead content of the wetted surface area of pipes, fittings and fixtures may not exceed 0.25 percent.

1. Provide lead-free water pipe, solder, and flux materials that meet the standards as outlined by the federal SDWA regulations and California AB 1953 if installed in drinking water system.
2. Collect pipe, solder, and flux material samples as required by the Project Inspector. Test samples shall be delivered to an Owner designated testing laboratory for testing of lead content.
 - a. Test samples for lead content by the atomic absorption spectrophotometry method.
3. Materials found not conforming to SDWA and California AB 1953 regulations shall be deemed defective Work and shall be replaced with lead-free materials.
4. Comprehensive testing of the remaining materials for their lead content shall be performed as required by the Project INSPECTOR.

- A. Materials, fabrication, equipment, and installation shall comply with industry standards and code requirements. Where manufacturer's recommendations exceed industry standards, the manufacturer's recommendation shall establish the minimum standard. As a minimum, standards from the following organizations shall apply:

1. ANSI - American National Standards Institute.
 2. ASME - American Society of Mechanical Engineers.
 - a. ASME Boiler and Pressure Vessel Code.
 - b. ASME B31 - Standards for Pressure Piping.
 3. ASHRAE - American Society of Heating, Refrigerating and Air-Conditioning Engineers.
 4. ASTM - American Society for Testing and Materials.
 - a. ASTM A53 Specification for Welded and Seamless Pipe.
 5. AWWA - American Water Works Association.
 6. CSA - Canadian Standards Association.
 7. FM Global - Factory Mutual Global
 8. IAPMO - International Association of Plumbing and Mechanical Officials.
 9. NFPA - National Fire Protection Association.
 10. OSHA - Occupational Safety and Health Administration.
 11. SMACNA - Sheet Metal and Air Conditioning Contractors' National Association.
 12. UL - Underwriters Laboratories Inc.
 13. Intertek (ETL Certification).
- B. Materials, fabrication, equipment, and installation shall comply with federal, state, and local codes including, but not limited to, the following:
1. CBC, California Building Code, and CMC, California Plumbing Code.
 - a. Latest edition as adopted by the City of Corona, County of Riverside and the State of California including amendments effective on the Effective Date of the Contract.
 2. California Code of Regulations, Title 8, Industrial Relations, Division 1, Chapter 4, Division of Industrial Safety.
3. OSHA - Occupational Safety and Health Administration.
4. CDPH - California Department of Public Health.
 5. SCAQMD - South Coast Air Quality Management District.
- C. Specifications or Drawings shall not be construed to permit deviation from the requirements of governing codes unless approval has been obtained from legally constituted authorities having jurisdiction, and the Architect. The Contract Documents may contain more stringent requirements than those legally required.
- D. Permits and Fees: Refer to the General and Supplementary Conditions.

1.3

SUBMITTALS

- A. Provide submittals in accordance with Section 01 3300: Submittal Procedures and with specific requirements of Division 22 sections, as applicable.

- B. The above information shall become the basis for inspecting and testing materials and actual installation procedures performed in the Work.
- C. Shop Drawings: Submit one additional copy when control diagrams having line voltage connections are indicated. Shop Drawings shall be specifically prepared for the Work of this Project. Drawings prepared in accordance with requirements of Section 01 3100: Project Coordination and Section 01 3300 may be provided by the Architect to serve as a background for the Shop Drawings. Shop Drawings shall comply with the requirements of Section 01 3100 and Section 01 3300 and shall indicate at a minimum:
 - 1. Complete system layout of equipment, components, plumbing fixtures, piping, indicating service clearances, and pipe sizes, fitting types and sizes and pipe elevations, distances of pipes and equipment from building reference points and hanger support locations. The above items shall be coordinated on the shop drawings according to the requirements of Section 01 3100.
 - 2. Schedule and description of equipment, piping and fittings.

1.4 PROJECT RECORD DOCUMENTS

- A. Comply with provisions of Section 01 7700: Contract Closeout.
- B. Project Record Drawings:
 - 1. Provide a complete set of plumbing and fire protection drawings in AutoCAD and, if available, BIM, complete with external reference drawings, fonts, blocks and plotter pen color/line thickness settings on CD-ROM. Also submit one set of full size reproducible plots on vellum and 3 sets of prints.
 - 2. Before Contract Completion, deliver corrected and completed prints to the OAR. Delivery of project record documents to the OAR does not relinquish responsibility of furnishing required information omitted from project record documents.
- C. Operation and Maintenance Manuals:
 - 1. Submit two copies of operation and maintenance manuals in required form and content. If no revisions are required, furnish one additional copy. If revisions are required, one copy shall be returned with instructions for changes; perform such changes and return three copies of manuals. Manuals shall be bound in accordance to Section 01 7700. Deliver manuals to the OAR. Submit an electronic copy of the entire manual in PDF file format.
 - 2. Contents of Manual:
 - a. Title sheet with Project name, including names, addresses and telephone number of Contractor, installer, and related equipment suppliers.
 - b. Manufacturer's operating instructions including, but not limited to, the following:
 - 1) Identification of components.
 - 2) Trouble shooting checklist and guidelines.
 - 3) Recommendations for optimum performance.
 - 4) Warnings and safety precautions on improper or hazardous operational procedures or conditions

- c. Manufacturer's product data and parts and maintenance booklet for each item of equipment furnished under Division 22 that includes the following as a minimum:
 - 1) Manufacturer's model, identification and serial numbers.
 - 2) Exploded view of assembly drawings identifying each component or part with the relevant part number.
 - 3) Directory of manufacturer's representatives, service contractors and part distributors.
 - 4) Maintenance and trouble-shooting instructions, including schedule for preventive maintenance, periodic inspection and cleaning criteria.
- d. Project Record Drawings: Complete set of plumbing, fire protection and control system drawings in 50 percent reduced print format shall be furnished with the manual. Submit the above record drawings on CD-ROM in AutoCAD and, if available, BIM, complete with external reference drawings, fonts, blocks, and plotter pen color/line thickness settings.
- e. Spare.
- f. South Coast Air Quality Management District (SCAQMD) permits to install and operate boilers, water heaters and other fuel burning equipment and third-party source test reports as required by SCAQMD to allow start-up and operation of equipment.
- g. Riverside County industrial waste permits if required.
- h. Valve directory complete with location, function, size, and model of each valve with reference to the project record drawings.
- i. Equipment and component identification chart complete with location, function, size, and model of each equipment or component with reference to the project record drawings.

1.5 COORDINATION

- A. Contract Documents indicate extent and general arrangement of Work under Division 22. Contractor shall coordinate work in accordance with Section 01 3100 requirements and make adjustments as required to provide maximum headroom, a neat arrangement to keep passageways and openings clear to provide accessibility and provisions for maintenance, and to meet code requirements.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Delivery and Storage: Deliver materials to Project site in their original unopened containers with labels intact and legible at time of delivery. Store in strict accordance with manufacturer's recommendations.
- B. Do not store plastic pipe or materials in direct sunlight.

1.7 PRELIMINARY OPERATION

- A. OAR may require any portion of plumbing Work to be operated before Substantial Completion. Such operation shall be in addition to regular tests, demonstrations and instructions required under the Contract Documents, and shall be performed as required.
- B. Notify the INSPECTOR at least 24 hours in advance of lighting or re-lighting pilots.

1.8 TRAINING OF OWNER PERSONNEL

- A. Training of Owner's personnel shall include:
 - 1. A minimum of 4 hours of on-site overview of the overall Plumbing System.
 - 2. Refer to Division 22 sections for specific training on each of the components of the Plumbing System.
- B. Contract shall include the cost of training Owner operation and maintenance personnel in operating, adjusting, maintenance, trouble-shooting, and Project site repair of each component, equipment, or system provided under this Contract.
- C. Operational and maintenance training shall be conducted on the Project site, unless indicated otherwise.
- D. Upon completion of Owner training, a completion certificate indicating the nature of the training and a description of the systems, complete with equipment and component lists shall be issued to each trainee. The certificate should be issued in duplicate with one copy retained by OAR.
- E. An attendance sheet with the names and signatures of all participants attending the training shall be submitted to the OAR and kept as part of the project documents.

1.9 GUARANTEES AND DAMAGE RESPONSIBILITY

- A. Sound of water flowing in piping shall not be transmitted to building structure. Operation of mechanical system shall not produce operational sounds that can be heard outside of rooms enclosing apparatus or equipment.

PART 2 – PRODUCTS

2.1 MATERIALS AND EQUIPMENT

- A. Unless otherwise specified, materials and equipment shall be new, in good and clean condition. Equipment, materials, and components shall be of the make; type and model number noted on Drawings or specified. Pieces of equipment of the same type shall be by the same manufacturer.
- B. Whenever an item is listed by a single proprietary name, with or without model number and type, it shall be for purpose of design only, to indicate characteristics and quality desired. Proprietary designation listed on Drawings, or listed first in Specifications, is used as a basis for design to establish a standard for quality and performance and space requirements.
- C. Equipment and materials indicated or required to be installed outdoors shall be of the type that is designed, manufactured, listed or approved by authorities having jurisdiction for outdoor installation by being resistant to the adverse effects of weather. The additional protective measures against outdoor weather required by the manufacturers' installation instructions and prevalent practice shall be provided.
- D. For substitution of materials or products, refer to the General Conditions.

PART 3 – EXECUTION

3.1 SERVICE INTERRUPTIONS, OFF-SITE, GAS AND WATER

- A. Schedule Work so there shall be no service interruptions of existing systems or systems during normal hours of operation of affected systems and facilities.
- B. When service interruptions are mandatory, arrange in advance with the OAR as to time and date of such interruptions.
- C. Systems, which are interrupted, shall be returned back into operation in such manner that they will function as originally intended.

3.2 CUTTING, NOTCHING, AND BACKING

- A. Conform to California Building Code, Title 24, Part 2, for notches and bored holes in wood and for pipes and sleeves embedded in concrete and for cuts in steel, as detailed on structural Drawings.
- B. Where pipes pass through, or are located within one inch of any construction element, install a resilient pad, ½ inch thick minimum, to prevent contact.
- C. Furnish provisions for recesses, chases, and accesses and provide blocking and backing for proper reception and installation of plumbing Work.

3.3 LOCATION OF PIPING AND EQUIPMENT

- A. Location of piping, apparatus and equipment indicated on the Drawings is approximate and shall be altered to avoid obstructions, preserve headroom, and provide free and clear openings and passageways.
- B. Trenches parallel to footings shall not be closer than 18 inches to the face of footings and shall not be below a plane having a downward slope of 2 horizontal to one vertical, from a line 9 inches above bottom of footing.
- C. Pipe in tunnels shall be installed close to one side of tunnel to provide maximum space for passage. Pipe shall not be installed through crawl hole unless otherwise specified or detailed on Drawings.
- D. Place equipment in locations and spaces indicated, disassemble and/or reassemble equipment as required by Project conditions.

3.4 TESTS AND TESTING

- A. Tests shall be as required under the applicable sections of Division 22, including this Section.
- B. Additional tests may be required in the case of products, materials, and equipment if:
 - 1. Submitted items are altered, changed, or cannot be determined as exactly conforming to the Contract Documents.
 - 2. Performance testing and results may also be required on certain items which are as specified, including fan, and pump performance.
- C. Piping Tests:
 - 1. Perform tests required to demonstrate that operation of plumbing systems and their parts are in accordance with Specifications covering each item or system, and furnish materials, instruments and equipment necessary to conduct such tests. Tests shall be performed in presence of the Inspector, and representatives

of any governmental agency having jurisdiction. Work shall not be concealed or covered until required results are provided.

2. If required tests are not performed, Owner may provide in accordance with the Contract Documents.
3. Pressure gauges furnished in testing shall comply with CPC. Air shall be bled from lines requiring hydrostatic or water tests.
4. Systems shall be pressure-tested in accordance with pipe testing schedule below. Pipe test shall indicate no loss in pressure after a minimum duration of 4 hours at test pressures indicated. Where local codes require higher test pressures than specified herein for fire sprinkler systems, local codes shall govern.
5. Fuel gas lines shall be first tested with piping exposed, before backfilling trenches or lathing; second with piping in finished arrangement, backfilled and paved where required, and walls finished.
6. Piping systems may be tested as a unit or in sections, but entire system shall successfully meet requirements specified herein, before final testing by the Inspector.
7. Repair of damage to pipes and their appurtenances or to any other structures resulting from or caused by these tests, shall be provided.

D. Pipe Testing Schedule:

System Tested	Test Pressure (psig)	Test With:
Durham system, glass or plastic acid waste, vent and roof drain (except pipes running under a slab or underground)	Fill with water to top of highest vent; allow to stand two hours, or longer, as required by Inspector. Minimum head required for any joint shall be 10 feet in building.	Water
Cast-iron soil, waste and interior downspout, condensate drain from air conditioning equipment	10 feet of water, vertically	
Storm water disposal lines	Running water test	Water
Vacuum pump or condensate pump discharge and condensate return piping	150	Water
Domestic water piping	200	Water
Standpipes, wet or dry	300	Water
Fire sprinkler piping	200	Water
Gas piping(steel threaded or plastic)	60 (both tests)	Air
Gas piping (steel welded)	100 (both tests)	Air
Gas welding station	1-1/2 Working pressure 100 min.	Dry nitrogen
Compressed air piping	175	Air

E. Equipment Performance Assurance Tests:

1. Before operating any equipment or systems, a thorough check shall be performed to determine that systems have been flushed and cleaned as required

and that equipment has been properly installed, aligned, lubricated, and serviced. Factory instructions shall be checked to verify installations have been completed and recommended lubricants have been installed in bearings, gearboxes, crankcases, and similar equipment. Particular care shall be furnished in lubricating bearings to avoid damage by over-lubrication and blowing out seals. Equipment shall also be checked for damage that may have occurred during shipment, after delivery, or during installation. Damaged equipment, products, and materials shall be replaced or repaired as required.

2. Upon completion of the above, adjust the system settings to within normal operating conditions to prevent the system from being damaged upon start-up.
3. Run-test the equipment after start-up for five consecutive days. Tests shall include operation of all equipment and systems for a period of not less than two 8 hour periods at 90 percent of the full specified capacities.
4. Equipment Start-up Reports: For each equipment or system on which start-up is performed, submit 8 copies of start-up report for review by the Architect.
 - a. The start-up report shall include the manufacturer's standard start-up form completed and signed by the start-up technician.
5. Provide, maintain, and pay costs for equipment, instruments, and operating personnel as required for specified tests.
6. Provide electric energy and fuel required for tests.
7. Final adjustment to equipment or systems shall meet specified performance requirements.
8. Equipment, systems, or Work deemed defective during testing shall be replaced or corrected as required. Test until satisfactory results are provided.

F. Specific Coordinated Plan for Test and Balance:

1. Provide a narrative of the operational intent that clearly describes the function and sequence of operation of each component, equipment, or system installed. Instruct designated Owner personnel in the operation of the installed systems.
2. Prior to final test and balance, plumbing equipment and systems shall be operated and tested as indicated in Article 3.04.F above to demonstrate satisfactory overall operation of the installed systems.
3. Welding performed as part of this Division may be subject to radiographic inspections at random in accordance with requirements specified in Section 22 0513: Basic Plumbing Materials and Methods.

3.5 NOISE AND VIBRATION REDUCTION

- A. Correct noise or vibration caused by plumbing systems. Provide all necessary adjustments to specified and installed equipment and accessories to reduce noise to the lowest possible level
- B. Correct noise or vibration problems caused by failure to install work in accordance with Contract Documents. Include all labor and materials required as a result of such failure. Pay for re-testing of corrected noise or vibration problems by the project acoustical consultant including travel, lodging, test equipment expenses, etc.

3.6 PROTECTION, CARE AND CLEANING

- A. In addition to storage criteria of the General Conditions, and provisions under Section 01 5000: Construction Facilities and Temporary Controls, the following shall be provided:
1. Provide for the safety and good condition of materials and equipment until Substantial Completion. Protect materials and equipment from damage.
 2. Protect installed Work.
 3. Replacements: In case of damage, immediately provide repairs and/or replacements as required.
 4. Protect covering for bearings, open connections to tanks, pumps, compressors and similar equipment.
 5. Interior of piping shall be maintained free of dirt, grit, dust, and other foreign materials.
 6. Fixtures, piping, finished brass or bronze, and equipment shall have grease, adhesive, labels, and foreign materials removed. Chromium, nickel plate, polished bronze or brass Work shall be polished. Glass shall be cleaned inside and out.
 7. Before initial start-up and again before Substantial Completion, piping shall be drained and flushed to completely remove grease and foreign matter. Pressure regulating assemblies, traps, strainers, boilers, flush valves, and similar items shall be thoroughly cleaned. Tag system with an information tag listing responsible party and date of element, before initial start-up and again before Substantial Completion. Compressed air, oil, and gas piping shall be blown out with oil-free compressed air or inert gas.

END OF SECTION

SECTION 22 0513

BASIC PLUMBING MATERIALS AND METHODS

PART 1 – GENERAL

1.1 SUMMARY

A. Section Includes:

1. This Section prescribes basic materials and methods generally common to the Work of Division 22.

B. Related Requirements:

1. Division 01: General Requirements.
2. Division 22: Plumbing.
3. Division 23: HVAC.
4. Division 26: Electrical.

1.2 SUBMITTALS

- A. Provide in accordance with Division 01, Section 22 0500 and specific requirements of each section of Division 22.

1.3 QUALITY ASSURANCE

- A. Standards: Comply with applicable national, state, and local codes and standards: ASTM, ASME, and ANSI. Federal Specifications, AWWA, SISPI, NFPA, FM, UL, CPC (California Plumbing Code), CMC (California Plumbing Code), CSA.
- B. Conform to provisions of Section 22 0500: Common Work Results for Plumbing.
- C. Manufacturer of plumbing products must be third-party certified to ANSI/NSF Standard 61, Section 9 certification, and ANSI/NSF 372 to demonstrate compliance with the federal requirements for lead contribution to drinking water, the Safe Drinking Water Act SDWA, and the California Health and Safety Code Section 116875.
- D. Qualifications of Manufacturer: Products used in the Work of this Section shall be produced by manufacturers regularly engaged in manufacture of similar items and with a history of successful production as reviewed by the ARCHITECT.

1.4 COORDINATION

- A. Coordinate related Work with all other construction trades.

PART 2 – PRODUCTS

2.1 GENERAL

- A. Provide the following products if they are indicated in the Contract Documents or if they are required for the proper installation, function or operation of equipment, systems or components indicated in the Contract Document.
- B. Provide the following products as a complete assembly with required accessories for a complete and functioning entity in compliance with governing codes and applicable standards as specified in Section 22 0500, manufacturer's instructions or as required.
 - 1. Omission of minor details in the Contract Documents does not waive and/or otherwise relinquish compliance with the above requirements.

2.2 MANUFACTURERS AND MATERIALS

- A. Ball Valves: 2-inch and smaller:

BV-1: Class 150, 600 psi, Bronze, CWP two piece construction with reinforced TFE seats, full port, adjustable packing gland, (no threaded stem designs allowed), threaded or solder ends.

Manufacturer: Apollo Valves 77CLF-100A/77CLF-200A, NIBCO T-685-66-LF/S-685-66-LF, Hammond UP8303A/UP8513, Milwaukee UPBA400S/ UPBA450S, or equal.

BV-2: Class 150, 600 psi, Stainless Steel, CWP two piece construction with reinforced TFE seats, full port, adjustable packing gland, (no threaded stem designs allowed), threaded or solder ends.

Manufacturer: Apollo Valves 76F-100, NIBCO T-585-S6-R-66-LL, Milwaukee BA260, or equal.

Ball Valves in Insulated Piping: Use extended operating handle of non-thermal conductive material, and protective sleeve that allows operation of valve without breaking the vapor seal or disturbing insulation and memory stops that are fully adjustable after insulation is applied. Apollo Valves Therma-Seal, NIBCO Nib-Seal Handle.

- B. Check Valves:

- 1. Bronze, 2-inch and smaller:

CHV-1: 200 psi, CWP horizontal swing, Y pattern, renewable seat and disc, threaded ends.

Manufacturer: Apollo Valves 163T-LF, NIBCO T-413-Y-LF, Milwaukee UP-509, Hammond UP-904, or equal.

CHV-2: 200 psi, CWP, bronze body, horizontal swing, Y pattern, renewable seat and disc, solder ends.

Manufacturer: Apollo Valves 163S-LF, NIBCO S-413-Y-LF, Hammond Up-943, or equal.

CHV-3: Class 125, 200 psi, swing check, bronze body, Teflon disc, soldered ends.

Manufacturer: Apollo Valves 163S, Stockham B-310TY, Crane 1340, NIBCO S-413-Y, Milwaukee 1509-T, Hammond IB-912, or equal.

2. Cast Iron 2 1/2-inch and larger:

CHV-4: Class 125, 200 psi, CWP, IBBM, renewable seat and disc, bolted cap, flanged:

Manufacturer: Apollo Valves 910F, Crane 372, Stockham G-927, NIBCO T-918-B, or equal.

CHV-5: Special low-pressure check valve for installation in gas lines.

Manufacturer: Circle Seal Products Co., 119B-xPP; 0-15 psi; #1:1/8 inch IPS; #2:1/4 inch IPS #3:3/8 inch IPS.

C. Earthquake Valve:

EQV-1: Mechanically triggered by seismic movement, complying with state of California seismic response specifications, UL listed and certified by D.S.A. Size and pressure as required or indicated on Drawings. (Minimum 1/4 psi, maximum 10 psi. Earthquake valve shall shut off gas automatically during an earthquake to prevent an explosion or fire. Acceptable Manufacturers: California Valve (former Koso), or equal.

1. Not sensitive to vibrations caused by passing trucks or accidental bumping.
2. Sensitive to wide amplitude G's only. Preset at factory for the correct G-rating.
3. Positive sealing from minus 10 degrees F. to 150 degrees F.
4. Visual open-close indicator.
5. Manual reset.
6. Plumb line for mounting.
7. Tripping mechanism has non-creeping rolling latch.
8. Install valve per manufacturer's recommendations only.
9. Bronze, 2-inch and smaller:

GV-1: Class 125, 200 psi, CWP, bronze body and bonnet, non-rising stem, inside screw, screw-in bonnet, solid disc, threaded ends:

Manufacturer: Apollo Valves 101T-LF, NIBCO T-113-LF, Milwaukee UP105-P2, Hammond UP645, or equal.

GV-2: Same as GV-1, except solder ends:

Manufacturer: Apollo Valves 101S-LF, NIBCO S-113-LF, Milwaukee UP115, Hammond UP647, or equal.

10. Iron, 2-1/2-inch and larger:

GV-3: Class 125 250 psi CWP iron body, flanged ends, bolted bonnet with wheel handle, resilient wedge, non-rising stem.

Manufacturer: Apollo Valves 610F-LFA, NIBCO F-619-RW, or equal.

GV-4: Class 125, 250 psi CWP iron body, flanged ends, bolted bonnet with 2-inch operating nut, resilient wedge, non-rising stem, fusion bonded epoxy coated.

Manufacturer: NIBCO F-619-RW-SON, or equal.

GV-5: Class 250, 250 psi, CWP, O S and Y, IBBM, resilient seat gate valve, flanged ends.

Manufacturer: Watts 408-OSYRW, or equal.

D. Globe Valves:

1. Bronze, 2-inch and smaller:

GLV-1: Class 125, 200 psi, CWP, screw-in bonnet, press ends:

Manufacturer: Apollo Valves 120T-LF, Milwaukee UP502-P2, Hammond UP440-P2, or equal.

GLV-2: Class 125, 200 psi, CWP, screw in bonnet, soldered ends.

Manufacturer: Apollo Valves 120S-LF, Hammond UP418, Milwaukee UP1502, or equal.

E. Heater Vent Pipe:

1. Schedule Number:

HVP-1 Shall be UL approved for service specified. Concealed heater vent pipe, including pipe in or through attic spaces, shall be Los Angeles City approved double wall metal vent pipe. For recessed wall heaters, furnish B.W. type. All others may be Type B, or B.W. Clearances must comply with Los Angeles City code and conditions of UL listing.

Manufacturer: American Metal Products Co., Inc., Simpson Dura-Vent, AmeriVent, Hart & Cooley Mfg. Co., Metalbestos, or equal.

HVP-2 For use in intake and exhaust of high efficiency condensing type gas water heaters only as required by manufacturer. Pipe shall be PVC, Schedule 40, extruded

from 100 percent virgin polyvinyl Chloride (PVC) compound, meeting requirements of class 1254-13 of ASTM D1784. Manufacturer: Spears, Charlotte, or equal.
Fittings shall be Schedule 40 molded from PVC type I compound, conforming to the requirements of specification ASTM D2466.
Manufacturer: Spears, Charlotte, Harvel Plastics Inc., or equal.

F. Liquid Level Gage:

LLG-1 Refrigerant type, carbon steel with stainless steel trim or all forged steel construction, back-seating standard design. Upper and lower valve furnished with ball check valves; 1/2 inch diameter glass on center. Four 3/16 inch diameter gage glass guard rods or slotted steel guard.

Manufacturer: Peneberthy, Henry, Apollo Valves, or equal.

G. Piping and fittings:

1. Piping shall be continuously and permanently marked with manufacturer's name, type of material, size, pressure rating, and the applicable ASTM, ANSI, UL, or NSF listing. On plastic pipe, date of extrusion must also be marked.

2. Underground non-ferrous pressure pipes shall be installed with proper color tracer wires. Refer to color code provisions in Section 22 0553: Plumbing Identification.

P-1: Cast iron: Hubless, service weight, ASTM A888, CISPI 301, conforming to CISPI 310 and installed in accordance to IAPMO IS 6.

Manufacturer: American Foundry, Tyler, AB & I, or equal.

PF-1a: Cast iron, soil or waste no-hub coupling with neoprene gaskets, stainless steel corrugated shields and stainless steel clamps. 2 bands for size 1 1/2-inch thru 4-inch, IAPMO, ASTM C 564 and CISPI 310.

Manufacturer: American Foundry, Tyler, AB & I, or equal.

PF-1b: Cast iron, soil or waste, Heavy-duty no-hub coupling with neoprene gaskets, stainless steel corrugated shields and stainless steel clamps. 4 bands for size 5-inch thru 10-inch. IAPMO, ASTM C564 and CISPI 310.

Manufacturer: American Foundry, Tyler, AB & I, or equal.

PF-1c: Same as PF-1a with Heavy Duty Husky SD 4000 Coupling and stainless steel clamps. IAPMO, ASTM C564 and CISPI 310.

P-2: Galvanized steel, Schedule 40, ASTM A53.

Manufacturer: US Steel or equal.

PF-2: Malleable iron, Class 150, threaded, galvanized, beaded, ANSI B 16.3.

Manufacturer: Stockham, Stanley Flagg, Grinnell, or equal.

- P-3: Copper drainage tube, inside structure and above grade. Type DWV hard temper, ASTM B 306.
Manufacturer: Mueller, Anaconda, Cerro Brass, Cambridge-Lee, Halstead, or equal.
- PF-3: Cast brass drainage fittings ASA B 16.23, ASTM B 42.
Manufacturer: Mueller Brass, Nibco, Stanley Flagg, Lee Brass, or equal.
- P-4: Copper water tube, Type L hard, ASTM B88. (For above ground use only.)
Manufacturer: Mueller, Cambridge-Lee, Halstead, or equal.
- PF-4a: Copper Press-Connect pressure fittings, comply with ASME B16.51 “Copper Alloy Press-Connect Pressure Fittings”, with Ethylene Propylene Diene Monomer, EPDM O-Ring Seal in each end. Fittings with the sizes of 2-1/2” and larger shall have cross-section Grab Rings and separation rings.
Manufacturer: Viega, Mueller Industries, Apollo, or equal.
- PF-4b: Wrought copper - solder type ANSI B 16.22.
Manufacturer: Mueller Brass, Nibco, Lee Brass, or equal.
- PF-4c: Grooved end type— ASTM B75 or B152 and ANSI B16.22 wrought copper, bronze sand casting per ASTM B584-87 copper alloy CDA 836 per ANSIB16.18. Couplings shall be CTS style 606 supplied with angle pattern bolt pads for rigidity, coated with copper coated alkyl enamel. Gaskets shall be pre-lubricated Flush seal type.
Manufacturer: Apollo Shurjoint, Victaulic, or equal.
- P-5: Copper water tube, Type K hard, ASTM B88.
Manufacturer: Mueller, Cerro Brass, Cambridge-Lee, Halstead, or equal.
- P-6: Type 316L Schedule 40 Stainless Steel chemical waste pipe, marked with manufacturer's identification and fittings. Manufacturer's representative shall instruct installers and certify them for joint installation. Piping system shall be provided with a five-year manufacturer's material warranty.
Manufacturer: Blucher-Josam, Viega, or equal.
- PF-6a: Type 316L Schedule 40 Stainless Steel Mechanical joints. Stainless steel joint for chemical waste piping systems including drain or bottle traps.
Manufacturer: Blucher-Josam, or equal.
- PF-6b: Type 316L Schedule 40 Stainless Steel Press Fittings. For chemical waste piping systems including drain, vent or bottle traps, provide with EPDM seals. For compressed air piping systems, provide with HNBR

seals. Manufacturer's representative shall instruct installers and certify them for joint installation.

Manufacturer: Viega, or equal.

P-7: Black steel pipe, Schedule 40, ASTM A53, Type E, ERW.

Manufacturer: US Steel, or equal.

PF-7a: Malleable iron, Class 125, ANSI B 16.3, threaded or welded Schedule 40 black steel for 2-inches and below and welded for 2 ½-inch and above.

Manufacturer: Stockham, or equal.

PF-7b: Grooved end type, ASTM A395 and A536 ductile iron; ASTM A234 WPB forged steel; fabricated from ASTM A53 carbon steel. Couplings shall be supplied with angle-pattern bolt pads for rigidity, except in locations where flexibility is desired. Gaskets shall be pre-lubricated.

Manufacturer: Apollo Shurjoint, Victaulic, Galvanized or painted, or equal.

PF-7c: Press fittings, ASME B31, Carbon Steel, – For aboveground piping 2-inches and below. Provide fittings with Hydrogenated Nitrile Butadiene Rubber, HNBR Sealing Element.

Manufacturer: Apollo Valves: Power Press, Viega: MegaPressG, or equal.

PF-7d: Malleable Iron, class 125, ANSI B 16.3, threaded schedule 80 black steel.

Manufacturer: Stockham, or equal.

P-8: Red seamless brass 85-5-5-5, iron pipe size (IPS), threaded pipe, ASTM B43.

Manufacturer: Mueller, Cerro Brass, Cambridge-Lee, Halstead, or equal.

PF-8: Bronze and brass, 250 psi, threaded, ASA B16.17 and F S WW-P-460.

Manufacturer: Mueller Brass, Lee Brass, or equal.

P-9: Underground site water service pipe sizes 4-inch and larger shall be C900 water service pipe material. Refer to guide specification section 33 1100 “site water distribution utilities”.

PF-9: Ductile Iron. Refer to guide specification section 33 1100 “site water distribution utilities”.

P-10: CPVC (Chlorinated polyvinyl Chloride) Laboratory Chemical Waste DWV pipe, in compliance with ASTM F2618 Standard for CPVC Chemical Waste Drainage Systems, and marked with a yellow stripe for identification as chemical waste drainage piping, and tested in compliance with UL723 (ASTM E84).

Manufacturer: Spears, Corzan, Charlotte, or equal.

PF-10: CPVC (Chlorinated Polyvinyl Chloride) DWV fittings, conforming to ASTM D3311, and UL723 (ASTM E84). The joints shall be of solvent cement type conforming to ASTM F493. Installer shall carry ASTM D2855 and ASME B31.3 qualification. Installer shall provide proof of these qualifications to IOR prior to commencing work.

Manufacturer: Spears, Corzan, Charlotte, or equal.

a. CPVC primer and solvent for chemical weld of pipe and fittings shall be as recommended by pipe manufacturer. Containers for solvent and primer shall be clearly marked with manufacturer's data. Solvent and primer shall not be more than one year old. The safety placards must be visible. Blue or red-hot glue shall not be used.

1) Primer: Weld-On P-70 by IPS, Conforming to ASTM F656.

2) Cement: Weld-On 711 (gray) by IPS, Conforming to ASTM D2564.

b. Drains, bottle traps, mechanical joints, and similar devices shall be the same material and gauge as the pipe.

P-11: PVDF (Polyvinylidene Fluoride) schedule 40 chemical waste pipe, conforming to ASTM F1673, ASTM D3222 and complying with UL723 (ASTM E84). The joints shall be no-hub mechanical Joints or Socket Fusion. Installer shall be certified by manufacturer for joint installation.

Manufacturer: Orion, or equal.

PF-11a: PVDF (Polyvinylidene Fluoride), schedule 40, No-hub coupling. Each coupling shall have 300 series stainless steel outer band and 5/16 inch bolts, nuts and washers plated to meet a 100-hour salt spray test per ASTM B117. Drains, bottle traps and similar devices shall be the same material and gauge as the pipe with mechanical joints. Installer shall be certified by the manufacturer for this type of joint installation.

Manufacturer: Orion, or equal.

PF-11b: PVDF (Polyvinylidene Fluoride), schedule 40 coupling. Joined using the socket fusion system conforming to ASTM 2657. Drains, bottle traps and similar devices shall be the same material and gauge as the pipe with mechanical joints. Installer shall be certified by the manufacturer for this kind of joint installation.

Manufacturer: Orion, or equal.

P-12: FRPP (Flame Retardant Polypropylene) schedule 40 chemical waste pipe, conforming to ASTM F1412 and ASTM D4101. The joints shall be no-hub mechanical joints or Socket Fusion type. Installer shall be certified by the manufacturer for joint installation.

Manufacturer: Orion, or equal.

PF-12a: FRPP (Flame Retardant Polypropylene), schedule 40, No-hub coupling. Each coupling shall have 300 series stainless steel outer band and 5/16 inch bolts, nuts and washers plated to meet a 100-hour salt spray test per ASTM B117. Drains, bottle traps and similar devices shall be the same material and gauge as the pipe with mechanical joints. Installer shall be certified by the manufacturer for this type of joint installation.

Manufacturer: Orion, or equal.

PF-12b: FRPP (Flame Retardant Polypropylene), schedule 40 coupling. Joined using the socket fusion system conforming to ASTM 2657. Drains, bottle traps and similar devices shall be the same material and gauge as the pipe with mechanical joints. Installer shall be certified by the manufacturer for this kind of joint installation.

Manufacturer: Orion, or equal.

P-13: Polyethylene plastic pipe, ASTM D 2513, Standard Dimension Ratio 11 rated at 80 psi working pressure and 73° Fahrenheit for 3 inches and smaller, SDR 11.5 rated at 76 psi and 73° Fahrenheit for 4 inches and above, butt or socket type fittings, joined by heat fusion, orange or yellow color. Installer shall be certified by the manufacturer for this kind of joint installation.

Manufacturer: CPCHEM (Chevron Phillips Chemical Company LP) PE 2406, or equal.

PF-13a: Polyethylene plastic fittings, ASTM D 3261 and D 2683, Standard Dimension Ratio 11 rated at 80 psi working pressure and 73° Fahrenheit for 3 inches and smaller, SDR 11.5 rated at 76 psi at 73° Fahrenheit for 4 inches and above, butt or socket type fittings, joined by heat fusion, Installer shall be certified by manufacturer for joint installation. Color orange or yellow.

Manufacturer: CPCHEM, (Chevron Phillips Chemical Company LP), or equal.

PF-13b: Polyethylene transition risers, for PF-13a above, Transition fitting must have a minimum vertical height of 36 inches from the horizontal connection which will allow for a 6-inch steel riser above ground. Polyethylene transition risers shall be anodeless.

Manufacturer: GF Piping Systems, or equal.

P-14: PVC, schedule 40, extruded from 100 percent virgin Polyvinyl Chloride (PVC) compound, meeting requirements of class 1254-13 of ASTM D1784. (Use for irrigation systems after the control valves only.)

Manufacturer: Spears, Charlotte, or equal.

PF-14 Plastic fittings, schedule 40 molded from PVC type I compound, conforming to the requirements of specification ASTM D2466.

Manufacturer: Spears, Charlotte, Harvel Plastics Inc., or equal.

- a. PVC primer and solvent for chemical weld of pipe and fittings shall be as recommended by pipe manufacturer. Containers for solvent and primer shall be clearly marked with manufacturer's data. Solvent and primer shall not be more than one year old. The safety placards must be visible. Blue or red hot glue shall not be used.
- 1) Primer: Weld-On P-70 by IPS, Conforming to ASTM F656.
 - 2) Cement: Weld-On 711 (gray) by IPS, Conforming to ASTM D2564.

P-15: Purple pipe, PVC, schedule 40 for reclaimed or recycled water (below ground only for non-potable irrigation systems), type 1, grade 1, PVC-1120, Cell Class 12454 B.

Manufacturer: Charlotte, or equal.

PF-15: Purple Plastic fittings, schedule 40 molded from PVC type I compound, conforming to the requirements of specification ASTM D2466. Refer to section 32 8426 "Reclaimed Water Irrigation".

Manufacturer: Charlotte, or equal.

P-16: High Density Polyethylene pipe (HDPE) with tracer wire. Refer to guide specification section 33 1100 "site water distribution utilities".

PF-16a: Butt Fusion HDPE Fittings. Refer to guide specification section 33 1100 "site water distribution utilities".

PF-16b: Bolted Connections to HDPE pipes. Refer to guide specification section 33 1100 "site water distribution utilities".

H. Pipe and Fitting Requirements Schedule: Unless otherwise specified or indicated on Drawings, pipe and fittings shall be installed in accordance with the following table:

TABLE I
PIPE AND FITTING SCHEDULE

Use	Limits	Pipe	Fittings
Compressed air	All sizes	P-6	PF-6
Condensate drains and drains From HVAC Equipment	All sizes	P-4, or P-6 *Roof penetration & above, and exterior exposed piping shall be P-6 only	PF-4b, or PF-6b *Roof penetration & above, and exterior exposed piping shall be P-6 only
Domestic Cold Water, underground	Within 5' from building, All sizes	P-5	PF-4a, or PF-4b
Domestic Cold Water, underground	Site distribution only, sizes up to 3"	P-5, or P-16	PF-4a, PF-4b, or

Use	Limits	Pipe	Fittings
		Refer to 33 1100	P-16a, P-16b Refer to 33 1100
Domestic Cold Water, underground	Site distribution only, 4" and over	P-9 Refer to 33 1100	PF-9 Refer to 33 1100
Domestic Hot and Cold water, aboveground	Interior only	P-4	PF-4a, or PF-4b
Downspouts, Interior Storm Drainage	Within 5' from building, All sizes	P-1	PF-1a, or PF-1b
Exposed Downspouts, Interior Storm Drainage	Existing Buildings and aboveground only	P-2	PF-2
Fire Mains (Fire Hydrants), Underground	Site distribution only, 4" and over	P-9 Refer to 33 1100	PF-9 Refer to 33 1100
Fire Suppression System, Interior	All sizes	P7 Refer to 21 1313	PF-7d Refer to 21 1313
Irrigation, After Backflow Preventer	All sizes	P14 Refer to 32 8413	PF-14 Refer to 32 8413
Irrigation, Meter to Backflow Preventer	Up to 4"	P-5 Refer to 33 1100	PF-4a, or PF-4b Refer to 33 1100
Irrigation, Meter to Backflow Preventer	4" and over	P-9 Refer to 33 1100	PF-9 Refer to 33 1100
Irrigation, Reclaimed Water or Recycled Water	All sizes	P15 Refer to 32 8426	PF-15 Refer to 32 8426
Natural Gas, Exterior	Underground, site only	P-13	PF-13a, and PF-13b
Natural Gas, Interior, aboveground	All sizes	P-7	PF-7a, PF-7b, or PF-7c
Vents-ACID,	All sizes	P-6, P-10, P-11, or P-12 *Roof penetration & above shall be P-6 only	PF-6a, PF-10, PF-11a, PF-11b, PF-12a, or PF-12b *Roof penetration & above: PF-6a only
Waste - ACID - Aboveground - Passing through Air Plenum	All sizes	P-11	PF-11a, or 11b
Waste - ACID - Aboveground - Fire-Rated	All sizes	P-12	PF-12a, or 12b
Waste - ACID - Aboveground	All sizes	P-10	PF-10
Waste - ACID - Underground	All sizes	P-6	PF-6a, or 6b
Waste - FORCED	All sizes	P-1	PF-1c
Waste and Vent -	All sizes	P-3	PF-3

Use	Limits	Pipe	Fittings
Indirect			
Waste and Vent – Sanitary/ Grease	All sizes	P-1	PF-1a, or 1b
Waste and Vent – Sanitary/ Grease	Underground, site only	P-1 Refer to 33 3000	PF-1a, or 1b Refer to 33 3000

I. Pipe Isolators:

PLA-1 Absorption pad shall be not less than ½ inch thick, unloaded. Pad shall completely encompass pipe.

Manufacturer: Holdrite, LSP, Stoneman, Potter-Roemer, Trisolator, PR-Isolator, or equal.

Manufacturer: Hydra-Zorb Cushion Clamps, Acousto-Clamp, or equal.

J. Pressure Gage: Aluminum or steel case, minimum 4 ¼-inch dial; pressure type or combination vacuum-pressure type, with provisions for field calibration. Dial indicator to indicate pressure in psi with accuracy to within plus or minus 0.5 percent of maximum dial reading. Furnish gages with restriction screw, size 60, to eliminate vibration impulses. Black case and ring, bourdon tube of seamless copper alloy with brass tip and socket. Three way gage cock, constructed of brass with stuffing box, 1/2 inch couplings, with fixed or movable cap nut to shut off pressure gage.

PG-1 Pressure type, black drawn steel case, 4-1/2-inch glass dial, range approximately twice line pressure.

Manufacturer: Marsh Keckley, Trerice, Weksler, Weiss, or equal.

K. Plug Valves:

PV-1 2 inches and smaller: Rockwell No.114, lubricated plug type, 200-pound., water operating gauge pressure iron body and plug, regular pattern, threaded, with indicating arc.

Manufacturer: Walworth, Homestead, WKM, or equal.

PV-2. 2 ½-inch and larger: Rockwell No.115 and No.165 lubricated plug type, 200 pound water operating gauge. Iron body and plug, regular pattern, flanged, with indicating arc.

Manufacturer: Walworth, Homestead, WKM, or equal.

L. Safety Relief Valves:

SRV-1: Combination temperature and pressure relief type. CSA approved. Set to open at 125 psi pressure.

Manufacturer: Apollo Valves: 18C, Watts: 40L, Cash-Acme: NCLX-1, or equal.

SRV-2: Same as SRV-1, except provide on storage type water heater with anode in dip tube.

Manufacturer: Apollo Valves: 18C, Watts: 100XL, Cash-Acme: NCLX-1, or equal.

SRV-3 Spring type, ASME and NB stamped and certified with manual lifting device for air or gas.

Manufacturer: Apollo Valves, Bailey, Cash-Acme, Watts, Keckley, or equal.

M. Strainers:

STR-1 Description: Wye type with monel or stainless steel strainer cylinder (manufacturer's standard mesh), and gasketed machine strainer cap. Where indicated on Drawings, provide with valved (globe valve) blowout piping, same size as blowout plug.

1. 2-inch and smaller:
C.M. Bailey No.100-A, 250 lb., cast iron body, threaded, Keckley: Style B, Spirax Sarco Y-type, or equal.
2. 2 ½-inch and larger:
C.M. Bailey No.100-A, 125 lb., cast iron body, flanged, or Victaulic style 732, 300 psi, ductile iron body, grooved, fusion bonded epoxy coated.

Manufacturer: C.M.Bailey, Armstrong, Muessco, Keckley 'A', or equal.

STR-2 Y pattern cast iron bodies, 125 psi, monel screen. Open area at least twice the cross-sectional area of IPS pipe in which strainer is installed and may be woven wire or perforated type. Screwed ends for sizes up to 2 inches, flanged ends fusion bonded epoxy coated for 2 ½-inch and larger perforations, in accordance with the following:

1. Steam service - 40 square mesh.
2. Other services - 16 square mesh.

Bailey No.100, Armstrong, RP&C, Keckley or equal.

STR-3 Flanged, bucket type, semi-steel body, 125 psi, stainless steel screen with 1/8 inch diameter perforations, all sizes.

Manufacturer: Bailey No.1, Zurn 150 Series, RP&C, Keckley GFV, or equal.

STR-4 Grooved, T-pattern, ductile iron body, 300 psi, stainless steel frame and mesh basket, grooved ends.

N. Vent Caps:

VC-1 Vandal-proof hood type, for plumbing vent lines.

Manufacturer: Stoneman Engineering and Mfg., Semco 1550, or equal.

O. Vacuum Valves:

VV-1 Vacuum valves; for vacuum serve, 125 psig working pressure, cast iron body, spring loaded lubricated plug type.

Manufacturer: General Controls, Honeywell, Valmatic, or equal.

P. Protective Coating for Underground Steel Piping Applied to Underground Automotive:

1. Black steel or galvanized steel piping indicated for below grade installation, shall be protected as specified prior to delivery to the Project site:
 - a. Sandblast black steel pipe to a gray finish. Sandblast galvanized steel pipe lightly only.
 - b. Install one coat of cut back asphalt to galvanized pipe immediately after sandblasting. Pre-heat black pipe to 180 degrees F. immediately before coating.
 - c. Install one coat of high-temperature (melting point of 240 degrees F. minimum) Grade B asphalt enamel.
 - d. Install one wrapping of 20 mils thick glass, fiber mat, Owens-Corning Coromat or L.O.F. Blueflag with 1/4 inch overwrap. Glass fiber shall be dry at time of installation.
 - e. Install a second coat of asphalt enamel as specified above. Glass fiber mat shall be centered in the asphalt enamel.
 - f. Install an overwrap of Kraft ripple paper.
2. Total thickness of pipe wrapping shall be not less than 1/8 inch. Entire coating operation shall be accomplished by mechanical means in a continuous operation. Hand installation of protective coating is not permitted.
3. Each piece of wrapped pipe shall be legibly identified at no greater than 5 feet intervals by fabrication company. Each material submittal shall include the name of the fabrication company. Maintain one reviewed Sample on the Project Site.
4. Acceptable manufacturers of wrapping are: Hunt, Mobile, Conway or equal.
5. Fittings (including couplings), unprotected pipe adjacent to fittings, and damaged pipe protection shall be wrapped at Project site as follows:
 - a. Fittings and pipe to be wrapped shall be thoroughly cleaned of material foreign to pipe manufacturer.
 - b. Install one coat of Plicoflex No. 105 or Protecto Wrap No. 1170 adhesive primer to metal.
 - c. Wrap pipe and fittings with a minimum thickness of 3/32 inch of Plicoflex No. 310 pipe line butyl molding tape, or Protecto Wrap No. 200 molding tape. Install 3 layers, each layer overlapping next

approximately 2/3 width of tape, without stretching. Tape and primer shall be of the same manufacturer.

- d. Wrap vinyl tape, 10 mil thickness, over molding tape with 1 inch minimum overlap.

Manufacturer: J.M. Trantex, 3M Scotchwrap or equal.

- 5. Pipe and fittings specified to be wrapped shall be tested with a holiday detector, after pipe has been installed in trench and before backfilling, in presence of the Project Inspector. Furnish a Tinkler and Raser model E-P holiday detector, or similar equipment for this test. Work, which is deemed defective, shall be repaired or replaced. The Project Inspector may test for damaged pipe wrapping after backfilling.
- 6. Instead of wrapping underground steel pipe as specified above, pipe may be machine-wrapped before delivery to the Project site as follows:
 - a. Pipe shall be cleaned of moisture, oil, grease, scale, and other foreign material by cleaning with non-oily solvent and wire brushing. Remove metal burrs and projections.
 - b. Install one coat of Plicoflex No.105 adhesive primer to cleaned pipe. If thinning is required, furnish only non-oily thinners as recommended by tape manufacturer.
 - c. Wrap coated pipe with Plicoflex No.340-25 tape (15 mil butyl and 10 mil vinyl laminate) Tape shall be installed by machine wrapping at approved plant only. Maintain tension (minimum of 5 pounds per inch of width) on tape over entire diameter of pipe. Tape shall be permanently identified and visible on vinyl side.
 - d. Fittings, unprotected pipe, and damaged pipe protection shall be wrapped as indicated above.

Q. Flanges: Flanges shall be furnished and installed at each flanged connection of each type of equipment, tanks, and valves. Faces of flanges being connected shall be furnished alike. Connection of a raised face flange to a flat-faced flange is not permitted. Flanges shall conform to following schedules:

TYPE OF PIPE	FLANGE
Screwed black or galvanized grooved steel pipelines.	125-pound black cast iron screwed flange, flat faced or grooved flange adapters, Victaulic Style 741, Tyco-Grinnell Fig. 71, Gruvlok Fig. 7401, or equal.
Welded or grooved steel pipe, except high pressure steam lines.	150-pound black forged steel welding flanges, 1/16 inch raised face ASTM A 105, Grade II or grooved flange adapters, Apollo Shurjoint 7041, Victaulic Style 741, Tyco-Grinnell Fig. 71, Gruvlok Fig. 7401, or

TYPE OF PIPE	FLANGE
	equal.
Copper and brass pipe or tubing.	150 pound cast bronze, flat-faced flange with solder end or grooved flange adapters, Apollo Shurjoint C341, Victaulic Style 641, Tyco-Grinnell Fig. 61, Gruvlok Fig. 6084, or equal.

1. Gasket material for flanged connections shall be full faced or ring type to suit facing on flanges and shall be furnished in accordance with following schedule:

<u>SERVICE</u>	<u>TYPE</u>
Cold water	1/16-inch-thick neoprene

Grooved end flange adapters supplied with pressure responsive elastomeric Gaskets supplied with grooved flange adapters shall be pre-lubricated by the manufacturer. Grade of gasket to suit intended service.

R. Unions:

1. Unions shall be furnished and installed in accordance with the following requirements (unless flanges are furnished):
 - a. At each threaded or soldered connection to equipment and tanks, except in Freon or fuel gas, piping systems, whether indicated or not.
 - b. Immediately downstream of any threaded connection to each manually operated threaded valve or cock, and each threaded check valve, yard box or access box except those in Freon piping systems, whether indicated or not.
 - c. At each threaded connection to threaded automatic valves (except those in Freon piping systems) such as reducing valves and temperature control valves, whether indicated or not.
 - d. If grooved piping is used, couplings shall serve as unions. Additional unions are not required
2. Unions shall be located so that piping can be easily disconnected for removal of equipment, tank, or valve.

PART 3 – EXECUTION

3.1 EXAMINATION

- A. Examine areas and conditions under which Work of this Section shall be performed. Correct conditions detrimental to proper and timely completion of Work. Do not proceed until unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Provide all materials and equipment for the Work. Furnish and install necessary apparatus, parts, materials, and accessories.
- B. Pipe Installation:
 - 1. Install piping parallel to wall and provide an orderly grouping of proper materials and execution.
 - 2. Piping shall clear obstructions, preserve headroom, provide openings and passageways clear, whether indicated or not. Verify the Work of other Divisions to avoid interference.
 - 3. If obstructions or the Work of other Divisions prevent installation of piping or equipment as indicated by the Drawings, perform minor deviations as required by the ARCHITECT.
 - 4. Install piping after excavation or cutting has been performed. Piping shall not be permanently enclosed, furred in, or covered before required inspection and testing is performed.
 - 5. Exposed polished or enameled connections from fixtures or equipment shall be installed with no resulting tool marks or threads at fittings. Residue or exposed pipe compound shall be removed from exterior of pipe.
 - 6. Piping shall be concealed in chases, partitions, walls, and between floors, unless otherwise directed or specifically noted on Drawings. When penetrating wood studs, joists, and other wood members, provide such members with reinforcement steel straps of Continental Steel & Tube Co., ULINE, Independent Metal Strap, or equal.
 - 7. Reduce fitting where any change in pipe size occurs. Bushings shall not be furnished unless specifically reviewed by the ARCHITECT, or indicated on Drawings.
 - 8. Piping subject to expansion or contraction shall be anchored in a manner, which permits strains to be evenly distributed. Swing joints or expansion loops shall be installed. Seismic restraints shall be installed so as not to interfere with expansion and contraction of piping. Seismic loops required at all building separations.
 - 9. Immediately after lines have been installed, openings shall be capped or plugged to prevent entrance of foreign materials. Caps shall be left in place until removal is necessary for completion of installation.

10. Couplings shall not be installed except where required pipe runs between other fittings are longer than standard length of type of pipe being installed and except where their installation is specifically reviewed by the ARCHITECT.
11. Water piping shall be installed generally level, free of traps, unnecessary offset, arranged to conform to building requirements, clear of ducts, flues, conduits, and other Work. Piping shall be arranged with valves installed to provide for complete drainage and control of system. Piping shall not be installed which causes an objectionable noise from flow of water therein under normal conditions. Refer to Section 23 0500: Common Work Results for Plumbing.
12. Water lines may be installed in same trench with sewer lines, provided bottom of water line is 12 inches minimum above top and to the side of sewer line.
13. Changes in pipe sizes shall be furnished with eccentric reducers, flat on top. Offsets to clear obstruction shall not be installed so as to produce air pockets.

C. Pipe Sleeves and Plates:

1. Provide pipe sleeves of Schedule 40 black steel pipe or Schedule 40 PVC plastic pipe in concrete or masonry walls, footings, and concrete floors below grade. Provide adjustable submerged deck type sleeves at locations where pipes pass through concrete floors, except concrete slab floors on grade, and at locations where soil pipe for floor type water closets passes through concrete floors.
2. Sleeves shall provide ½ inch clearance around pipes, except plastic pipe shall have 1 inch clearance. Caps of deck type sleeves shall be removed just prior to installation of pipe. Area around sleeves shall be smooth and without high or low spots. Sleeves in walls shall not extend beyond exposed surface of wall. Sleeves in concrete floors and walls shall be securely fastened to forms to prevent movement while concrete is being placed.
3. Piping installed on a roof shall clear the roof surface by 10 inches minimum, with or without insulation. Bottom of individual fittings may infringe on 10 inches clear space but not groups of fittings or fittings located within 27 inches of each other.
4. Stiles shall be provided to facilitate crossing of piping when parallel piping runs are laterally greater than 12 inches out-to-out, or any pipe is higher than 18 inches, and more than 40 feet long or runs between two or more major pieces of equipment or housings greater than 20 feet apart. Stiles shall be not less than 20 inches wide with a minimum tread depth of 10 inches. Where stiles are required, they shall be located so greatest obstructed distance is 30 feet.
5. Where pipes pass through waterproofed walls, floors, or floors on grade, sealant with Link-Seal Modular Seals, or equal, between pipe and sleeve to provide a waterproof joint. Where earth is in contact with pipe on both sides of

a wall or foundation, the waterproof joint is not required. Commercial rubber compression units may be furnished instead of sealed sleeves if reviewed by the ARCHITECT.

6. A swing joint, or other required device, shall be furnished and installed in hot water lines with 10 feet of sealant or compression joint to allow for expansion.
7. Provide polished, chrome-plated flanges when plumbing pipes pass through walls at plumbing fixtures, etcetera as specified in Section 22 1000 Plumbing. Provide polished steel, chromium-plated split floor and ceiling plates at locations where pipes pass through walls, floors, ceilings, and partitions in finished portion that neatly conceals pipe insert.
8. Pipe sleeves shall be provided where pipes intersect footings or foundation walls and sleeve clearances shall provide for footing settlement, but not less than one inch all around pipe.

D. Welding of Pipe and Qualifications of Welder:

1. Joints above grade or accessible conduit or tunnels in steel piping may be either welded or screwed unless specifically indicated otherwise on Drawings or specified. Joints in below grade steel piping, whether in insulation or not, shall not be welded, unless otherwise indicated.
2. Welded joints in pipe shall be continuous around pipe and shall comply with ASME B31: Code for Pressure Piping, unless otherwise specified.
3. Each pipe weld shall be stamped with welder's identification mark. Welding shall be performed by welders possessing a valid certificate of qualification for welding carbon steel welding pipe in horizontal position (2G) and horizontal fixed position (5G) in accordance with the requirements of Section IX of the ASME Boiler and Pressure Vessel Code, by an OWNER-recognized, DSA approved testing laboratory.
4. Before any welder performs welding on the Work, furnish the INSPECTOR with a copy of welder's valid qualification papers and obtain verification. Welder qualification is not valid unless it has been issued while welder was performing work for current employer, and has performed type of work described by qualification in the preceding 3 months.
5. Welding performed under these Specifications is subject to special tests and inspections including rigid Ultra Sonic Testing (UT) and radiographic inspection at random, in accordance with Technique for Radiographic Examination of Welded Joints by an OWNER recognized, DSA approved testing laboratory.

E. Unacceptable Welds and Repairs to Welding:

1. Welds containing any of the following types of imperfections shall be deemed defective Work:

- a. Cracks of any type.
 - b. Zones of incomplete (in excess of 1/32 inch) fusion or penetration.
 - c. Elongated slab inclusions longer than 1/4 inch.
 - d. Groups of slag inclusions in welds having an aggregate length greater than thickness of parent metal in a length 12 times the thickness of the parent metal.
 - e. Undercuts greater than 1/32 inch.
 - f. Overlaps, abrupt ridges or valleys.
3. When a defective weld is detected by examination as outlined above, two additional welds shall be radiographed at locations selected by the Project Inspector. If the two selected welds demonstrate compliant welding, then the two tested welds shall be deemed to be in compliance. Welding revealed by radiographs to be defective Work shall be removed, repaired, and tested by radiograph.
 4. If either of the two selected welds demonstrates welding deemed to be defective Work, all welding in that portion of the Work shall be deemed defective Work and either: all welds shall be cutout, prepare new ends for welding and weld to comply with this Specification, or radiograph all welds, removing and repairing only such welding deemed to be defective Work.
 5. Repair welding shall be performed in a manner in full compliance with ASME B31. The welded joints or repairs shall be spot examined with UT or radiographic tests in accordance with foregoing requirements.
 6. OWNER shall cause to be performed additional random UT and radiographic examinations of welds. OWNER shall be responsible for the costs of any UT and radiographic examinations found to be in compliance with specified requirements.
 7. Installer shall be responsible for the costs of UT and radiographic re-examinations of welds deemed defective Work and not in compliance with this Specification, and shall repair or replace said welds in accordance with specified requirements.
- F. Welding Rods: Submit a written list of materials and proposed type of welding rods.
- G. Backing Rings: Backing rings may be submitted for installation provided the Product Data is submitted with the material list.
- H. Qualification Tests for Low-pressure Welding:
1. Tests shall be performed on 3-inch standard weight pipe ASTM A53, Grade A, and shall be welded by acetylene and electric arc. Each sample shall consist of 2 pieces, each 10 inches long, with 30-degree bevel at point weld.

2. Two 20-inch samples shall be performed in the 2G and two 20-inch samples in the 5G positions, with positions defined in Section IX, ASME Boiler and Pressure Vessel Code. Welds shall have the reinforcement ground or machined flush to the surface of the pipe before testing. Samples shall be tested as full section tensile.
3. Weld shall develop a load of 90 percent of 50,000 psi, i.e., 45,000 psi or shall develop a fracture in parent metal.
4. Each qualified welder shall carry an identification card listing welder's name, date of test, and type of welding tests passed; signed by the welder and the laboratory.
5. A valid certificate of qualification issued in compliance with requirements of the ASME Boiler Pressure Vessel Code Section IX shall qualify a welder for issuance of a certificate for low-pressure pipe welding.

I. Certificates of Qualification for Welding of Unfired Pressure Vessels:

1. Certificates of qualification shall be issued by a laboratory recognized by the OWNER in compliance with the requirements of the ASME Boiler Pressure Vessel Code Section IX. Qualifications shall be for both acetylene and arc welding of Schedule 40 ASTM A53, Type B, steel welded or seamless pipe in the Horizontal Position (2G) and the Horizontal Fixed Position (5G) as defined by said code.
2. Certificate described above is not valid unless it has been issued while welder was working for his current employer, and unless welder has performed type of work described by certificate in the preceding three months. Requirements for possession of a valid certificate shall not be waived for welders fabricating unfired pressure vessels when the Specifications require compliance with ASME code or when welding pipe carries working pressures greater than 75 psi and temperatures greater than 250 degrees F.

J. Pipe Joints and Connections:

1. Pipe and tubing shall be cut per IAPMO Installation Standards. Pipe shall have rough edges or burrs removed so that a smooth and unobstructed flow shall be provided.
2. Hot tapping of gas lines is strictly prohibited.
3. Threaded Pipe: Joints in piping shall be installed according to the following service schedule:
 - a. Soap Piping: Litharge and glycerine, or Expando, Gasoila, or equal.
 - b. Plastic Piping: Teflon pipe joint compound tape.
 - c. Oxygen Piping: Wash threads with S.P., rinse, blow-dry and apply litharge and glycerine.

- d. Cleanout Plugs: No compound shall be used. After inspection and test, plugs shall be removed, cleaned, greased, and replaced.
 - e. Other services furnish sealant, suitable and as reviewed by the ARCHITECT.
4. Threads on pipe shall be cut with sharp, clean, unblemished dies and shall conform to ANSI/ASME B2.1 for tapered pipe threads.
 5. Joint compounds shall be smoothly placed on male thread and not in fittings. Threaded joints shall be installed tight with tongs or wrenches and sealant of any kind is not permitted. Failed joints shall be replaced with new materials. Installation of thread cement or sealant to repair a leaking joint is not permitted.
 6. Sharp-toothed Stillson, or similar wrenches, is not permitted for the installation of brass pipe or other piping with similar finished surfaces.
- K. Copper Tubing and Brass Pipe with Threadless Fittings:
1. Silver brazed joints shall be used for attaching fittings to non-ferrous metallic refrigerant piping.
 2. Non-pressure gravity fed condensate lines may be soldered with 95/5 solder.
 3. Silver brazing alloy, Class BCUP-5. Surfaces to be joined shall be free of oil, grease, and oxides. Socket of fitting and end of pipe shall be thoroughly cleaned with emery cloth and wiped to remove oxides. After cleaning and before assembly or heating, flux shall be installed to each joint surface and spread evenly. Heat shall be applied in accordance with instructions in the Copper Tube Handbook issued by Copper Development Associates. Joints constructed of rough bronze fittings shall be provided as recommended by manufacturer.
 4. Do not overheat piping and fittings when installing silver brazing.
 5. Joints in non-ferrous piping for services not covered above shall be installed with solder composed of 95/5 tin/antimony, ASTM B32, Grade 5A. Surfaces to be jointed shall be free of oil, grease, and oxides. Sockets of fitting and end of pipe shall be cleaned with emery cloth to remove oxides. Solder flux shall be sparingly installed and solder added until joint is completely filled. Do not overheat. Excess solder, while plastic, shall be removed with a small brush in order to provide an uninterrupted fillet completely around joint. Random inspection of joints shall be conducted by Project Inspector to ensure joints are lead-free.
 6. Grooved end joints for copper piping shall be assembled in accordance with the latest manufacturer recommendations. Pipe ends shall be clean and free from indentations, projections, and roll marks in the area from pipe end to groove for proper gasket sealing. Grooving tools shall be as manufactured by Victaulic, RIDGID, MAG Tool, or equal.

7. Pressed fittings for copper or copper alloy pipe or tubing shall have an elastomeric O-ring that forms the joint. The pipe or tubing shall be fully inserted into the fitting, and the pipe or tubing marked at the shoulder of the fitting. Pipe or tubing shall be cut square, mechanically cleaned and reamed prior to joining to remove all burrs (interior and exterior) and restore full inside diameter and a smooth, chamfered exterior surface. The fitting alignment shall be checked against the mark on the pipe or tubing to ensure the pipe or tubing is inserted into the fitting. The joint shall be pressed using the tool recommended by the manufacturer.
 - a. Press Installation Training Requirement: Installation training shall be provided on site by manufacturer personnel and documented with Engineer. Installation procedures, depth guides, and tool inspection shall be provided by manufacturer for all product types (steel or copper) for reference and safety assurance.
- L. Ring-Type Pipe: Joints shall be installed in accordance with manufacturer's instructions with grooved couplings, fittings and rubber rings. Couplings and pipe shall be compatible and of the same manufacturer. Rings shall be accurately located and installed by grooves in coupling. Pipe shall be installed with zero deflection unless otherwise specified. Pressure pipe shall be furnished with thrust blocks at each offset point.
- M. Welded Pipe Joints:
 1. Joints in welded steel pipelines shall be installed by oxyacetylene or electric arc process. Welding shall be continuous around pipe and provided as specified.
 2. Butt welds shall be of the single V-type, with ends of pipe and fittings beveled approximately $37\frac{1}{2}$ degrees. Piping shall be aligned before welding is started with the alignment maintained during welding.
 3. Welds for flanges and socket fittings shall be of the fillet type with a throat dimension not less than pipe wall thickness.
- N. Grooved End Pipe Joints: Grooved end joints for carbon steel piping shall be assembled in accordance with the latest manufacturer recommendations. Pipe ends shall be clean and free from indentations, projections, and roll marks in the area from pipe end to grove for proper gasket sealing. Grooving tools shall be as manufactured by Victaulic, RIDGID, MAG Tool, or equal.
- O. Stainless steel press joints: Joints shall be Vic-Press 304TM, or equal, made with Victaulic Series 'PFT' tools and the appropriate sized jaw. Pipe shall be certified for use with Vic-Press 304TM system, and shall be square cut, properly deburred and cleaned, and marked at the required location to insure full insertion into the fittings and/or couplings.
- P. Polyethylene (Plastic) Pipe:

1. Joints shall be installed by the heat fusion method, in accordance with manufacturer's recommendations and IAPMO installation standard IS 12, for natural gas.
2. Pipe Riser at Meter, Regulator and Building Wall: Prefabricated, anodeless type, utilizing a grade level transition between underground polyethylene pipe and gas supply steel pipe of riser outlet, GF Piping Systems, or equal. Below grade to above grade transition shall be installed in a welded, epoxy coated, steel casing.
3. Connections to Existing Pipe Line or Branch:
 - a. Steel-to-plastic (PE): Provide manufacturer's prefabricated standard transition fitting, transition from epoxy-coated steel pipe to plastic, R. W. Lyall Co., or equal.
 - b. Plastic-to-plastic, PVC to PE: Provide manufacturer's prefabricated standard transition fitting, transition from PVC to epoxy-coated steel pipe to PE; R.W. Lyall Co., or equal.
 - c. Plastic-to-plastic, PE to PE: Provide manufacturer's standard fused tapping tee assembly with shut-off feature.
4. Provide PE reinforcing sleeves where PE pipe is fused to multi-saddles, service punch tee, reducing tees, transition fittings and anodeless risers.

Q. Valves: Valves shall conform to the following:

1. Piping systems shall be furnished with valves at points indicated on Drawings and specified, arranged to provide complete regulating control of piping system throughout building and the Project site.
2. Valves shall be installed in a neat grouping, so that parts are easily accessible and maintained.
3. Valves shall be full size of line in which they are installed, unless otherwise indicated on Drawings or otherwise specified, and shall be one of types specified.
4. Provide chain operators on valves 2-inch and larger located 7 feet or more above the servicing floor level.
5. Valves for similar service shall be of one manufacturer.
6. Except where otherwise specified, valves shall be Apollo, Belimo, Victaulic, Stockham, Crane, Jenkins, Milwaukee, Hammond, American, NIBCO, Hoffman, or equal.
7. Ball valves below grade in yard boxes shall have stainless steel handles.

8. Hose bibs in dense garden areas shall be $\frac{3}{4}$ inch in size with one hose bib in the lunch pavilion 1 inch in size. Other hose bibs shall be $\frac{3}{4}$ inch lock shield type. Bibs shall be furnished with vacuum breaker protection.
 9. Safety valves and pressure relief valves shall have stamp of approval as required by ASME and shall be provided with annual test lever. Where a hot water storage tank is heated by means of a coil, pressure relief valve shall have a steam BTU discharge rating of the coil. Discharge pipe from safety or pressure relief valves shall be not less than one pipe size larger than inlet pipe size of valve. Discharge pipe shall terminate as indicated and shall be free of traps. In addition to locations specified, pressure relief valves shall be installed in the following locations:
 - a. On discharge side of each pressure-reducing valve.
 - b. On each water heater connected to a hot water storage tank and other pressure vessels.
 - c. On cold water line to each water heater or hot water storage tank when there is a check valve, backflow prevention valve or similar device between water heater or hot water storage tank and meter or relief valve at the pressure reducing valve assembly.
 - d. On discharge side of each air compressor.
 - e. On each air receiver connected to an air compressor.
 10. Temperature relief valves and combination temperature and pressure relief valves shall be as specified and furnished as set forth in this Section. Discharge pipe from relief valves shall be not less than discharge area of valve or valves it connects, based on discharge area of valves, and shall terminate as indicated and free of any traps. Valves shall be installed at following locations:
 11. A combination temperature and pressure relief valve or combination of valves on each heating hot water storage tank. Temperature sending element shall extend into water inside tank.
 12. Manual air vent valve assemblies shall be installed at each high point of hot water space heating and chilled water piping systems. Valves shall discharge through $\frac{1}{4}$ inch diameter copper tubing and drain to nearest floor sink. Automatic type air vent valve shall only be installed where specifically indicated. Radiator, convectors, and finned pipe convectors shall be fitted with packless radiator valves, angle or straight pattern. Each convector or radiator installed as part of a space hot water heating system shall be furnished with a manual-type air vent valve.
- R. Strainers: Strainers shall be installed on each water main (except for fire line) downstream of the meter, above grade, when a pressure regulator assembly is not installed. Main strainer shall be of Y-flange or groove type. On closed loop chilled and heating hot water systems pump systems, a strainer shall be installed at each pump inlet and upstream of each flow control valve assembly. The control valve assembly

may include a modulating temperature control valve and a flow-limiting valve, manufactured by Griswold, AutoFlow, Flow Control Industries, Inc., or equal.

S. Hangers and Supports:

1. Piping shall be securely fastened to building structure by approved iron hangers, supports, guides, anchors, and sway braces to maintain pipe alignment to prevent sagging and to prevent noise or excessive strain on piping due to uncontrolled or seismic movement under operating conditions. Hangers and supports shall conform to Manufacturer's Standardization Society Specification SP-69. Hangers shall be relocated as required to correct unsatisfactory conditions that may become evident when system is placed into operation. Appliances, heat exchangers, storage tanks, and similar equipment shall be securely fastened to structure in accordance with seismic requirements. Outdoor metal hangers and supports shall be hot-dipped galvanized steel, unless otherwise specified.
2. Hose faucets, compressed air outlets, and similar items at ends of pipe branches shall be rigidly fastened to building construction near point of connection.
3. Piping shall not be supported by wire, rope, wood, plumbers' tape, or other non-recognized devices.
4. Hangers and supports shall be designed to support weight of pipe, fittings, weight of fluid and weight of pipe insulation, and shall have a minimum factor of safety of five, based on ultimate tensile strength of material installed.
5. Burning or welding of any structural member under load is not permitted. Field welding not specified on Drawings or reviewed Shop Drawings is not permitted without review by ARCHITECT and DSA.
6. Burning holes in beam flanges or other structural members is not permitted without review by the ARCHITECT and DSA.
7. Pipe hangers on piping covered with low temperature insulation shall be installed on outside of insulation and not in contact with pipe unless otherwise detailed on Drawings. Insulation shall be protected by 18 gage galvanized steel shield, with a minimum length of 10 inches, installed completely around pipe covering between covering and hanger. Installing hangers directly on pipe and butting adjoining sections of insulation against hanger is permitted provided void and hanger rod are properly insulated and sealed so that no sweating occurs at hangers.
8. Hanger rods shall be fastened to structural steel members with suitable beam clamps. Clamps shall be Tolco, Carpenter & Patterson, Fee and Mason, or equal, as follows:
 - a. Tolco I beam, Fig.62 for maximum 1000 pounds.
 - b. Tolco I or WF beam, Fig. 329, for maximum of 1290 pounds.

9. Hanger rods shall be fastened to concrete inserts in concrete slabs or beams. Inserts shall be Tolco, Carpenter & Patterson, Fee and Mason, or equal, as follows:
 - a. Tolco Fig.310 for maximum of 600 pounds.
 - b. Tolco Fig. 309 for maximum of 1140 pounds.
10. For fastening to wood ceilings, beams, or joists, furnish Grinnell Fig. 128R, Grinnell Fig. 153, Tolco 78, or equal pipe hanger flange fastened with drive screws. Under wood floors, 3/8 inch hanger rods shall be hung from 2-inch by 2-inch by 1/4 inch angle clips 3 inches long, with 2, staggered 10d nails, clinched over joist.
11. Pipe hanger rod sizes: 3/8-inch for pipe sizes 1/2-inch through 4-inch, 1/2-inch for pipe sizes 5-inch through 8-inch, and 5/8-inch for pipe size 10-inch through 12-inch.
12. Where rod hangers are used with a diameter greater than 3/8-inch, they shall be equipped with swivels or eye nuts to prevent bending in the rod.
13. Turnbuckles, if furnished, shall provide a load carrying capacity equal to that of the pipe hanger with which they are being installed.
14. Pipe hangers shall be of same size, or nearest larger manufactured size available, as pipe or tubing on which they are being installed.
15. Hangers, clamps, and guides furnished for support of non-metallic pipe shall be padded with 1/8 inch thick rubber, neoprene, or soft resilient cloth.
16. Where special pipe-supporting requirements in the Specifications conflict with any standard requirements specified herein, the Specification requirements shall govern.
17. Vertical Piping:
 - a. Vertical pipe risers shall be securely supported with riser clamps of recognized type. Risers in reinforced concrete buildings shall be furnished with extension clamps fastened to pipe above each concrete floor slab with extended arms of clamp to rest on slab. Clamps shall be provided with lead or Teflon liners when installed on copper tubing. Clamps shall be plastic-coated when installed on non-ferrous pipe or tubing.
 - b. Copper tubing in sizes 1 1/2-inches and larger and steel pipelines passing up through building shall be supported at each floor of building or every 15 feet whichever is less.
 - c. Copper tubing sizes 1 1/4-inches and smaller shall be supported at not intervals not more than 6 feet on center. Special provisions shall be

installed for vertical lines subject to expansion and contraction caused by operating temperature differences.

- d. Vertical cast iron pipelines shall be supported from each floor and at its base. Malleable iron or steel pipe clamps with minimum thickness of 1/4 inch shall be furnished and fastened around pipe for support.

18. Horizontal Piping:

- a. Roof Mounted Piping: Pressure and non-pressure piping shall be supported from channels, stands, clamps, trapezes, rollers, or structures mounted on 100% rubber, UV resistant rooftop supports with reflective strips, Dura-Block, or equal. Roller type supports shall be provided below and above pipe to prevent its dislodgement. Bottom of pipes shall clear the roof surface by 10 inches.
- b. Insulated steam and space heating hot water insulated condensate lines, insulated domestic hot water supply and return piping shall be supported with Tolco Figure 4, B-Line Figure B3140, Grinnell Figure 212, or equal, steel hangers with welded eye rods to permit hinge movement at point of attachment of hangers. Hinge movement at point of support shall be provided by welded eye linked rods Tolco Figure 101L, B-Line Figure B3211X, Grinnell Figure 278, or equal.
- c. Domestic cold water piping, water supply and return piping, condenser water piping, insulated refrigerant piping gas piping, compressed air piping, cast iron soil piping, galvanized steel vents, waste and downspout piping and glass to be supported with Tolco Figure 1, B-Line Figure B3100, Grinnell Figure 260, or equal, hangers with rods, turnbuckles and inserts suitable for above hangers.
- d. Maximum hanger and support spacing shall conform to CPC schedule for horizontal piping installed above grade.

19. A hanger or support shall be installed close to the point of change in direction of a pipe run, in either a horizontal or vertical plane.

20. When practicable, supports and hangers for cast iron soil pipe shall be installed as close as possible to joints and when hangers or supports are not located within one foot of a branch line fitting, an additional hanger or support shall be installed at fitting.

21. In systems where grooved piping is used, couplings shall be provided with angle pattern bolt pads to comply with support and hanging requirements of ANSI/ASME B31.1, ANSI/ASME B31.9, and NFPA Pamphlet 13.

T. Flashings:

1. Each pipe, duct, or gas-fired equipment vent passing through roof shall be installed with waterproof flashing.

2. Flashing or flanges on pipes, vents, and ducts passing through a tile or slate roof shall be constructed of sheet lead. Flashing for pipes and heater vents passing through a roof shall be 4 pound soft sheet lead. Flashing and flanges for ducts and heater vents passing through exterior walls shall be 22 gage sheet metal. Install caps on top of heater pipes. Flanges and flashing shall be installed waterproof at point of connection with pipe or duct by welding. No soldered joints on roof flashings will be allowed. No Stoneman lead roof flashings will be allowed.
 3. Lead flashing and flanges shall be constructed of 4 pound sheet lead with burned joints. Flange of lead flashing or lead flange on a duct shall extend out onto roof a minimum of 12 inches from pipe or duct. Lead flashing shall extend up the pipe or duct not less than 8 inches.
 4. Sheet metal flashing shall be constructed of 24 gage galvanized sheet steel. Flanges on these flashings shall extend out onto roof a minimum of 10 inches from pipe or duct. Flanges on ducts through exterior walls shall extend out from duct a minimum of 2 ½ inches. Flanges on gas-fired equipment single-wall vents shall be of ventilated type. Type B gas vents through a roof shall be furnished with non-ventilated flashing as per NFPA Pamphlet 211.
 5. Cast iron, steel, brass, and copper pipe, which terminates less than 18 inches above roof, shall be furnished with a combination counter-flashing and vandal-proof hood for protection against water, birds and foreign matter. Cast iron, steel, brass and copper pipe, which does not terminate within 18 inches of roof, shall be furnished with a counter-flashing sleeve. Pipe, which terminates more than 18 inches above roof, shall be furnished with protection against entrance of water, birds, and foreign matter.
 6. Counter-flashing and combination counter-flashing sleeves and vandal-proof hoods shall be cast iron, vandal-proof, threaded, sealed or approved gas-heated sleeve type. Counter-flashing sleeves on each of these items shall extend down over flashing a minimum of ¾ inch.
 7. Storm collars shall be securely screwed and installed waterproof around appliance vent pipe immediately above flashing.
 8. Vent piping above roof shall be furnished with a combination counter-flashing sleeve and vandal-proof hood.
- U. Equipment Installation: Install roof or floor mounted equipment on level platforms, housekeeping pads or curbs and provide sound, vibration and seismic control measures per Section 23 0548 even if not indicated on Drawings.

END OF SECTION

SECTION 22 0553

PLUMBING IDENTIFICATION

PART 1 – GENERAL

1.1 SUMMARY

- A. Section Includes: Marking and identification on mechanical piping systems, ducts, controls, valves, and apparatus.
- B. Related Requirements:
 - 1. Division 01: General Requirements
 - 2. Section 21 1313: Fire-Suppression Sprinkler Systems.
 - 3. Section 22 0513: Basic Plumbing Materials and Methods.
 - 4. Section 22 1000: Plumbing.
 - 5. Section 22 2013: Plumbing Piping.

1.2 SUBMITTALS

- A. Submit in accordance with Division 01 and Section 22 0500: Common Work Results for Plumbing.
- B. Submit product data and installation instructions for each item specified.
- C. Submit Samples of materials.

1.3 QUALITY ASSURANCE

- A. Comply with provisions of:
 - 1. Section 22 0500: Common Work Results for Plumbing.
 - 2. ANSI/ASME A13.1: Scheme for the Identification of Piping Systems.
 - 3. APWA: Uniform Color Code.
 - 4. IAPMO: Uniform Plumbing Code (UPC)

PART 2 – PRODUCTS

2.1 MATERIALS

- A. General: Piping systems, controls, valves, apparatus, etc., except those that are installed in inaccessible locations in partitions, walls, and floors, shall be permanently identified.

2.2 VALVES

- A. Furnish prepared chart or diagram for each piping system, indicating by identifying letter or model number of each valve in the system, its location, and function.
- B. Install charts in aluminum frame with clear glass front and secure on wall where designated by the Project Inspector.
- C. Bind copies of each chart in operating instructions manual.
- D. Provide each valve with a brass, aluminum, or plastic disc, not less than 1-1/4 inches diameter bearing engraved numbers corresponding to those indicated on chart. Fasten discs to valve with No. 14 brass wire.
- E. Provide an additional tag for safety valves and other valves that could be hazardous to safety and health of occupants. Distinguish these tags from regular valve tags by color (such as yellow with black letters and marked "Danger"); submit Sample tag to the Architect for review.

2.3 INSTRUMENTS AND CONTROLS

- A. Identify panel-mounted instruments and controls with engraved bakelite nameplates permanently affixed to panel boards.
- B. Identify alarm indicating devices and alarm reset devices by nameplates.
- C. Identify automatic valves, flow switches, and pressure switches, with embossed aluminum or plastic tape affixed to controller, indicating service and setting.

2.4 EQUIPMENT

- A. Identify each major piece of equipment with engraved bakelite nameplates permanently affixed to the equipment, indicating the room numbers it services, Equipment identification designation shall be the same to its designation indicated on the "As-Built Drawings". Room numbers in the nameplates shall correspond to the final room numbers.

2.5 ABOVE GRADE PIPE IDENTIFICATION

- A. Identify pipes by means of colored labels with directional flow arrows and identification of the pipe content, in conformance to ANSI/ASME A13.1 or the UPC.
- B. Materials: Precoiled acrylic plastic with clear polyester coating, all-temperature, self-adhering, as manufactured by Brady, Brimar Industries, Seton, Stranco, Inc., or equal.
- C. Size:

Outside Diameter of Pipe or Insulation (in inches)	Length of Color Field (in inches)	Size of Letter (in inches)
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¾ to 1 ¼	8	½
1 ½ to 2	8	¾
2 ½ to 6	12	1 ¼
8 to 10	24	2 ½
over 10	32	3 ½

D. Locations:

1. On accessible piping, whether insulated or not (including mechanical rooms, attic and ceiling spaces); except that labels shall be omitted from piping where contained material is obvious due to its connection to fixtures (such as faucets, water closets, etcetera.).
2. Near each valve and branch connection in such accessible piping.
3. At each pipe passage through wall or floor.
4. At not more than 20 feet spacing on straight pipe run between bands required in 2 and 3 above.
5. At each change in direction.

E. Application: Install on clean surfaces free of dust, grease, oil, or any material that will prevent proper adhesion. Replace non-adhering or curling labels with new labels.

F. Color Schedule:

Content of Pipe	Legend	Background Color	Lettering Color
Domestic cold water	Domestic. C.W.	Green	White
Non-potable cold water	Caution: Non-potable Water Do Not Drink (1)(2)	Purple	Black
Domestic hot-water 140°F	Domestic H.W. 140°F	Blue	Black
Sanitary waste	San waste	Green	White
Sanitary vent	San vent	Green	White
Storm drain or downspout	Storm drain	Green	White
Indirect drain	Ind drain	Green	White
Sump pump discharge	Pump discharge	Green	White
Fire sprinkler supply	Fire Sprinkler supply	Red	White
Fire sprinkler drain	Sprinkler drain	Red	White

Fuel oil	Diesel oil	Yellow	Black
Gas	Gas	Yellow	White
Reclaimed Water	Caution: Reclaimed Water Do Not Drink (1)(3)	Purple	Black

H. Notes on Schedule:

1. Note (1) indicates 2 ¼ inch by 1 inch yellow label with ½ inch letters reading UNSAFE WATER at one end of primary label.

Note (2) words should read “CAUTION: NONPOTABLE WATER DO NOT DRINK.” with international *do not drink* symbol.

Note (3) words should read “CAUTION: RECLAIMED WATER DO NOT DRINK.” with international *do not drink* symbol.

2.6 UNDERGROUND PIPE

A. Detectable Marking Tape:

1. Provide and install detectable marking tape along buried piping. Tape shall be specifically manufactured for marking and locating underground utilities with electronic equipment. Tape shall be acid and alkali resistant, and manufactured with integral wires or foil backing, encased with protective cladding. Tape shall be a minimum of two inches in width.
2. Manufacturer: Reef Industries, Inc., Advantage Brands, Inc., Northtown Company, Mutual Industries, Inc., or equal.
3. Detectable marking tape shall be color-coded per APWA Color Code:
 - a. Yellow: Oil and gas.
 - b. Blue: Water, irrigation and slurry lines.
 - c. Green: Sewer and drain lines.

B. Tracer Wire:

1. Solid copper wire type THWN, 12 AWG gauge, with heat and moisture resistant insulation.

PART 3 – EXECUTION

3.1 INSTALLATION

- A. Correct detrimental conditions prior to commencing the Work of this Section. Install markers and identification tags as specified with materials and installation procedures recommended by manufacturer.

- B. Place tracer wire on top of non-metal utility lines allowing some slack. Do not wrap tracer wire around pipe. Fasten tracer wire in place at approximately 10 feet on centers with non-metal ties.
- C. Install underground detectable pipe marking tape continuously buried 8 to 10 inches above the buried utility pipe. Wrap tape on pipe risers up to a height of 12 inches above grade.

3.2 CLEANUP

- A. Remove rubbish, debris, and waste materials and legally dispose of off the Project site.

END OF SECTION

SECTION 22 0700
PLUMBING INSULATION

PART 1 – GENERAL

1.1 SUMMARY

A. Section Includes:

1. Insulation for plumbing piping.

B. Related Requirements:

1. Division 01: General Requirements.
2. Section 22 0500: Common Work Results for Plumbing.
3. Section 22 0513: Basic Plumbing Materials and Methods.
4. Section 22 0553: Plumbing Identification.
5. Section 22 1000: Plumbing.

1.2 REFERENCES

A. American Society for Testing and Materials International (ASTM):

1. ASTM C302 - Standard Test Method for Density and Dimensions of Preformed Pipe-Covering-Type Thermal Insulation.
2. ASTM C411 - Standard Test Method for Hot-Surface Performance of High-Temperature Thermal Insulation.
3. ASTM C423 - Standard Test Method for Sound Absorption and Sound Absorption Coefficients by the Reverberation Room Method.
4. ASTM C533 - Standard Specification for Calcium Silicate Block and Pipe Thermal Insulation.
5. ASTM C547 - Standard Specification for Mineral Fiber Pipe Insulation.
6. ASTM C1104 - Standard Test Method for Determining the Water Vapor Sorption of Unfaced Mineral Fiber Insulation.
7. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials.

8. ASTM G21 - Standard Practice for Determining Resistance of Synthetic Polymeric Materials to Fungi.
- B. Underwriters Laboratories, Inc.
1. UL 723 - Test for Surface Burning Characteristics of Building Materials.
- C. National Fire Protection Association:
1. NFPA 255 - Standard Method of Test of Surface Burning Characteristics of Building Materials.
- D. California Code of Regulation Title 24.
1. California Green Building Standards Code.

1.3 SUBMITTALS

- A. Submit in accordance with Division 01 and Section 22 0500: Common Work Results for Plumbing.
1. Complete material list of items to be furnished and installed under this Section.
 2. Manufacturer's specifications and other data required demonstrating compliance with the specified requirements.
 3. Shop Drawings, catalog cuts and manufacturer's data indicating insulation, jacketing, adhesives, and coating. Insulating materials shall be certified by manufacturer to comply with the California quality standards for insulating materials.
 4. Display sample cutaway sections.
 5. Manufacturer's recommended method of installation procedures, which will become part of this Section.

1.4 QUALITY ASSURANCE

- A. Qualifications of Manufacturer and Installer, Materials, Fabrication, Execution, and Standard of Quality: Comply with provisions stated under Section 22 0500: Common Work Results for Plumbing and Section 22 0513: Basic Plumbing Materials and Methods.
- B. Insulation Work shall be in accordance with the California Building Energy Efficiency Standards, CBC, and Uniform Mechanical Code and the California Green Building Standards Code.
- C. Test Ratings:

1. Comply with provisions stated under Section 22 0500 and 22 0513 with emphasis on ASTM E84, NFPA 255, or UL 723. ASTM C167, ASTM C302, UL label or listing of satisfactory test results from the National Institute of Standards and Technology, or a satisfactory certified test report from an acceptable testing laboratory. Approval by the State Fire Marshal is required.
 2. Furnish labels, legibly printed with the name of the manufacturer or listings indicate that fire hazard ratings do not exceed those specified for materials proposed for installation. Flame spread index of not more than 25 and smoke developed rating not exceeding 50.
 3. Tests shall be performed on each item individually when insulation, vapor barrier covering, wrapping materials, or adhesives are installed separately at the Project site.
 4. Test insulation, vapor barrier covering, wrapping materials and adhesives as an assembly when they are factory composite systems.
- D. Regulatory Requirements: Insulation furnished and installed under this Section shall meet minimum legal requirements of the Building Energy Efficiency Standards adopted and incorporated in the California Energy Commission, Title 24, Part 2, Chapters 2 through 53 and the California Green Building Standards Code unless otherwise noted, for the piping,
- E. Chemically based products such as sealers, primers, fillers, adhesives, etcetera must meet the California air quality regulations.

1.5 PRODUCT HANDLING

- A. Protection, Replacement, Delivery and Storage: Comply with provisions stated under Sections 22 0500: Common Work Results for Plumbing and 22 0513: Basic Plumbing Materials and Methods.

PART 2 – PRODUCTS

2.1 MATERIALS

- A. General:
1. Insulating material shall be fire resistant, non-corrosive, shall not break, settle, sag, pack or disintegrate under vibration, nor absorb more than 1 percent moisture by weight.
 2. Insulating material shall be furnished with thickness indicated in Table 1, and shall furnish thermal resistance in the range of R-4.0 to 4.6 in accordance with inch at 75 degrees F. For any other value of R, insulation thickness shall be calculated accordingly and submitted for review.

3. Asbestos in any quantity in insulating material is not permitted.
4. Provide insulation materials, adhesives, coatings, sealants, fitting covers, and other accessories with a fire hazard rating not to exceed 25 for flame spread, 25 for fuel contributed and 50 for smoke developed, except for materials listed as follows:
 - a. Nylon anchors for installing insulation to equipment.
 - b. Treated wood blocks.
5. Flame-proofing treatments subject to moisture damage are not permitted.

TABLE 1 - MINIMUM PIPING INSULATION THICKNESS ⁽¹⁾

Insulation Thickness Required (in inches)

Piping System Type	Temp. Range (degrees F)	Runouts up to 2 (2)	1 and less	1.25 to 2	2.5 to 4	5 to 6	8 and larger
Service Water Heating Systems (recirculating, piping supply and return)							
Hot Water	Up to 180	0.5	1.0	1.0	1.5	1.5	1.5
Condensate Drain	½ inch minimum insulation thickness.	0.5	0.5	0.5	0.5	0.5	0.5
From A/C Equipment:	Insulate condensate drain lines within building, in room, inside walls and above ceilings.	0.5	0.5	0.5	0.5	0.5	0.5

NOTES: (1) For piping exposed to ambient temperatures, increase thickness by 0.5 inch.

(2) Runouts to individual terminal units, not exceeding 12 feet in length.

- B. Lagging Adhesives: Shall be nonflammable and fire-resistant and shall have a maximum flame spread index of 25 and a maximum smoke developed index of 50 when tested in accordance with ASTM E84. Insulation finished with canvas shall be provided with laps adhered in accordance to manufacturer's recommendation. A finish coat of same material shall be applied to entire outer surface of lagging cloth at coverage specified by manufacturer.
- C. Canvas Jackets: Provide 6 ounce, in accordance with square foot minimum, 48 by 48 thread count canvas jacketing.
- D. Insulation Jackets:

1. Exterior insulation exposed to weather shall be weatherproofed with Childers aluminum jacketing as basis of design, or Pabco, RPR, or equal. Jacketing shall be manufactured from 1100, 3105 or 5010 aluminum alloy with 3/16 inch corrugations. Smooth or embossed jackets may be permitted in special situations to match an existing installation. Jacketing shall be furnished with an integrally bonded moisture barrier over entire surface in contact with insulation. A minimum thickness of 0.016 aluminum jacketing is to be provided on ducts and piping. A minimum thickness of 0.020 shall be provided on tanks, equipment, and heat exchangers.
 2. Insulated elbows, of 90 degrees and 45 degrees, with a nominal iron pipe size of ½ inch to 8-inch shall be provided with Childers aluminum Ell-Jacs insulation covers as basis of design, or Pabco, RPR, or equal, manufactured from 1100 aluminum alloy of 0.024 inch thickness. Insulated elbows with a nominal pipe size of 10-inch to 18-inch shall be provided with Childers 4-piece aluminum Ell-Jacs as basis of design, or Pabco, RPR, or equal.
 3. Tees, Flanges, and Valve Insulation in Conjunction with Aluminum Jacketing: Furnish Childers Aluminum Special Fabrications Insulation Covers as manufactured by Childers Products Company, Pabco, RPR, or equal.
- E. Adhesives: Adhesives shall be water based, UL Classified, meet the requirements of NFPA 90A and NFPA 90B, have been tested according to relevant ASTM requirements, and be acceptable to the State Fire Marshal. Name, type and method of installation shall be submitted for review.
- F. Valve and Fitting Cover: When installed in conjunction with PVC jacketing, furnish Zeston 25/50 rated polyvinyl chloride fitting covers as manufactured by Johns Manville, Knauf Insulation, Speedline, or equal.

2.2 DOMESTIC HOT WATER PIPING SYSTEM INSULATION

- A. General: Insulate domestic hot water supply and return piping, including valves, strainers and fittings with insulation thickness as indicated on Table 1.
- B. Materials:
1. Classes of Insulation:
 - a. Class A: Glass fiber molded pipe insulation suitable for service temperatures up to 850 degrees F. Pipe insulation shall be one piece, preformed, and provide a minimum R factor of 4.0 at 75 degrees F mean temperature. Insulation shall be faced with all-purpose fire retardant vapor barrier jacket. Pipe insulation shall be Johns Manville Micro-Lok, Knauf Redi-Klad 1000, Owens Corning FIBERGLAS Pipe Insulation SSL II-ASJ, or equal.

- b. Class B: Flexible open-cell melamine (foam insulation) suitable for service temperature -150 degrees F to 400 degrees F. Thermal conductivity at 75 degrees F, K= 0.26. Pipe insulation, one-piece pre-formed, laminated to heavy non-reinforced PVC jacket, with locking track, factory installed to jacket, to snap insulation and jacket onto pipe. Similar to TechLite 079 Series as manufactured by Accessible Products Co., or equal. Installation shall comply with manufacturers recommendations.
- c. Class C: Mineral fiber pipe insulation suitable for service temperatures up to 1200 degrees F. Pipe insulation shall be one-piece, preformed up to 3 inches thick, and provide a minimum R factor of 4.0 at 75 degrees F mean temperature. Insulation shall be faced with all-purpose fire-retardant vapor barrier jacket. Pipe insulation shall be 8 pounds in accordance with cubic foot density by Roxul Tecton 1200, Fibrex COREPLUS 1200, Industrial Insulation Group, LLC (IIG) MinWool-1200, or equal.

2. Locations and Class of Insulation Required:

TABLE 2 – LOCATIONS AND CLASS OF INSULATION REQUIRED

<u>LOCATION</u>	<u>CLASS OF INSULATION</u>
Equipment Room	A, B or C
Other Locations	A, B or C

- 3. Fittings on indoor piping shall be covered with flush, hand-wrapped Class A, B, or C insulation, to match the adjoining pipe insulation and covered with polyvinyl chloride fitting covers: Zeston 2000 25/50 by Johns Manville, Knauf Insulation Proto PVC Fitting Cover, Speedline Polycos Smoke Safe, or equal.
- 4. Adhesive: Fibrous Adhesive to bond calcium silicate to itself and non-porous surfaces.

PART 3 – EXECUTION

3.1 INSTALLATION

- A. Except as specified herein, install material in accordance with recommendations of manufacturer. Do not install insulation materials until tests specified in other sections are completed. Remove foreign material such as rust, scale, or dirt. Surfaces shall be clean and dry. Maintain insulation clean and dry at all times.
- B. On cold surfaces where a vapor barrier must be provided and maintained, insulation shall be installed with a continuous, unbroken moisture and vapor seal. Hangers,

supports, anchors, or other projections that are fastened to cold surfaces shall be insulated and vapor sealed to prevent condensation.

- C. Surface finishes shall be extended in such a manner as to protect raw edges, ends, and surfaces of insulation.
- D. Pipe or duct insulation shall be continuous through walls, ceiling or floor openings, or sleeves; except where firestop or firesafing materials are required.
- E. Metal shields shall be installed between hangers or supports and the piping insulation. Rigid insulation inserts shall be installed between the pipe and the insulation shields. Inserts shall be of equal thickness to adjacent insulation and shall be vapor sealed accordingly.
- F. Insulation shall not be installed in the following locations unless otherwise noted:
 - 1. On unions, flanged connections or valve handles.
 - 2. Over edges of any manhole, clean-out hole, clean-out plug, and to restrict opening or identification of access.
 - 3. Over any label or stamp indicating make, approval, rating, inspection, or similar data, unless provision is made for identification and access to label or stamp.

3.2 INSTALLATION OF DOMESTIC HOT WATER PIPING SYSTEM INSULATION

- A. General: Domestic hot water, tempered water supply and return piping and condensate return piping, after having been tested, shall be cleaned and insulated.
- B. Application: Insulate condensate return piping, domestic hot water supply and return, including tempered supply and return piping in accordance with manufacturer's instructions and as specified herein.
 - 1. Install insulation on valve bodies up to valve bonnet. Fill void in saddles, in accordance with Section 22 0513: Basic Plumbing Materials and Methods, with insulation and seal joints.
 - 2. Install insulating material to fittings, valves, and strainers and smooth to thickness of adjacent covering. Leave strainer clean-out plugs accessible. Covers fabricated from polyvinyl chloride shall be furnished.
- C. Insulation Jackets in Exposed Indoor Locations:
 - 1. Cover completed insulation with canvas jacket tightly pasted to covering with lagging adhesive. Lap jacket seams 1 1/2-inch minimum. Finish entire jacket with coating of undiluted adhesive.

2. Equivalent factory applied pre-sized, glass fiber reinforced, or glass fiber jackets may be furnished. Seal jacket seams with adhesive in accordance with manufacturer's instructions.
 3. Johns Manville Zeston 2000, Knauf Insulation Proto PVC Fitting Cover, Speedline Polyco Smoke Safe, or equal, fitting covers may be furnished, with molded or segmented insulation equal to specified insulation applied to fittings. Secure covers in accordance with manufacturer's instructions.
 4. In addition to above requirements, cover exposed insulated piping within a distance of 8 feet above floors with 26 gage galvanized steel jacket. Omit jacket in areas accessible only to maintenance personnel, such as mechanical equipment rooms, utility corridors, accessible pipe tunnels and manholes.
- D. Concealed Indoor Locations: Cover insulation over fittings, valves, and strainers with canvas. Provide pipe insulation with factory or field applied standard jacket of 4 ounce minimum canvas, fiberglass cloth, or glass fiber reinforced jacket. Seal jacket laps with adhesive in accordance with manufacturer's instructions.
- E. Exposed Outdoors: In addition to canvas or fiberglass cloth cover, pipe insulation exposed to weather shall be provided with an additional 0.016 inches thick aluminum jacket with 2-inch lap connected with one inch hem overlap joint located on side of pipe and turned down to shed water. Jacket shall be strapped 12 inches on center with ½-inch wide stainless steel strapping and wing seals. Aluminum jacket shall be mitered to fit fittings.

3.3 CLEANUP

- A. Remove rubbish, debris, and waste materials and legally dispose of off the Project site.

3.4 PROTECTION

- A. Protect the Work of this Section until Substantial Completion.

END OF SECTION

SECTION 22 1000

PART 1 - GENERAL

PLUMBING

1.1 SUMMARY

- A. Section Includes: Labor, materials, tools, and equipment to install plumbing systems as indicated.
- B. Related Sections:
 - 1. Division 01 - General Requirements.
 - 2. Section 22 0500: Common Work Results for Plumbing.
 - 3. Section 22 0513: Basic Plumbing Materials and Methods.
 - 4. Section 22 0553: Identification for Plumbing piping and Equipment.
 - 5. Section 22 0700: Plumbing Insulation..

1.2 QUALITY ASSURANCE

- A. Unless otherwise noted, the California Plumbing Code is hereby made part of this section.
- B. Conform to provisions of Section 22 0500: Common Work Results for Plumbing.
- C. Manufacturer of plumbing products must be third-party certified to ANSI/NSF Standard 61, Section 9 certification, and ANSI/NSF 372 to demonstrate compliance with the federal requirements for lead contribution to drinking water, the Safe Drinking Water Act SDWA, and the California Health and Safety Code Section 116875.

1.3 PRODUCT HANDLING

- A. Conform to provisions of Section 22 0513: Basic Plumbing Materials and Methods.

PART 2 - PRODUCTS

2.1 PIPING SYSTEMS

- A. Materials: Refer to Section 22 0513: Basic Plumbing Materials and Methods.
- B. Insulation for Piping: Refer to Section 23 0700: Plumbing Insulation.

2.2 FIXTURES AND DRAINS

- A. General: Fixtures specified shall be furnished complete with trim and fittings. Cast iron plumbing fixtures shall be acid resistant enamel, and identified by casting letters "AR" or words "acid-resistant" into metal. Fixtures shall be white unless otherwise specified. Cast iron fixtures shall be white enamel inside and on back, rim and apron, with exposed unfinished surfaces painted white. Fixtures of same general classifications shall be of same make.
- B. Finished Brass:
 - 1. Unless otherwise specified, finished brass of a similar type shall be of same manufacturer and model throughout buildings.
 - 2. Finished and exposed brass plumbing, except floor, shower and urinal drains shall be chromium-plated and polished. Floor, shower and urinal drains, unless otherwise specified, shall be nickel-bronze metal.
- C. Traps, Trap Arms and Tailpieces:
 - 1. Fixture Traps shall be all L.A. Code Cast Brass Chromium-plated and polished. Exceptions as follows:
 - a. Traps that are an integral part of a fixture.
 - b. Traps concealed in floors, walls and furring.
 - 2. Trap Arms shall be all IPS Threaded Brass Nipples into Female IPS Threaded Drainage Tee.
 - 3. Tailpieces, Extension Tailpieces, 2-part wastes and any other tubular products shall be minimum 17 gage polished chromium-plated brass, except as otherwise specified.
 - 4. Furnish polished chromium-plated brass wall flanges with setscrews and polished chromium-plated brass cover casing on discharge side of each trap.
- D. Faucet Handles: Faucet and shower valve handles shall be solid brass, chromium-plated and polished, and fastened to their stems by Allen type hollow head stainless steel set screws through the side of the handle extending into the stem. Handles with sharp edges or projections shall not be furnished. At accessible fixtures: handles shall be operable with one hand and shall not require tight grasping, pinching, or twisting of the wrist. The force required to activate handles shall be 5 pounds maximum.
- E. Fixture Supplies:

1. Hot and Cold water fitting supply outlet piping serving drinking fountains, hose bibbs shall be iron pipe size (IPS) brass nipple, and piped in such a manner that through wall water supply outlet piping be removable, size appropriate, and lead free. The use of copper, copper MIP sweat adapters or similar fittings, in lieu of brass nipples is not allowed. The IPS brass nipple shall be directly connected to the fixture as follows:
 - a. Angle stop for lavatories, sinks and drinking fountains.
 - b. Iron pipe size (IPS) brass nipple connection for hose bibs, sillcocks, and other plumbing related fixture and/or plumbing fitting water supply outlets.
2. Water supply pipe that penetrates a finished surface, wall, countertop or part of a cabinet shall be appropriately sized polished chromium-plated cover casing and wall flange/escutcheon fitting tight to the brass through wall nipple and securely affixed to the finished wall surface.
3. Water supplies of plumbing fixtures shall be protected against back-siphonage in event of a vacuum in piping system

2.3 ACCESS PLATES (To cleanouts, valves, water hammer arrestors and hose faucets)

A. Schedule Numbers:

AP-1: Square, unless otherwise noted, steel, prime coated; frame, 18 gage minimum. Door shall be 16 gage minimum with concealed hinge or be removable, with vandal-proof lock operated by Allen wrench. **(Specify for painted and stucco walls.)**

SMITH	ZURN	ELMDOR	MILKOR	WATTS	MIFAB	JOSAM
Fig 4760 AK	Z-1462- VP	DW-AKL	MOR DW AK1	CO-300- S-6	UA-A	58650-VP OR EQUAL

AP-2: Round type, stainless steel, vandal-proof, 5/16 inch No. 18 or 1/4 inch No. 20 flat-head machine screw into cleanout plug. Plate shall be prime coated minimum 18 gage steel or polished chrome-plated brass, 18-8 No. 302 stainless steel, or polished nickel bronze.

SMITH	ZURN	JOSAM	WADE	WATTS	MIFAB	OR EQUAL
4710U	Z-1469- VP	58600	8480R	CO-480- RD-6	C1400-RD-6	

AP-3: Square, polished face chrome-plated bronze, aluminum alloy or brass chrome-plated brass frame with 14 gage polished 18-8 No. 302 stainless steel or brass chrome-plated secured cover with vandal-proof screws.

SMITH	ZURN	WADE	WATTS	MIFAB	JOSAM	OR EQUAL
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4735U	Z-1460-VP	58630	CO-300-S-6	C1400-S-3-6	58640-VP	
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2.4 CLEANOUT ASSEMBLIES

- A. Cleanout plug shall be line size.
- B. Schedule Numbers:

CO-1: Iron body cleanout tee full line size up to 4 inches and round access plate, plugs shall be brass, countersunk with tapped boss for 5/16 inch No. 18 or ¼ inch No. 20 screws. **(Specify for finished walls at base of waste stack, above urinal and service sink.)** AB&I and TYLER may be used as iron body cleanouts. Trim and accessories shall be Smith or Zurn or equal.

SMITH	ZURN	WATTS	MIFAB	JOSAM	OR EQUAL
4532-U	Z-1446-BP	CO-460-RD-34B	C1460-RD-6	58600-CO	

CO-2: Iron body with approved UPC plug, top and adjustable sleeve, cut-off ferrule, polished scoriated brass nickel bronze secured cover. AB&I and TYLER may be used as iron body cleanouts. Trim and accessories shall be Smith or Zurn or equal Square:

SMITH	ZURN	WATTS	MIFAB	JOSAM	OR EQUAL
4053L-U-NB	ZN-1400-T	CO-200-S	C1220-S-1-6	55000-1-SQ	

Round:

SMITH	ZURN	WATTS	MIFAB	JOSAM	OR EQUAL
4033-L-U-NB	ZN-1400	CO-200-R	C1220-1-6	55000-1	

CO-3: Secured cover, extra heavy-duty, adjustable sleeve, cut-off ferule, UPC. Brass approved type plug, scoriated tractor type cover.

SMITH	ZURN	WATTS	MIFAB	JOSAM	OR EQUAL
4233-U	ZN-1400-HD	CO-200-RX-4	C1220-4-6	55000-22	

2.5 DRINKING FOUNTAINS

- A. Also see Electric Water Coolers, below.
- B. Drinking Fountains shall be provided with brass free waterways and provisions for future installation of water filter as required.

- C. Dual al Height - Two unit, access compliant, wall-mounted, 14 gage Type 304 stainless steel dual height (high, low) drinking fountains, each of one-piece construction, with 1/4 inch thick stainless steel backs, furnished with two (one each unit) integral basin shank, vandal-resistant bubbler heads, with brass free flow/pressure regulating valves with flow adjustable push button activation, chrome-plated cast brass waste strainers, and with bottom plates, and with stainless steel screen water supply strainers at inlet. Install with a 3/16-inch-thick steel mounting plate inside the wall. Complete drinking fountain with trim and brass free fittings must be certified to ANSI/NSF 61, and ANSI/NSF 372 lead free

HAWS	MURDOCK	HALSEY TAYLOR	OR EQUAL
1011 with mounting plate 6700.4 and bottle filler 1920.	-	-	

2.6 FLEXIBLE HOSES

- A. Schedule Numbers:

FLH-1: Braided stainless-steel metal hose (for gas and non-pressure condensate drainage connection use). US Flex, Metraflex, Nelson Dunn or equal.

FLH-2: Braided bronze metal hose (for interior non-pressure condensate drainage connection use only). US Flex, Metraflex, Nelson Dunn or equal.

2.21 PIPE HANGERS

- A. Refer to Section 22 0513: Basic Plumbing Materials and Methods.

- B. Schedule Numbers:

1. PH-1: Complete with clamps, inserts, etc.

SUPERSTRUT	UNISTRUT	TOLCO	B-LINE	OR EQUAL
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2.22 P-TRAPS

- A. Schedule Numbers:

PT-1: Cast brass complete, chrome-plated.

AB&A	OR EQUAL
107 or 108 chrome 1-1/2"x1-1/4".	

2.23 WASHING MACHINE OUTLET BOX

A. Schedule Numbers:

WMOB-1: Recessed, fire rated washing machine outlet box. Furnished with top mounted quarter turn ball valves with integral hammer arresters. Box material: White powder coat on cold rolled steel finish & UL listed intumescent pad.

GUY GRAY	OR EQUAL
FRM12SHA	

2.24 HEIGHT OF FIXTURES

A. Heights for standard fixtures.

Fixture	Adults and Students Ages 12 and Over (Inches)	Elementary Ages 6 to 11 (Inches)	Kindergarten and Younger Ages 3 to 5 (Inches)
Toilets, height to top of seat	15 to 17	15	11 to 12
Lavatories, sink top height	32	30	25
Wash Sinks	30	28	24
Urinals, lip height	24	18	N/A
Shower Heads From tip of shower head to finish floor	72		
Shower valves	48		

B. Heights for access compliant fixtures.

Fixture	Adults and Students Ages 12 and Over (Inches)	Elementary Ages 6 to 11 (Inches)	Kindergarten and Younger Ages 3 to 5 (Inches)
Toilets, center line from wall/partition	17-1/2	15	12
Toilets Seat Height	18	15	12
Lavatories, sink top height	34 maximum	30	24 maximum

Lavatories, sink knee clearance	27 minimum	24 minimum	Parallel (Side) Approach
Urinals, lip height	16	15 maximum	13 maximum
Urinals, flush handle height	43	40 maximum	32 maximum
Drinking fountains, bubbler height.	36 maximum	30 maximum	30 maximum
Drinking fountains, knee clearance	27 minimum	24 minimum – not required	24 minimum – not required
Wash Sink	Per Drawings		
Shower Valves	Per CBC		
Shower Seat	Per CBC	Per CBC	Per CBC
Shower Head (adjustable) Bar	Per CBC		

2.25 SERVICE STOP GAS VALVES

A. Schedule Numbers:

SGV-2: Bronze/Brass, ¾-inches to 2-inch IPS (WOG) water, oil, or gas – full port ball valve. CSA approved.

WATTS	NIBCO	WILKINS	OR EQUAL
LFFBV-4	F-510-CS-R-66-FS	Model 850	

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas and conditions under which Work of this section will be performed. Correct conditions detrimental to proper and timely completion of Work. Do not proceed until unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. General:

1. Unless otherwise specified, plumbing fixtures, equipment and appliances that require connections to plumbing line shall be connected. This shall include fixtures specified or indicated as furnished by others, furnished by Owner, or specified in other related sections. Install supplies, stops, valves, traps, wall flanges, or pipe casing for connection of this equipment.
2. Install equipment as indicated on reviewed and accepted Shop Drawings.
3. Avoid interference with Work of other trades. Do not deviate from Drawings without review of the Architect.

B. Examination: Check each piece of equipment in system for defects verifying that parts are properly furnished and installed.

C. For piping Work, refer to Section 22 0513: Basic Plumbing Materials and Methods.

D. Plumbing Fixture and Equipment Installation:

1. Unless otherwise indicated, fixtures shall be installed with 5/16 inch brass bolts or screws of sufficient length to securely fasten fixture to backing, wall, or closet ring.
2. Fixtures installed against concrete or masonry walls shall have their hangers fastened with 5/16 inch brass bolts, Philip Shield type anchors, or 2 unit cinch anchors. Wood or plastic plugs are not permitted.
3. Fixtures installed against wood or metal stud walls shall have their hangers fastened to metal backing plates with 5/16 inch brass bolts screwed into plate. Fixture hangers for urinals shall be fastened centered vertically on metal backing plate with three 5/16 brass bolts each for small individual hangers and six, for larger one piece hangers. Lavatories shall be hung with not less than four 5/16 inch brass bolts or not less than five 1/4 inch brass bolts. Each sink hanger shall be hung with not less than four 5/16 inch brass bolt or not less than five 1/4 inch brass bolts.
4. Pan type drinking fountains shall be hung with 5/16 inch cadmium plated bolts with a bolt in each bolt opening in hanger. Hangers for pan type drinking fountains shall provide 2 inches (plus or minus 1/4 inch) between pan and wall. Spaces due to irregularities between fixtures and tile walls shall be neatly filled with white cement or silicone filler.
5. Backing for hanging of plumbing fixtures and equipment shall be installed in supporting wall at time rough piping is installed. Backing for stud walls shall be steel plate 1/4 inch thick, not less than 4 inches wide. Backing for urinals shall be 1/4-inches thick by 6-inch wide steel plate. Steel plate shall be attached to stud at each end of plate and to each stud it crosses. Plate shall be attached to metal studs by bolting with two 1/4 inch U-bolts per stud

with bolts through plate and around stud flange or by welding with a 1/8 inch fillet weld full width of stud flange, top and bottom of plate. At wood studs, plate shall be carefully recessed flush with face of stud and attached to each stud with 2 No. 14 flat-head wood screws, 2 inches in length into pre-drilled 1/8 inch holes. Backing for stud walls supporting wall-hung closets shall be as detailed.

6. Rough-in for fixtures, equipment and appliances shall be as indicated on Drawings and as specified, including those items indicated as furnished by others, furnished by Owner, or future capacity. When connections to equipment from capped or plugged lines are required, caps or plugs shall be removed at time equipment is set and stops or valves installed and connections provided as specified.
7. Piping shall be stubbed out to exact location of fixtures and stubs shall be installed symmetrical with fixtures. Hot and cold water supplies for center set faucets on lavatories shall be installed on 8-inch centers, unless otherwise specified or required.

E. Cleanouts in Drain, Waste, Vent and Sewer Lines:

1. Cleanouts shall be installed at locations stated in the California Plumbing Code and accessible at following locations:
 - a. At locations above first floor as stated on construction documents and 5 feet outside of the building.
 - b. Install an accessible main line upper terminal cleanout in all restrooms above water closet overflow. (Install above upper terminal water closet where there are more than one water closets in a restroom).
 - c. Above faucets of each sink with brass plug.
 - d. At each Drinking Fountain with brass plug.
 - e. Where indicated on Drawings.
 - a. Where cleanouts occur under concrete.
 - b. Where marked for future connections.
2. Other cleanouts shall be iron body type.
3. Cleanout extensions shall be no-hub cast iron soil pipe. Exterior cleanouts, those in concrete excepted, shall terminate in a 14-inch by 6-inch thick concrete block with cleanout assembly and top of block flush with finish grade.

4. Fittings in lines utilized as cleanouts shall be approved soil fittings including no-hub pipe. Tees and crosses in vent headers excepted.
5. Pipe joint compound shall not be installed on cleanout plug. After lines are tested and approved, each cleanout plug shall be removed, greased, and replaced.

3.3 EXCAVATION, TRENCHING AND BACKFILLING

- A. Perform trenching, excavation, and backfilling required for Work of this section as specified herein.

3.4 WATER HAMMER ARRESTORS

- A. Install water hammer arrestors indicated on Drawings and in following locations (only non-ferrous arrestors may be installed in copper water system):
 1. Water lines to lavatory headers, water closet and urinal headers, service sinks, kitchen sinks, wash fountains, drinking fountains: between drinking fountain and water filter head assembly, laboratories with medical type faucets and on wash sinks having three or more stations and all other quick closing fixture such as clothes washers, as close to fixture as possible.
- B. When possible, arrestor shall be installed in wall or furring. When arrestor is installed in wall or furring, furnish an access plate large enough to permit removal of arrestor. Access plate shall be a minimum of 2 inches larger in each direction than the arrestor.
- C. Fixture water lines shall be provided with mechanical water arrestor hammer dampening devices. Air chambers are not approved.

3.5 CONDENSATE DRAINS - FROM AIR CONDITIONING UNITS

- A. Connect drain piping from drain pan of air conditioning unit to condensate disposal location indicated. When coil or unit housing is shock or vibration isolated, connection shall be furnished through a flexible connector not less than 10 inches long. Drain line shall pitch to flow out at not less than one inch in 8 feet. Drain line shall not be reduced smaller than unit outlet connection.
- B. Condensate drain piping installed within building whether in air conditioned space or not shall be insulated. Refer to Section 22 0700: Plumbing Insulation, for type of material required.
- C. Condensate Trap:
 1. A condensate trap shall be installed for each air conditioning coil. Trap shall be assembled from 2 brass unions: one between A/C unit and inlet of trap, and one at outlet of trap that connects to main drain.

2. Trap configuration shall be per manufacturer's recommendations based on total unit casting static pressure (simulated plugged filter condition), but not less than 3 inch water seal.
 3. Running trap design is not permitted.
 4. Secondary drain shall not be trapped.
- D. Condensate trap shall be checked at equipment operational tests for proper water drainage flow from air conditioning unit. Cooling condensate pan shall be filled with water, filters covered with plastic (plugged filter simulated), unit panels replaced, and unit motor running at design condition. Pan shall drain without hesitation to bottom of inlet connection. Tests are made prior to installation of ceiling.
- E. Secondary Overflow Drain:
1. Drain pan installed underneath air conditioning units in concealed ceiling space or units that incorporate dam fitting shall be furnished with secondary drain piped to outside planter area with outflow location clearly visible.
 2. If outside building location is not available or feasible, secondary drains shall be piped to a classroom sink, if sink is not available pipe to a room corner away from cabinets, computers, desks, door ways/entrances or stairs.
 3. Secondary vertical pipe that penetrates through suspended ceiling shall be furnished with a coupling or threaded adapter so ceiling tile can be removed without damage.
1. pipe entering the building.

3.6 CLEANING - PLUMBING PIPING SYSTEMS AND FIXTURES

- A. Plumbing lines and fixtures shall be flushed to remove dirt and foreign material until water runs clear and no foreign substance or odor is present. Strainers and screens on faucets shall be removed during this cleaning operation.
- B. After satisfactory cleaning of strainer and screen replacements has been witnessed by the Project Inspector, post and maintain signs stating: "CAUTION - Water at this construction project has not yet been certified for human consumption." Signs shall be furnished with letters at least 1/2 inch in height and shall be conspicuously posted at entrances to the Project site. Signs shall be paneled, black and yellow, in conformance with OSHA Section 1910.1455.

3.7 DISINFECTING DOMESTIC WATER PIPING SYSTEMS

- A. Newly installed or replaced piping and/or fixtures dispensing potable water, and any additional piping and/or equipment impacting the integrity of this system shall

be disinfected and undergo an approved bacteriological analysis before water system is allowed for public use.

- B. Disinfection shall commence upon complete installation of all related domestic water systems including fixtures, valves, faucets, water heating systems, etc.
- C. Work shall be performed by Technicians Certified by the American Water Works Association (AWWA) and/or the State of California Department Health Services, Grade II Water Treatment Operator Certification or higher issued by the Department of Health Services (DHS) for the State of California. Comply with Title 22, Code of Regulations Division 4, Chapter 13, and Article 2 Operator Certification Grades.
- D. Method:
 - 1. A Physical Separation of minimum 6” or Reduced Pressure Backflow assembly shall be installed to protect from cross contamination of the local water purveyor’s meter service supply when at any time there is any type of water connection with the piping to be disinfected (Chlorinated) and the water meter service supply.
 - 2. Install a Chlorination Port including a T fitting and a shut off valve to the proximity of the point of connection at the new piping system.
 - 3. System is to be flushed to remove any materials that may have entered the system.
 - 4. Using a chemical feed metering pump and a chlorine tank, the chlorine solution is injected into the water system.
- E. Disinfection and De-chlorination procedure (24 or 3 Hour Contact Time):
 - 1. 24-hour Test Method:
 - a. Prior to disinfection, post signs on all water outlets of the system to be disinfected. Sign or tags shall read, “Water System Being Chlorinated- “Danger Do Not Drink Water” or similar warning.
 - b. Piping system shall then be adequately flushed with water to remove any particles and eliminate air pockets.
 - c. Using the continuous feed method, sodium hypochlorite conforming to ANSI/ AWWA B300 will be injected into the water system at a minimum of 50 PPM. A water flow meter provided by the water treatment technician will be used to determine the rate of injection and a chlorine test kit, Hach or equivalent, will be used to monitor the residual.

- d. Chlorine residual test will be taken at all appropriate points and outlets to verify 50 PPM residual levels.
 - e. The chlorinated system shall be shut down for any use and the chlorinated water shall remain in the water system for retention of 24 hours.
 - f. After 24 hours, chlorine residual levels will again be tested at various points throughout the system to insure a minimum of 25 PPM residual. If the system has not met the minimum of a 25 PPM residual, the above disinfection process shall be repeated.
 - g. After satisfactory completion of the residual testing, flush out system until Hach or equivalent test reveal the water outlets have a free chlorine residual concentration less than 0.5 PPM. The procedure shall be in accordance with the AWWA standard C651-05.
 - h. The OAR may allow temporary use of the water system for construction purposes pending results of the bacteriological test analysis. Sign or Tags shall be left on all outlets stating water system is not safe for consumption until laboratory results are complete and meet these specifications.
2. 3 Hour Test Method:
- a. If the water systems must be turned on for use as soon as possible, a 3 hours chlorine contact time to allow for disinfection is permitted with the OAR's approval.
 - b. Prior to disinfection, post signs on all water outlets of the system to be disinfected. Sign or tags shall read, "Water System Being Chlorinated- "Danger Do Not Drink Water" or similar warning.
 - c. Piping system shall be then adequately flushed with water to remove any particles and eliminate air pockets. Using the continuous feed method, sodium hypochlorite conforming to ANSI/ AWWA B300 will be injected into the water system at a minimum of 200 PPM. A water flow meter provided by the water treatment technician will be used to determine the rate of injection and a chlorine test kit, Hach or equivalent, will be used to monitor the residual.
 - d. Chlorine residual test will be taken at all appropriate points and outlets to verify 200 PPM levels. The chlorinated system shall be shut down for any use and the chlorinated water shall remain in the water system for retention of 3 hours.
 - e. After satisfactory completion of a 3 hour disinfection period, flush out system until Hach or equivalent test reveal the water outlets have a free chlorine residual concentration less than 0.5 PPM. The

procedure shall be in accordance with the AWWA standard C651-05.

- f. The OAR may allow temporary use of the water system for construction purposes pending results of the bacteriological test analysis. Sign or Tags shall be left on all outlets stating water system is not safe for consumption until laboratory results are complete and meet these specifications.

F. Bacteriological Test:

1. After final flushing and satisfactory results from the residual free chlorine concentration test, Bacteriological test samples shall be collected. The intent of the following is to provide insurance for an accurate representation to a complete Bacteriological test of the water system. At least two samples shall be taken from each floor of each building.
2. Bacteriological test samples shall be delivered to a State of California Department of Health Services Certified Laboratory to perform qualitative and quantitative bacterial analyses on the water samples for the presence of any Total Coliform bacteria and Plate Count. This count must be less than 500 cfu/mL.
3. The procedure shall be repeated if it shown by bacteriological examination made by an approved agency that the level of Disinfection does not meet these specifications.
4. After satisfactory results for the bacteriological test are provided to the OAR, the physical barrier or temporary reduce pressure back flow devise shall be removed, and the new piping shall be connected to the point of connection. All the connecting piping and fittings shall be disinfected prior to installation. Chlorination Port shall be capped water tight. Warning sign or tags shall be removed.

- G. Drinking Fountain and Bottle Filler Lead Test: After installation of Drinking Fountain or Bottle Filler, and successful Bacteriological Test, shut off domestic water supply line feeding the fixture, and inform OAR. OAR will coordinate with the Drinking Water Quality Program (DWQP) Supervisor in local Project Unit and M&O's Plumbing Technical Unit Supervisor to conduct lead detection test and mitigate as necessary. Do not remove related construction warning sign and tags.

3.8 VALVES ON PLUMBING SYSTEM

- A. Furnish and install gates, ball, globes, angles, and check valves on plumbing Work at following locations whether indicated on drawings or not.
- B. Hot and cold valves shall be:
 1. Lead free complying with AB1953.

2. Above the ground copper water system, 2-inch and larger, may utilize Victaulic butterfly valves and fittings for their connections. A 2-inch or larger Victaulic valve may be in a wall if an adequately sized access panel is provided for maintenance or removal.
- C. Valves shall be accessible and installed within an access panel approximately 3 feet above floor and no more than 7 feet above floor, or in a marked yard box to prevent tampering.
1. Immediately after each water meter, in addition to any valve furnished by utility company, there shall be an accessible valve on the inlet side for a strainer assembly, dual backflow device assembly and/or possibly a dual pressure reducing valve assembly.
 2. A gate or ball valve on each water supply before it enters building. Valves shall be accessible from outside building and shall be installed in a marked yard box, unless otherwise indicated on drawings. Ball valves 2 ½-inch size or larger shall omit gate valve handle and furnish 2-inch square operating nut.
 3. At multi story buildings, provide an isolation-valve or multiple valves for both hot and cold water in access panel to isolate and control each floor level.
 4. For classrooms, shops, offices and boiler or mechanical room, install a gate or ball valve to control hot and cold water lines to each group of fixtures, a group of fixtures shall be considered to be 2 or more fixtures in the same room. When practical, valves shall be installed on the same wall as group of fixtures. Valves shall control only fixtures in rooms in which they are installed.
 5. For restrooms, a gate or ball valve shall be installed in each restroom to isolate the hot and cold water supply into a restroom regardless of the number of fixtures. These valves shall control and be accessible only from within the restroom in which fixtures are installed. Valves shall be installed on the same wall as the group of fixtures it serves. Valves shall control only fixtures in restroom in which they are installed. Back to back restrooms shall be isolated separately and individually.
 6. Install a gate or ball valve on each building branch line, which serves two or more fixtures, when these fixtures are not provided with a group isolation valve as specified above. These valves shall be located approximately 3 feet but not more than 7 feet above finish floor.
 7. Install a gate, ball valve or partition stop for a drinking fountain or a group of drinking fountains.

8. Install a gate, ball valve or partition stop for hot and cold water supply to plumbing fixtures with no accessible supply stops, such as wall mounted faucets.
9. Install a gate, ball valve or partition stop for stops adjacent to, and controlling water flow to each sill cock and hose bib except as follows:
 - a. A sill cock immediately below an exterior drinking fountain may be controlled by the same gate, ball valve or partition stop as drinking fountain.
 - b. Valves or stops will not be required for individual hose bibs when these hose bibs are on a branch line serving only hose bibs and branch line is furnished with a shut-off valve.
10. Install a loose key angle stop, on each exposed fixture supply, and for each flush valve unless otherwise specified,
11. Install gate or ball valve at each location where a water line is connected to a piece of equipment other than items mentioned above.
12. Install a check valve on each hot water return line where it connects to a hot water storage tank or a water heater.
13. Handles, hand wheels (including dishwasher fill valve handles) and operating nuts shall be furnished of steel, brass, or cast iron and shall be removable. Unless specified to be loose key type, handles shall be securely fastened to their stems. On exposed outdoor valves, omit operating handles and provide operating nuts.
14. Provide a handle or a key for each five, or fraction thereof, loose key valves, bibs, or stops and deliver them to the project OAR.

3.9 ELECTROLYSIS PREVENTION

- A. Brass nipples, 6 inches, with recognized brass unions; flanges shall be furnished and installed at locations described herein. Flanges shall be installed with complete insulating component consisting of gasket bolt sleeves and bolt washers. Dielectric insulators shall be installed at following locations:
 1. Where special applications indicated on Drawings require an insulation flange or brass union, with 6-inch brass nipple to be installed in a condensate line, or steam line, flange insulation shall be of a high temperature type, suitable for continuous operation at temperatures up to 220 degrees F. for condensate and 400 degrees F. for steam.
 2. Where steel or cast iron in ground connects to copper or brass piping above ground, transition from steel or cast iron pipe to copper or brass pipe shall be provided in an accessible location.

3. Above ground dielectric connections shall be exposed; or if in finished rooms shall be located in accessible access boxes.

A. n, dry condition.

3.10 DEPTH OF SEWER LINES

- A. Minimum depth of below grade sewer lines shall be 24 inches to centerline of pipe. Sewer lines shall slope $\frac{1}{4}$ inch per foot minimum, unless otherwise indicated. Minimum depth at Owner property line shall be 6 feet, unless otherwise required.

3.11 GAS SERVICE

- A. Above Grade Service: Pipe shall be steel, hammered, free of dirt and scale, and blown out with oil-free air or nitrogen to a clean, dry condition. Piping shall not be installed in or through a ventilation duct or plenum.

B. Underground Service, Gas approved (yellow) Polyethylene Plastic Pipe: Refer to Section 22 0513: "Basic Plumbing Materials and Methods".

2. Pipes shall be joined with polyethylene fitting and joined together by thermal fusion in accordance with procedures recommended by Polyethylene plastic pipe and fitting manufacturer.
3. Plastic pipe shall be installed not less than 30 inches below grade.
4. Underground Warning Tape shall be installed 12 inches above buried gas piping. Warning tape shall be yellow with caution statement as follows: "CAUTION – BURIED GAS LINE BELOW".
5. Plastic pipe shall not be installed in or under a building or structure. Pipe shall be installed under bituminous surfacing or compacted soil area, free from large stones. Pipe may be installed under sidewalks or driveways, as long as no joint occurs. Pipe installed under paved covered areas wider than 40 feet shall be installed in ventilated conduits extending 2 feet past paving.
6. Pipe shall be installed on a 6 inches deep sand bed. After required pressure-leak test, pipe shall be covered with sand not less than 6 inches thick.
7. Piping shall not support weight of valves, metal fittings or other items. Pipe shall be installed strain free.
8. Plastic pipe fittings shall not be stored or left exposed to sunlight. Pipe in open trenches shall be shielded. A sand envelope of 6 inches minimum shall be placed around pipe, with exception of joints, until inspection by IOR is completed. Protection for pipe shall be provided when necessary to leave pipe exposed overnight.

9. Installer of piping is required to have training and to have attained a certification. Non-trained/Non-certified installer must contact the manufacturer or manufacturer's representative to provide on-site fusion training and certification, prior to work commencement
10. Polyethylene plastic pipe shall connect to a steel epoxy coated anodeless type riser to minimum of 6 inches above grade, when exiting the underground installation and transitioning to steel pipe connection.

Where a steel pipe riser passes into a structure or building, a double swing or double-offset joint shall be furnished. Pipe shall pass into structure 6-inches above grade and through a sleeve with a minimum one inch clearance. An isolation valve is required before pipe entering

3.12 CLEANUP

- A. Remove rubbish, debris, and waste materials and legally dispose from the project site.

3.13 PROTECTION

- A. Protect Work of this section until Substantial Completion.

END OF SECTION

SECTION 23 0500
COMMON WORK RESULTS FOR HVAC

PART 1 – GENERAL

1.1 SUMMARY

A. Section Includes:

1. This Section provides the basic mechanical requirements that apply to the Work of Division 23.

B. Related Requirements:

1. 2. Division 26: Electrical.

1.2 REGULATORY REQUIREMENTS

A. Materials, fabrication, equipment, and installation shall comply with industry standards and code requirements. Where manufacturer's recommendations exceed industry standards, the manufacturer's recommendation shall establish the minimum standard. As a minimum, standards from the following organizations shall apply:

1. AMCA - Air Movement and Control Association.
2. ANSI - American National Standards Institute.
3. ASME - American Society of Mechanical Engineers.
 - a. ASME Boiler and Pressure Vessel Code.
 - b. ASME B31 - Code for Pressure Piping.
4. AHRI - Air-Conditioning, Heating, and Refrigeration Institute.
5. ASHRAE - American Society of Heating, Refrigerating and Air-Conditioning Engineers.
6. ASTM - American Society for Testing and Materials.
 - a. ASTM A53 - Specification for Welded and Seamless Pipe.
7. CSA - Canadian Standards Association.
8. FM Global - Factory Mutual Global
9. IAPMO - International Association of Plumbing and Mechanical Officials.
10. NFPA - National Fire Protection Association.
11. OSHA - Occupational Safety and Health Administration.
12. SMACNA - Sheet Metal and Air Conditioning CONTRACTORS' National Association.
13. UL - Underwriters Laboratories Inc.
14. Intertek (ETL Certification).

B. Materials, fabrication, equipment, and installation shall comply with federal, state, and local codes including, but not limited to, the following:

1. CBC, California Building Code, and CMC, California Mechanical Code.
 - a. Latest edition as adopted by the City of Corona, the County of Riverside, and the State of California including amendments effective on the Effective Date of the Contract.

2. California Code of Regulations, Title 8, Industrial Relations, Division 1, Chapter 4, Division of Industrial Safety.
 3. OSHA - Occupational Safety and Health Administration.
 4. CDPH – California Department of Public Health.
 5. SCAQMD - South Coast Air Quality Management District.
- C. Specifications or Drawings shall not be construed to permit deviation from the requirements of governing codes unless approval has been obtained from legally constituted authorities having jurisdiction, and the Architect. The Contract Documents may contain more stringent requirements than those legally required.
- D. Permits and Fees: Refer to the General and Supplementary Conditions.

1.3

SUBMITTALS

- A. Provide submittals in accordance with Section 01 3300. Submittal Procedures and with specific requirements of Division 23 sections, as applicable.
- B. After Architect's approval, the above information shall become the basis for inspecting and testing materials and actual installation procedures performed in the Work.
- C. Shop Drawings: Submit one additional copy when control diagrams having line voltage connections are indicated. Shop Drawings shall be specifically prepared for the Work of this Project. Drawings prepared in accordance with requirements of Section 01 3100: Project Coordination and Section 01 3300 may be provided by the Architect to serve as a background for the Shop Drawings. Shop Drawings shall comply with the requirements of Section 01 3100 and Section 01 3300 and shall indicate at a minimum:
 1. Complete system layout of equipment, components, ductwork, and piping, indicating service clearances, duct and pipe sizes, fitting types and sizes, top or bottom of duct and pipe elevations, distances of ducts, pipes and equipment from building reference points and hanger / support locations. All the above items shall be coordinated on the shop drawings according to the requirements of Section 01 3100.
 2. Schedule and description of equipment, ductwork, piping, fittings, valves, dampers, and controllers.

1.4

PROJECT RECORD DOCUMENTS

- A. Comply with provisions of Section 01 7700: Contract Closeout.
- B. Project Record Drawings:
 1. Provide a complete set of mechanical and control system drawings in AutoCAD and, if available, BIM, complete with external reference drawings, fonts, blocks and plotter pen color/line thickness settings on CD-ROM. Also submit one set of full size reproducible plots on vellum and three sets of prints.
 2. Before Contract Completion, deliver corrected and completed prints to the OAR. Delivery of project record documents to the OAR does not relinquish responsibility of furnishing required information omitted from project record documents.
- C. Operation and Maintenance Manuals:
 1. Submit operation and maintenance manuals in required form and content. If no revisions are required, furnish one additional copy. If revisions are required, one copy shall be returned with instructions for changes; perform such changes and return manuals. Manuals shall be bound in accordance to Section 01 7700. Deliver manuals to the OAR. Submit an electronic copy of the entire manual in PDF file format.
 2. Contents of Manual:

- a. Title sheet with Project name, including names, addresses and telephone number of CONTRACTOR, installer, and related equipment suppliers.
- b. Manufacturer's operating instructions including, but not limited to, the following:
 - 1) Identification of components and controls.
 - 2) Pre-start checklist and start-up procedures.
 - 3) Normal operation settings and checklists.
 - 4) Pre-shut down checklist and shut down procedures.
 - 5) Trouble shooting checklist and guidelines.
 - 6) Recommendations for optimum performance.
 - 7) Warnings and safety precautions on improper or hazardous operational procedures or conditions
- c. Manufacturer's product data and parts and maintenance booklet for each item of equipment furnished under Division 23 that includes the following as a minimum:
 - 1) Manufacturer's model, identification and serial numbers.
 - 2) Exploded view of assembly drawings identifying each component or part with the relevant part number.
 - 3) Directory of manufacturer's representatives, service CONTRACTORS and part distributors.
 - 4) Maintenance and trouble-shooting instructions, including schedule for preventive maintenance, periodic inspection and cleaning criteria.
- d. Project Record Drawings: Complete set of mechanical and control system drawings in 50 percent reduced print format shall be furnished with the manual. Submit the above record drawings on CD-ROM in AutoCAD and, if available, BIM, complete with external reference drawings, fonts, blocks, and plotter pen color/line thickness settings.
- e. Testing, Adjusting, and Balancing reports: Submit as specified in Section 01 4525.
- f. South Coast Air Quality Management District (SCAQMD) permits to install and operate boilers, water heaters and other fuel burning equipment and third-party source test reports as required by SCAQMD to allow start-up and operation of equipment.
- g. Riverside County industrial waste permits.
- h. Valve directory complete with location, function, size, and model of each valve with reference to the project record drawings.
- i. Equipment and component identification chart complete with location, function, size, and model of each equipment or component with reference to the project record drawings.

1.5 COORDINATION

- A. Contract Documents indicate extent and general arrangement of Work under Division 23. CONTRACTOR shall coordinate work in accordance with Section 01 3100 requirements and make adjustments as required to provide maximum headroom, a neat arrangement to keep

passageways and openings clear to provide accessibility and provisions for maintenance, and to meet code requirements.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Delivery and Storage: Deliver materials to Project site in their original unopened containers with labels intact and legible at time of delivery. Store in strict accordance with manufacturer's recommendations.
- B. Do not store plastic pipe or materials in direct sunlight.

1.7 PRELIMINARY OPERATION

- A. OAR may require any portion of mechanical Work to be operated before Substantial Completion. Such operation shall be in addition to regular tests, demonstrations and instructions required under the Contract Documents, and shall be performed as required.
- B. Notify the Project Inspector at least 24 hours in advance of lighting or re-lighting pilots.

1.8 TRAINING OF OWNER PERSONNEL

- A. Training of Owner's personnel shall include:
 - 1. A minimum of 8 hours of on-site overview of the overall Mechanical System.
 - 2. Refer to Division 23 sections for specific training on each of the components of the Mechanical System.
 - 3. A minimum of 8 hours of on-site overview identifying location and function of all Control Valves and Actuator assemblies.
 - 4. A minimum of 40 hours of (in classroom) software training for a minimum of 20 OWNER personnel on EMS/BMS if such systems are utilized in the project. Training shall be conducted at control CONTRACTOR training facility with computer setup for each person attending.
- B. Contract shall include the cost of training Owner operation and maintenance personnel in operating, adjusting, maintenance, trouble-shooting, and Project site repair of each component, equipment, or system provided under this Contract.
- C. Operational and maintenance training shall be conducted on the Project site, unless indicated otherwise.
- D. Upon completion of Owner training, a completion certificate indicating the nature of the training and a description of the systems, complete with equipment and component lists shall be issued to each trainee. The certificate should be issued in duplicate with one copy retained by OAR.
- E. An attendance sheet with the names and signatures of all participants attending the training shall be submitted to the OAR and kept as part of the project documents.

1.9 GUARANTEES AND DAMAGE RESPONSIBILITY

- A. Sound of water flowing in piping shall not be transmitted to building structure. Operation of mechanical system shall not produce operational sounds that can be heard outside of rooms enclosing apparatus or equipment.

PART 2 – PRODUCTS

2.1 MATERIALS AND EQUIPMENT

- A. Unless otherwise specified, materials and equipment shall be new, in good and clean condition. Equipment, materials, and components shall be of the make; type and model number noted on Drawings or specified. Pieces of equipment of the same type shall be by the same manufacturer.

- B. Whenever an item is listed by a single proprietary name, with or without model number and type, it shall be for purpose of design only, to indicate characteristics and quality desired. Proprietary designation listed on Drawings, or listed first in Specifications, is used as a basis for design to establish a standard for quality and performance and space requirements.
- C. HVAC equipment products from different manufacturers are never identical. Equipment approved as being equal is interpreted as being equivalent in capacity, performance and quality. The dimensions, weight, configuration and utility requirements could be quite different from the equipment used as the basis of design. Due to these differences, additional coordination and adjustments by the CONTRACTOR are required. For the equipment to be deemed truly equal, the additional coordination and adjustments by the CONTRACTOR should not incur any additional cost to the Owner and any additional labor to the design team.
- D. Equipment and materials indicated or required to be installed outdoors shall be of the type that is designed, manufactured, listed or approved by authorities having jurisdiction for outdoor installation by being resistant to the adverse effects of weather. All the additional protective measures against outdoor weather required by the manufacturers' installation instructions and prevalent practice shall be provided.
- E. For substitution of materials or products, refer to the General Conditions.

PART 3 – EXECUTION

3.1 GENERAL INSTALLATION REQUIREMENTS

- A. CONTRACTOR shall arrange for a preconstruction meeting with IOR prior to the installation of refrigerant piping to discuss installation and testing requirement.

3.2 SERVICE INTERRUPTIONS, OFF-SITE, GAS AND WATER

- A. Schedule Work so there shall be no service interruptions of existing systems or systems during normal hours of operation of affected systems and facilities.
- B. When service interruptions are mandatory, arrange in advance with the OAR as to time and date of such interruptions.
- C. Systems, which are interrupted, shall be returned back into operation in such manner that they will function as originally intended.

3.3 CUTTING, NOTCHING, AND BACKING

- A. Conform to California Building Code, Title 24, Part 2, for notches and bored holes in wood and for pipes and sleeves embedded in concrete and for cuts in steel, as detailed on structural Drawings.
- B. Where pipes or ducts pass through or are located within one inch of any construction element, install a resilient pad, 1/2 inch thick minimum, to prevent contact.
- C. Furnish all necessary provisions for recesses, chases, and accesses and provide blocking and backing as necessary for proper reception and installation of mechanical Work.

3.4 LOCATION OF PIPING AND EQUIPMENT

- A. Location of piping, apparatus and equipment as indicated on Drawings is approximate and shall be altered to avoid obstructions, preserve headroom, and provide free and clear openings and passageways.
- B. Trenches parallel to footings shall not be closer than 18 inches to the face of footings and shall not be below a plane having a downward slope of 2 horizontal to one vertical, from a line 9 inches above bottom of footing.

- C. Pipe in tunnels shall be installed close to one side of tunnel to provide maximum space for passage. Pipe shall not be installed through crawl hole unless otherwise specified or detailed on Drawings.
- D. Place equipment in locations and spaces indicated, disassemble and/or reassemble equipment as required by Project conditions.

3.5 VALVE AND SPECIALTY APPLICATIONS

- A. Install thermostatic/ electronic expansion valves as close as possible to distributors on evaporators.
 - 1. Secure bulb to clean, straight, horizontal section of suction line using two bulb straps. Do not mount bulb in a trap or at bottom of the line.
 - 2. If external equalizer lines are required, make connection where it will reflect suction-line pressure at bulb location.
- B. Install safety relief valves where required by ASME Boiler and Pressure Vessel Code. Pipe safety-relief-valve discharge line to outside according to ASHRAE 15.
- C. Install moisture/liquid indicators in liquid line near condensing unit.
- D. Install filter dryers in liquid line between compressor and thermostatic expansion valve.
- E. Consult refrigeration equipment manufacturer to determine the need for a receiver.
- F. Install receivers sized to accommodate pump-down charge.
- G. See Evaluations for discussion of flexible connectors.
- H. Install flexible connectors at condensing unit.

3.6 PIPING INSTALLATION

- A. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems; indicated locations and arrangements were used to size pipe and calculate friction loss, expansion, pump sizing, and other design considerations. Install piping as indicated unless deviations to layout are approved on Shop Drawings.
- B. Install refrigerant piping according to ASHRAE 15.
- C. Install piping in concealed locations unless otherwise indicated and except in equipment rooms and service areas.
- D. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.
- E. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal.
- F. Install piping adjacent to machines to allow service and maintenance.
- G. Install piping free of sags and bends.
- H. Install fittings for changes in direction and branch connections.
- I. Select system components with pressure rating equal to or greater than system operating pressure.
- J. Install piping as short and direct as possible, with a minimum number of joints, elbows, and fittings.

- K. Arrange piping to allow inspection and service of refrigeration equipment. Install valves and specialties in accessible locations to allow for service and inspection. Install access doors or panels as specified in Division 08 Section "Access Panels Frames" if valves or equipment requiring maintenance is concealed behind finished surfaces.
- L. Install refrigerant piping in protective conduit where installed belowground.
- M. Install refrigerant piping in rigid or flexible conduit in locations where exposed to mechanical injury.
- N. Slope refrigerant piping as follows:
 1. Install horizontal hot-gas discharge piping with a uniform slope downward away from compressor.
 2. Install horizontal suction lines with a uniform slope downward to compressor.
 3. Install traps and double risers to entrain oil in vertical runs.
 4. Liquid lines may be installed level.
- O. When brazing or soldering nitrogen must be present and flow in the piping, remove solenoid-valve coils and sight glasses; also remove valve stems, seats, and packing, and accessible internal parts of refrigerant specialties. Do not apply heat near expansion-valve bulb.
- P. Retain first paragraph and subparagraphs below for steel pipe. Review the cost of steel pipe using these procedures versus the cost of copper piping. Also consider limiting the size of the refrigerant system and its piping to avoid the use of steel pipe.
- Q. Install pipe sleeves at penetrations in exterior walls and floor assemblies.
- R. Seal penetrations through fire and smoke barriers according to Division 07 Section "Penetration Firestopping."
- S. Install piping with adequate clearance between pipe and adjacent walls and hangers or between pipes for insulation installation.
- T. Install sleeves through floors, walls, or ceilings, sized to permit installation of full-thickness insulation.
- U. Seal pipe penetrations through exterior walls according to Division 07 Section "Joint Sealants" for materials and methods.
- V. Identify refrigerant piping and valves according to Division 23 Section "HVAC Identification."

3.7 PIPE JOINT CONSTRUCTION

- A. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.
- B. Remove scale, slag, dirt, and debris from inside and outside of pipe and fittings before assembly.
- C. Fill pipe and fittings with an inert gas (nitrogen), during brazing or welding, to prevent scale formation.
- D. Soldered Joints: Construct joints according to ASTM B 828 or CDA's "Copper Tube Handbook."
- E. Brazed Joints: Construct joints according to AWS's "Brazing Handbook," Chapter "Pipe and Tube."

1. Use Type BcuP, copper-phosphorus alloy for joining copper socket fittings with copper pipe.
 2. Use Type BAg, cadmium-free silver alloy for joining copper with bronze or steel.
- F. Welded Joints: Construct joints according to AWS D10.12/D10.12M.

3.8 TESTS AND TESTING

- A. Tests shall be as required under the applicable sections of Division 23, including this Section.
- B. Tests required by other sections of the Contract Documents include the following:
1. Test and balance of mechanical equipment and systems: Refer to Section 01 4525: Testing, Adjusting, and Balancing for HVAC.
 2. Hydrostatic test of boilers: Refer to Section 01 4525: Testing, Adjusting, and Balancing.
 3. Test of smoke and fire detectors: Refer to Division 26: Electrical.
- C. Additional tests may be required in the case of products, materials, and equipment if:
1. Submitted items are altered, changed, or cannot be determined as exactly conforming to the Contract Documents.
 2. Performance testing and results may also be required on certain items which are as specified, including fan, and pump performance.
- D. Piping Tests:
1. Perform tests required to demonstrate that operation of mechanical systems and their parts are in accordance with Specifications covering each item or system, and furnish materials, instruments and equipment necessary to conduct such tests. Tests shall be performed in presence of the Project Inspector of Record and Owner Authorized Representative. Work shall not be concealed or covered until required results are provided.
 2. Pressure gages furnished in testing shall comply with CPC. Air shall be bled from lines requiring hydrostatic or water tests.
 3. Systems shall be pressure-tested in accordance with pipe testing schedule below. Pipe test shall indicate no loss in pressure after a minimum duration of 48 hours at test pressures indicated. Where local codes require higher test pressures than specified herein for fire sprinkler systems, local codes shall govern.
 4. Fuel gas lines shall be first tested with piping exposed, before backfilling trenches or lathing; second with piping in finished arrangement, backfilled and paved where required, and walls finished.
 5. Piping systems could be tested as a unit or in sections, but entire system shall successfully meet requirements specified herein, before final testing by the Project Inspector.
 6. Repair of damage to pipes and their appurtenances or to any other structures resulting from or caused by these tests, shall be provided.
 7. Refrigerant piping shall be pressure tested by using a calibrated electronic testing equipment.
 8. Refrigerant Piping Brazing and Deburring Testing procedures for each building:

- a. OWNER will randomly select maximum Two installed split systems serving each building for the inspection of proper brazing and deburring of associated refrigerant piping systems. Maximum Two copper fittings within the piping systems shall be randomly selected by OWNER and cut and removed by CONTRACTOR for inspection.
- b. If a sign of oxidation is found on any selected fittings or adjacent piping, then the tested split system piping, and all connected equipment including evaporator and condensing unit with sign of oxidation shall be removed and replaced in entirety by CONTRACTOR at no additional cost to OWNER.
- c. If a burr is found on any selected joint, then the entire tested refrigerant piping system shall be removed and replaced by CONTRACTOR at no additional cost to OWNER.
- d. CONTRACTOR shall repair all tested systems after OWNER's inspection and approval at no additional cost to OWNER.
- e. Inspector of Record shall be present during the replacement of the defective systems and the repair of the tested systems by CONTRACTOR.
- f. If one or more selected split systems fail, then Two additional split systems (not including the ones previously tested) shall be selected for further testing. Selection of additional split systems and retesting will be performed until neither oxidation nor burr is found within the tested systems.

9. Pipe Testing Schedule:

System Tested	Test Pressure (psig)	Test With:
Steam piping, hot water heating system piping and chilled water piping	150	Water
Vacuum pump or condensate pump discharge and condensate return piping	150	Water
Refrigeration piping	600	Dry nitrogen

E. Equipment Performance Assurance Tests:

1. Before operating any equipment or systems, a thorough check shall be performed to determine that systems have been flushed and cleaned as required and that equipment has been properly installed, aligned, lubricated, and serviced. Factory instructions shall be checked to verify installations have been completed and recommended lubricants have been installed in bearings, gearboxes, crankcases, and similar equipment. Particular care shall be furnished in lubricating bearings to avoid damage by over-lubrication and blowing out seals. Equipment shall also be checked for damage that may have occurred during shipment, after delivery, or during installation. Damaged equipment, products, and materials shall be replaced or repaired as required.
2. Upon completion of the above, adjust the system settings to within normal operating conditions to prevent the system from being damaged upon start-up.
3. Run-test the equipment after start-up for five consecutive days. Tests shall include operation of heating, ventilating, and air conditioning equipment and systems for a period of not less than two 8 hour periods at 90 percent of the full specified heating and cooling capacities. If equipment passes, install new filters. If equipment fails, it shall be adjusted and retested until system meets all applicable codes.
4. Equipment Start-up Reports: For each equipment or system on which start-up is performed, submit 8 copies of start-up report for review by the Architect.

- a. The start-up report shall include the manufacturer's standard start-up form completed and signed by the start-up technician.
 - 5. Provide, maintain, and pay costs for equipment, instruments, and operating personnel as required for specified tests.
 - 6. Provide electric energy and fuel required for tests.
 - 7. Final adjustment to equipment or systems shall meet specified performance requirements.
 - 8. Equipment, systems, or Work deemed defective during testing shall be replaced or corrected as required. Test until satisfactory results are provided.
- F. Specific Coordinated Plan for Test and Balance:
- 1. Provide a narrative of the operational intent that clearly describes the function and sequence of operation of each component, equipment, or system installed. Instruct designated Owner personnel in the operation of the installed systems.
 - 2. Prior to final test and balance, mechanical equipment and systems shall be operated and tested as indicated in Paragraph 3.04.F above to demonstrate satisfactory overall operation of the installed systems.
 - 3. Immediately before starting tests, air filter media shall be cleaned or renewed. Roll-type filters shall be advanced to provide new clean media. Cleanable type media shall be thoroughly cleaned and re-oiled with new, clean oil as recommended by manufacturer if they are of viscous impingement type. Disposable type filters shall be replaced with new filters. Replaceable media shall be replaced with new media.
 - 4. An accurate means of measuring air flow and temperatures shall be furnished to balance air supply, return, and exhaust systems so uniform temperatures occur in every room and design airflow is obtained through registers, diffusers, and grilles.
 - 5. Systems shall be adjusted to provide airflows indicated including maximum fresh air and maximum return air. Dampers shall be checked for proper settings and operation. Air and water inlet and leaving temperatures at coils shall be checked. Complete operational data including airflows, room temperatures, fan speeds, motor currents, plenum, and duct static pressures shall be tabulated.
 - 6. Welding performed as part of this Division may be subject to radiographic inspections at random in accordance with requirements specified in Section 23 0513: Basic HVAC Materials and Methods.

3.9 NOISE AND VIBRATION REDUCTION

- A. Correct noise or vibration caused by mechanical systems. Provide all necessary adjustments to specified and installed equipment and accessories to reduce noise to the lowest possible level
- B. Correct noise or vibration problems caused by failure to install work in accordance with Contract Documents. Include all labor and materials required as a result of such failure. Pay for re-testing of corrected noise or vibration problems by the project acoustical consultant including travel, lodging, test equipment expenses, etc.

3.10 PROTECTION, CARE AND CLEANING

- A. In addition to storage criteria of the General Conditions, and provisions under Section 01 5000: Construction Facilities and Temporary Controls, the following shall be provided:
 - 1. Provide for the safety and good condition of materials and equipment until Substantial Completion. Protect materials and equipment from damage.
 - 2. Protect installed Work.

3. Replacements: In case of damage, immediately provide repairs and/or replacements as required.
4. Protect covering for bearings, open connections to tanks, pipe coils, pumps, compressors and similar equipment.
5. Interior of ductwork shall be maintained free of dirt, grit, dust, loose insulation, and other foreign materials.
6. Air handling equipment shall not be operated until building is cleaned and air filters are installed.
7. Fixtures, piping, finished brass or bronze, and equipment shall have grease, adhesive, labels, and foreign materials removed. Chromium, nickel plate, polished bronze or brass Work shall be polished. Glass shall be cleaned inside and out.
8. Before initial start-up and again before Substantial Completion, piping shall be drained and flushed to completely remove grease and foreign matter. Pressure regulating assemblies, traps, strainers, boilers, flush valves, and similar items shall be thoroughly cleaned. Tag system with an information tag listing responsible party and date of element, before initial start-up and again before Substantial Completion. Compressed air, oil, and gas piping shall be blown out with oil-free compressed air or inert gas. Refrigerant piping shall be cleaned as specified.

END OF SECTION

SECTION 23 0513

BASIC HVAC MATERIALS AND METHODS

PART 1 – GENERAL

1.1 SUMMARY

A. Section Includes:

1. This Section prescribes basic materials and methods generally common to the Work of Division 23.

B. Related Requirements:

1. Division 01: General Requirements.
2. Division 07: Thermal and Moisture Protection: Polyvinyl-Chloride Roofing.
3. Division 23: Heating, Ventilating, and Air-Conditioning.
4. Division 26: Electrical.
5. Section 31 2323: Excavation and Fill for Utilities.

1.2 SUBMITTALS

- ###### A.
- Provide in accordance with Division 01, Section 23 0500 and specific requirements of each section of Division 23.

1.3 QUALITY ASSURANCE

- ###### A.
- Standards: Comply with applicable national, state, and local codes and standards: ASTM, ASME, and ANSI. Federal Specifications, AWWA, CISPI, NFPA, FM Global, UL, CPC (California Plumbing Code), CMC (California Mechanical Code), CSA.
- ###### B.
- Qualifications of Manufacturer: Products used in the Work of this Section shall be produced by manufacturers regularly engaged in manufacture of similar items and with a history of successful production as reviewed by the Architect.

1.4 COORDINATION

- ###### A.
- Coordinate related Work in accordance with provisions of Section 01 3113: Project Coordination.

PART 2 – PRODUCTS

2.1 GENERAL

- ###### A.
- Provide the following products if they are indicated in the Contract Documents or if they are required for the proper installation, function or operation of equipment, systems or components indicated in the Contract Document.

B. Provide the following products as a complete assembly with required accessories for a complete and functioning entity in compliance with governing codes and applicable standards as specified in Section 23 0500, manufacturer's instructions or as required.

1. Omission of minor details in the Contract Documents does not waive and/or otherwise relinquish compliance with the above requirements.

2.2 MANUFACTURERS AND MATERIALS

A. Piping:

1. Piping shall be continuously and permanently marked with manufacturer's name, type of material, size, pressure rating, and the applicable ASTM, ANSI, UL, or NSF listing. On plastic pipe, date of extrusion must also be marked.

2. Underground non-ferrous pressure pipes shall be installed with proper color tracer wires. Refer to color code provisions in Section 23 0553: HVAC Identification.

3. Refer to HVAC Piping: Section 23 2013 for heating and chilled water piping and fittings.

B. Pipe Isolators:

PLA-1 Absorption pad shall be not less than 1/2 inch thick, unloaded. Pad shall completely encompass pipe.

Holdrite, LSP, Stoneman, Potter-Roemer, Trisolator, PR-Isolator, or equal.

PLA-2 Plastic cushion to form an insulating liner and eliminate metal to metal contact when securing copper tubes and pipes in air conditioning and refrigeration insulation preventing galvanic erosion. (Acoustical Type for Sound Absorption)

Hydra-Zorb Cushion Clamps, LSP Products Group Acousto Clamp, or equal.

C. Pressure Gage: Aluminum or steel case, minimum 4-1/4 inches dial; pressure type or combination vacuum-pressure type, with provisions for field calibration. Dial indicator to indicate pressure in psi with accuracy to within plus or minus 0.5 percent of maximum dial reading. Furnish gages with restriction screw, size 60, to eliminate vibration impulses. Black case and ring, bourdon tube of seamless copper alloy with brass tip and socket. Three way gage cock, constructed of brass with stuffing box, 1/2 inch couplings, with fixed or movable cap nut to shut off pressure gage.

PG-1 Pressure type, black drawn steel case, 4 1/2-inch glass dial, range approximately twice line pressure.

Marsh Keckley, Trerice, Weksler, Weiss, or equal.

D. Flanges: Flanges shall be furnished and installed at each flanged connection of each type of equipment, tanks, and valves. Faces of flanges being connected shall be furnished alike. Connection of a raised face flange to a flat-faced flange is not permitted. Flanges shall conform to following schedules:

TYPE OF PIPE	FLANGE
Screwed black or galvanized grooved steel pipelines.	125 pound black cast iron screwed flange, flat faced or grooved flange adapters, Victaulic Style 741, Tyco-Grinnell Fig. 71, Gruvlok Fig. 7401, or equal.

Welded or grooved steel pipe, except high pressure steam lines.	150 pound black forged steel welding flanges, 1/16 inch raised face ASTM A105, Grade II or grooved flange adapters, Victaulic Style 741, Tyco-Grinnell Fig. 71, Gruvlok Fig. 7401, or equal.
Copper and brass pipe or tubing.	150 pound cast bronze, flat-faced flange with solder end or grooved flange adapters, Victaulic Style 641, Tyco-Grinnell Fig. 61, Gruvlok Fig. 6084, or equal.

1. Gasket material for flanged connections shall be full faced or ring type to suit facing on flanges and shall be furnished in accordance with following schedule

<u>SERVICE</u>	<u>TYPE</u>
Cold water	1/16 inch thick neoprene
Steam, hot water	1/16 inch Teflon

Grooved end flange adapters supplied with pressure responsive elastomeric Gaskets supplied with grooved flange adapters shall be pre-lubricated by the manufacturer. Grade of gasket to suit intended service.

E. Unions:

1. Unions shall be furnished and installed in accordance with the following requirements (unless flanges are furnished):
 - a. At each threaded or soldered connection to equipment and tanks, except in Freon or fuel gas, piping systems, whether indicated or not.
 - b. Immediately downstream of any threaded connection to each manually operated threaded valve or cock, and each threaded check valve, yard box or access box except those in Freon piping systems, whether indicated or not.
 - c. At each threaded connection to threaded automatic valves (except those in Freon piping systems) such as reducing valves and temperature control valves, whether indicated or not.
 - d. If grooved piping is used, couplings shall serve as unions. Additional unions are not required
2. Unions shall be located so that piping can be easily disconnected for removal of equipment, tank, or valve.

PART 3 – EXECUTION

3.1 EXAMINATION

- A. Examine areas and conditions under which Work of this Section shall be performed. Correct conditions detrimental to proper and timely completion of Work. Do not proceed until unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Provide all materials and equipment for the Work. Furnish and install necessary apparatus, parts, materials, and accessories.
- B. Pipe Installation:
 1. Install piping parallel to wall and provide an orderly grouping of proper materials and execution.

2. Piping shall clear obstructions, preserve headroom, provide openings and passageways clear, whether indicated or not. Verify the Work of other Divisions to avoid interference.
3. If obstructions or the Work of other Divisions prevent installation of piping or equipment as indicated by the Drawings, perform minor deviations as required by the Architect.
4. Install piping after excavation or cutting has been performed. Piping shall not be permanently enclosed, furred in, or covered before required inspection and testing is performed.
5. Exposed polished or enameled connections from fixtures or equipment shall be installed with no resulting tool marks or threads at fittings. Residue or exposed pipe compound shall be removed from exterior of pipe.
6. Piping shall be concealed in chases, partitions, walls, and between floors, unless otherwise directed or specifically noted on Drawings. When penetrating wood studs, joists, and other wood members, provide such members with reinforcement steel straps of Continental Steel & Tube Co., ULINE, Independent Metal Strap, or equal.
7. Reduce fitting where any change in pipe size occurs. Bushings shall not be furnished unless specifically reviewed by the Architect, or indicated on Drawings.
8. Piping subject to expansion or contraction shall be anchored in a manner, which permits strains to be evenly distributed. Swing joints or expansion loops shall be installed. Seismic restraints shall be installed so as not to interfere with expansion and contraction of piping. Seismic loops required at all building separations.
9. Immediately after lines have been installed, openings shall be capped or plugged to prevent entrance of foreign materials. Caps shall be left in place until removal is necessary for completion of installation.
10. Couplings shall not be installed except where required pipe runs between other fittings are longer than standard length of type of pipe being installed and except where their installation is specifically reviewed by the Architect.
11. Water piping shall be installed generally level, free of traps, unnecessary offset, arranged to conform to building requirements, clear of ducts, flues, conduits, and other Work. Piping shall be arranged with valves installed to provide for complete drainage and control of system. Piping shall not be installed which causes an objectionable noise from flow of water therein under normal conditions. Refer to Section 23 0500: Common Work Results for HVAC.
12. Water lines may be installed in same trench with sewer lines, provided bottom of water line is 12 inches minimum above top and to the side of sewer line.
13. Hot and chilled water circulating piping installed for space heating or cooling shall pitch up to a high point at a slope of 1/4 inch in 10 feet in the direction of flow. Where supply and return lines are exposed, both lines shall pitch in same direction. Otherwise, where possible, lines shall pitch up toward compression tank.
14. Changes in pipe sizes shall be furnished with eccentric reducers, flat on top. Offsets to clear obstruction shall not be installed so as to produce air pockets.

C. Pipe Sleeves and Plates:

1. Provide and install pipe sleeves of Schedule 40 black steel pipe or Schedule 40 PVC plastic pipe in concrete or masonry walls, footings, and concrete floors below grade. Provide and install adjustable submerged deck type sleeves at locations where pipes pass through concrete floors, except concrete slab floors on grade, and at locations where soil pipe for floor type water closets passes through concrete floors.
2. Sleeves shall provide 1/2 inch clearance around pipes, except plastic pipe shall have 1-inch clearance. Caps of deck type sleeves shall be removed just prior to installation of pipe. Area around sleeves shall be smooth and without high or low spots. Sleeves in walls shall not extend beyond exposed surface of wall. Sleeves in concrete floors and walls shall be securely fastened to forms to prevent movement while concrete is being placed.
3. Piping installed on a roof shall clear the roof surface by 10 inches minimum, with or without insulation. Bottom of individual fittings may infringe on 10 inches clear space but not groups of fittings or fittings located within 27 inches of each other.
4. Stiles shall be provided to facilitate crossing of piping when parallel piping runs are laterally greater than 12 inches out-to-out, or any pipe is higher than 18 inches, and more than 40 feet long or runs between 2 or more major pieces of equipment or housings greater than 20 feet apart. Stiles shall be not less than 20 inches wide with a minimum tread depth of 10 inches. Where stiles are required, they shall be located so greatest obstructed distance is 30 feet.
5. Where pipes pass through waterproofed walls, floors, or floors on grade, sealant with Link-Seal Modular Seals, or equal, between pipe and sleeve to provide a waterproof joint. Where earth is in contact with pipe on both sides of a wall or foundation, the waterproof joint is not required. Commercial rubber compression units may be furnished instead of sealed sleeves if reviewed by the Architect.
6. A swing joint, or other required device, shall be furnished and installed in hot water lines with 10 feet of sealant or compression joint to allow for expansion.
7. Pipe sleeves shall be provided where pipes intersect footings or foundation walls and sleeve clearances shall provide for footing settlement, but not less than one inch all around pipe.

D. Welding of Pipe and Qualifications of Welder:

1. Joints above grade or accessible conduit or tunnels in steel piping may be either welded or screwed unless specifically indicated otherwise on Drawings or specified. Joints in below grade steel piping, whether in insulation or not, shall not be welded, unless otherwise indicated.
2. Welded joints in pipe shall be continuous around pipe and shall comply with ASME B31: Code for Pressure Piping, unless otherwise specified.
3. Each pipe weld shall be stamped with welder's identification mark. Welding shall be performed by welders possessing a valid certificate of qualification for welding carbon steel welding pipe in horizontal position (2G) and horizontal fixed position (5G) in accordance with the requirements of Section IX of the ASME Boiler and Pressure Vessel Code, by an Owner-recognized, DSA approved testing laboratory.

4. Before any welder performs welding on the Work, furnish the Project Inspector with a copy of welder's valid qualification papers and obtain verification. Welder qualification is not valid unless it has been issued while welder was performing work for current employer, and has performed type of work described by qualification in the preceding 3 months.
 5. Welding performed under these Specifications is subject to special tests and inspections including rigid Ultra Sonic Testing (UT) and radiographic inspection at random, in accordance with Technique for Radiographic Examination of Welded Joints by an Owner recognized, DSA approved testing laboratory.
- E. Unacceptable Welds and Repairs to Welding:
1. Welds containing any of the following types of imperfections shall be deemed defective Work:
 - a. Cracks of any type.
 - b. Zones of incomplete (in excess of 1/32 inch) fusion or penetration.
 - c. Elongated slab inclusions longer than 1/4 inch.
 - d. Groups of slag inclusions in welds having an aggregate length greater than thickness of parent metal in a length 12 times the thickness of the parent metal.
 - e. Undercuts greater than 1/32 inch.
 - f. Overlaps, abrupt ridges or valleys.
 2. When a defective weld is detected by examination as outlined above, two additional welds shall be radiographed at locations selected by the Project Inspector. If the two selected welds demonstrate compliant welding, then the two tested welds shall be deemed to be in compliance. Welding revealed by radiographs to be defective Work shall be removed, repaired, and tested by radiograph.
 3. If either of the two selected welds demonstrates welding deemed to be defective Work, all welding in that portion of the Work shall be deemed defective Work and either: all welds shall be cutout, prepare new ends for welding and weld to comply with this Specification, or radiograph all welds, removing and repairing only such welding deemed to be defective Work.
 4. Repair welding shall be performed in a manner in full compliance with ASME B31. The welded joints or repairs shall be spot examined with UT or radiographic tests in accordance with foregoing requirements.
 5. Owner shall cause to be performed additional random UT and radiographic examinations of welds. Owner shall be responsible for the costs of any UT and radiographic examinations found to be in compliance with specified requirements.
 6. Installer shall be responsible for the costs of UT and radiographic re-examinations of welds deemed defective Work and not in compliance with this Specification, and shall repair or replace said welds in accordance with specified requirements.

- F. Welding Rods: Submit a written list of materials and proposed type of welding rods for review by the Architect.
- G. Backing Rings: Backing rings may be submitted for installation provided the Product Data is submitted with the material list.
- H. Qualification Tests for Low-pressure Welding:
 - 1. Tests shall be performed on 3-inch standard weight pipe ASTM A53, Grade A, and shall be welded by acetylene and electric arc. Each sample shall consist of two pieces, each 10 inches long, with 30-degree bevel at point weld.
 - 2. Two 20-inch samples shall be performed in the 2G and two 20-inch samples in the 5G positions, with positions defined in Section IX, ASME Boiler and Pressure Vessel Code. Welds shall have the reinforcement ground or machined flush to the surface of the pipe before testing. Samples shall be tested as full section tensile.
 - 3. Weld shall develop a load of 90 percent of 50,000 psi, i.e., 45,000 psi or shall develop a fracture in parent metal.
 - 4. Each qualified welder shall carry an identification card listing welder's name, date of test, and type of welding tests passed; signed by the welder and the laboratory.
 - 5. A valid certificate of qualification issued in compliance with requirements of the ASME Boiler Pressure Vessel Code Section IX shall qualify a welder for issuance of a certificate for low-pressure pipe welding.

I. Certificates of Qualification for Welding of Unfired Pressure Vessels:

- 1. Certificates of qualification shall be issued by a laboratory recognized by the Owner in compliance with the requirements of the ASME Boiler Pressure Vessel Code Section IX. Qualifications shall be for both acetylene and arc welding of Schedule 40 ASTM A53, Type B, steel welded or seamless pipe in the Horizontal Position (2G) and the Horizontal Fixed Position (5G) as defined by said code.

NOTE: Certificate described above is not valid unless it has been issued while welder was working for his current employer, and unless welder has performed type of work described by certificate in the preceding three months. Requirements for possession of a valid certificate shall not be waived for welders fabricating unfired pressure vessels when the Specifications require compliance with ASME code or when welding pipe carries working pressures greater than 75 psi and temperatures greater than 250 degrees F.

J. Pipe Joints and Connections:

- 1. Pipe and tubing shall be cut per IAPMO Installation Standards. Pipe shall have rough edges or burrs removed so that a smooth and unobstructed flow shall be provided.
- 2. Threaded Pipe: Joints in piping shall be installed according to the following service schedule:
 - a. Refrigerant and Soap Piping: Litharge and glycerine, or Expando, Gasoila, or equal.
 - b. All other services Furnish sealant, suitable and as reviewed by the Architect.

3. Threads on pipe shall be cut with sharp, clean, unblemished dies and shall conform to ANSI/ASME B1.20.1 for tapered pipe threads.
 4. Joint compounds shall be smoothly placed on male thread and not in fittings. Threaded joints shall be installed tight with tongs or wrenches and sealant of any kind is not permitted. Failed joints shall be replaced with new materials. Installation of thread cement or sealant to repair a leaking joint is not permitted.
 5. Sharp-toothed Stillson, or similar wrenches, is not permitted for the installation of brass pipe or other piping with similar finished surfaces.
- K. Copper Tubing and Brass Pipe with Threadless Fittings:
1. Silver brazed joints shall be used for attaching fittings to non-ferrous metallic refrigerant piping.
 2. Non-pressure gravity fed condensate lines may be soldered with 95/5 solder.
 3. Silver brazing alloy, Class BCUP-5. Surfaces to be joined shall be free of oil, grease, and oxides. Socket of fitting and end of pipe shall be thoroughly cleaned with emery cloth and wiped to remove oxides. After cleaning and before assembly or heating, flux shall be installed to each joint surface and spread evenly. Heat shall be applied in accordance with instructions in the Copper Tube Handbook issued by Copper Development Associates. Joints constructed of rough bronze fittings shall be provided as recommended by manufacturer.
 4. Do not overheat piping and fittings when installing silver brazing.
 5. Joints in non-ferrous piping for services not covered above shall be installed with solder composed of 95/5 tin/antimony, ASTM B32, Grade 5A. Surfaces to be jointed shall be free of oil, grease, and oxides. Sockets of fitting and end of pipe shall be thoroughly cleaned with emery cloth to remove oxides. Solder flux shall be sparingly installed and solder added until joint is completely filled. Do not overheat. Excess solder, while plastic, shall be removed with a small brush in order to provide an uninterrupted fillet completely around joint. Random inspection of joints shall be conducted by Project Inspector to ensure joints are lead-free.
 6. Grooved end joints for copper piping shall be assembled in accordance with the latest manufacturer recommendations. Pipe ends shall be clean and free from indentations, projections, and roll marks in the area from pipe end to groove for proper gasket sealing. Grooving tools shall be as manufactured by Victaulic, RIDGID, MAG Tool, or equal.
- L. Ring-Type Pipe: Joints shall be installed in accordance with manufacturer's instructions with grooved couplings, fittings and rubber rings. Couplings and pipe shall be compatible and of the same manufacturer. Rings shall be accurately located and installed by grooves in coupling. Pipe shall be installed with zero deflection unless otherwise specified. Pressure pipe shall be furnished with thrust blocks at each offset point.
- M. Welded Pipe Joints:
1. Joints in welded steel pipelines shall be installed by oxyacetylene or electric arc process. Welding shall be continuous around pipe and provided as specified.

2. Butt welds shall be of the single V-type, with ends of pipe and fittings beveled approximately 37 ½ degrees. Piping shall be aligned before welding is started with the alignment maintained during welding.
 3. Welds for flanges and socket fittings shall be of the fillet type with a throat dimension not less than pipe wall thickness.
- N. Grooved End Pipe Joints: Grooved end joints for carbon steel piping shall be assembled in accordance with the latest manufacturer recommendations. Pipe ends shall be clean and free from indentations, projections, and roll marks in the area from pipe end to groove for proper gasket sealing. Grooving tools shall be as manufactured by Victaulic, RIDGID, MAG Tool, or equal.
- O. Joints shall be Vic-Press 304TM, or equal, made with Victaulic Series ‘PFT’ tools and the appropriate sized jaw. Pipe shall be certified for use with Vic-Press 304TM system, and shall be square cut, properly deburred and cleaned, and marked at the required location to insure full insertion into the fittings and/or couplings.
- P. Valves: Valves shall conform to the following:
1. Piping systems shall be furnished with valves at points indicated on Drawings and specified, arranged to provide complete regulating control of piping system throughout building and the Project site.
 2. Valves shall be installed in a neat grouping, so that parts are easily accessible and maintained.
 3. Pressure Independent Characterized Control valve type shall be suitable for service on which installed.
 4. Valves shall be full size of line in which they are installed, unless otherwise indicated on Drawings or otherwise specified, and shall be one of types specified.
 5. Provide chain operators on valves 2-inch and larger located 7 feet or more above the servicing floor level.
 6. Valves for similar service shall be of one manufacturer.
 7. Except where otherwise specified, valves shall be Belimo, Victaulic, Stockham, Crane, Jenkins, Milwaukee, Hammond, American Valve, NIBCO, Hoffman, or equal.
 8. Ball valves below grade in yard boxes shall have stainless steel handles.
 9. Temperature relief valves and combination temperature and pressure relief valves shall be as specified and furnished as set forth in this Section. Discharge pipe from relief valves shall be not less than discharge area of valve or valves it connects, based on discharge area of valves, and shall terminate as indicated and free of any traps. Valves shall be installed at following locations:
 - a. A combination temperature and pressure relief valve or combination of valves on each heating hot water boiler. Temperature sending element shall extend into water inside boiler.

10. Manual air vent valve assemblies shall be installed at each high point of hot water space heating and chilled water piping systems. Valves shall discharge through 1/4 inch diameter copper tubing and drain to nearest floor sink. Automatic type air vent valve shall only be installed where specifically indicated. Radiator, convectors, and finned pipe convectors shall be fitted with packless radiator valves, angle or straight pattern. Each convector or radiator installed as part of a space hot water heating system shall be furnished with a manual-type air vent valve.
- Q. Strainers: Strainers shall be installed on each water main (except for fire line) downstream of the meter, above grade, when a pressure regulator assembly is not installed. Main strainer shall be of Y-flange or groove type. On closed loop chilled and heating hot water systems pump systems, a strainer shall be installed at each pump inlet and upstream of each flow control valve assembly. The control valve assembly may include a modulating temperature control valve and a flow-limiting valve, manufactured by Griswold, AutoFlow, Flow Control Industries, Inc., or equal.
- R. Hangers and Supports:
1. Piping shall be securely fastened to building structure by approved iron hangers, supports, guides, anchors, and sway braces to maintain pipe alignment to prevent sagging and to prevent noise or excessive strain on piping due to uncontrolled or seismic movement under operating conditions. Hangers and supports shall conform to Manufacturer's Standardization Society Specification SP-69. Hangers shall be relocated as required to correct unsatisfactory conditions that may become evident when system is placed into operation. Appliances, heat exchangers, storage tanks, and similar equipment shall be securely fastened to structure in accordance with seismic requirements. Outdoor metal hangers and supports shall be hot-dipped galvanized steel, unless otherwise specified.
 2. Piping shall not be supported by wire, rope, wood, plumbers' tape, or other non-recognized devices.
 3. Hangers and supports shall be designed to support weight of pipe, fittings, weight of fluid and weight of pipe insulation, and shall have a minimum factor of safety of 5, based on ultimate tensile strength of material installed.
 4. Burning or welding of any structural member under load is not permitted. Field welding not specified on Drawings or reviewed Shop Drawings is not permitted without review by Architect and DSA.
 5. Burning holes in beam flanges or other structural members is not permitted without review by the Architect and DSA.
 6. Pipe hangers on piping covered with low temperature insulation shall be installed on outside of insulation and not in contact with pipe unless otherwise detailed on Drawings. Insulation shall be protected by 18 gage galvanized steel shield, with a minimum length of 10 inches, installed completely around pipe covering between covering and hanger. Installing hangers directly on pipe and butting adjoining sections of insulation against hanger is permitted provided void and hanger rod are properly insulated and sealed so that no sweating occurs at hangers.
 7. Hanger rods shall be fastened to structural steel members with suitable beam clamps. Clamps shall be Tolco, Carpenter & Patterson, Fee and Mason, or equal, as follows:

- a. Tolco I beam, Fig.62 for maximum 1000 lbs.
 - b. Tolco I or WF beam, Fig. 329, for maximum of 1290 lbs.
8. Hanger rods shall be fastened to concrete inserts in concrete slabs or beams. Inserts shall be Tolco, Carpenter & Patterson, Fee and Mason, or equal, as follows:
- a. Tolco Fig.310 for maximum of 600 lbs.
 - b. Tolco Fig. 309 for maximum of 1140 lbs.
9. For fastening to wood ceilings, beams, or joists, furnish Anvil Fig. 128R, Anvil Fig. 153, Tolco 78, or equal pipe hanger flange fastened with drive screws. Under wood floors, 3/8 inch hanger rods shall be hung from 2-inch by 2-inch by 1/4 inch angle clips 3-inch long, with two staggered 10d nails, clinched over joist.
10. Hanger rod sizes for copper, iron, or steel pipe: 3/8 inch for pipe sizes 1/2 inch through 2-inch, 1/2 inch for pipe sizes 3-inch, 4-inch and 5-inch, 5/8 inch for pipe size 6-inch, and 3/4 inch for 8-inch and 10-inch pipe.
11. Turnbuckles, if furnished, shall provide a load carrying capacity equal to that of the pipe hanger with which they are being installed.
12. Pipe hangers shall be of same size, or nearest larger manufactured size available, as pipe or tubing on which they are being installed.
13. Hangers, clamps, and guides furnished for support of non-metallic pipe shall be padded with 1/8 inch thick rubber, neoprene, or soft resilient cloth.
14. Where special pipe-supporting requirements in the Specifications conflict with any standard requirements specified herein, the Specification requirements shall govern.
15. Vertical Piping:
- a. Vertical pipe risers shall be securely supported with riser clamps of recognized type. Risers in reinforced concrete buildings shall be furnished with extension clamps fastened to pipe above each concrete floor slab with extended arms of clamp to rest on slab. Clamps shall be provided with lead or Teflon liners when installed on copper tubing. Clamps shall be plastic-coated when installed on non-ferrous pipe or tubing.
 - b. Copper tubing in sizes 1 1/2-inches and larger and steel pipelines passing up through building shall be supported at each floor of building or every 15 feet whichever is less.
 - c. Copper tubing sizes 1 1/4-inch and smaller shall be supported at not intervals not more than 6 feet on center. Special provisions shall be installed for vertical lines subject to expansion and contraction caused by operating temperature differences.
 - d. Vertical cast iron pipelines shall be supported from each floor and at its base. Malleable iron or steel pipe clamps with minimum thickness of 1/4 inch shall be furnished and fastened around pipe for support.

16. Horizontal Piping:

- a. Roof Mounted Piping: Pressure and non-pressure piping shall be supported from channels, stands, clamps, trapezes, rollers, or structures mounted on 100% rubber, UV resistant rooftop supports with reflective strips, Dura-Block, or equal. Roller type supports shall be provided below and above pipe to prevent its dislodgement. Bottom of pipes shall clear the roof surface by 10 inches.
 - 1) At PVC roofing provide walk tread, polyester reinforced, UV resistant, with surface embossment at rooftop supports. Heat welding of walk pads shall only be done by manufacturer certified installers.
 - a) Sika-Sarnafil and Carlisle: Walk tread shall be no more than one inch larger than the plan area of the pipe support blocks and adhered to the roof membrane with Sika 1A or Carlisle Universal Single-Ply sealant, as applicable.
 - b) Johns Manville: Walk tread shall be installed under the pipe support blocks and adhered to the blocks, if possible, and left loose laid on top of the PVC roof system. Walk-pad shall have a minimum of 4 inches of material past perimeter on all 4 sides of block.
 - 2) Built-up roofing: Provide APP granulated modified torch-down at each pipe support block. Torch-down shall extend 2 to 4 inches beyond the edges of the block and adhered by torch application over existing cap sheet membrane. This work shall be performed by a certified roofer.
 - b. Piping Mounted to Underside of Roof and Decks and from Structure:
 - 1. Insulated steam and space heating hot water supply and return piping shall be supported with Tolco Figure 4, B-Line Figure B3140, Anvil Figure 212, or equal, steel hangers with welded eye rods to permit hinge movement at point of attachment of hangers. Hinge movement at point of support shall be provided by welded eye linked rods Tolco Figure 101L, B-Line Figure B3211X, Anvil Figure 278X, or equal.
 - 2. Chilled water supply and return piping, condenser water piping, insulated refrigerant piping may be supported with Tolco Figure 1, B-Line Figure B3100, Anvil Figure 260, or equal, hangers with rods, turnbuckles and inserts suitable for above hangers.
 - c. Maximum hanger and support spacing shall conform to CPC schedule for horizontal piping installed above grade.
- 17. A hanger or support shall be installed close to the point of change in direction of a pipe run, in either a horizontal or vertical plane.
 - 18. When practicable, supports and hangers for cast iron soil pipe shall be installed as close as possible to joints and when hangers or supports are not located within one foot of a branch line fitting, an additional hanger or support shall be installed at fitting.

19. In systems where grooved piping is used, couplings shall be provided with angle pattern bolt pads to comply with support and hanging requirements of ANSI/ASME B31.1, ANSI/ASME B31.9, and NFPA Pamphlet 13.

S. Flashings:

1. Each pipe, duct, or gas-fired equipment vent passing through roof shall be installed with waterproof flashing.
2. Flashing or flanges on pipes, vents, and ducts passing through a tile or slate roof shall be constructed of sheet lead. Flashing for pipes and heater vents passing through a roof shall be 4 pound soft sheet lead. Flashing and flanges for ducts and heater vents passing through exterior walls shall be 22 gage sheet metal. Flanges and flashing shall be installed waterproof at point of connection with pipe or duct. No soldered joints on roof flashings will be allowed.
3. Lead flashing and flanges shall be constructed of 4 pound sheet lead with burned joints. Flange of lead flashing or lead flange on a duct shall extend out onto roof a minimum of 12 inches from pipe or duct. Lead flashing shall extend up the pipe or duct not less than 7 inches.
4. Sheet metal flashing shall be constructed of 24 gage galvanized sheet steel. Flanges on these flashings shall extend out onto roof a minimum of 10 inches from pipe or duct. Flanges on ducts through exterior walls shall extend out from duct a minimum of 2 ½ inches. Flanges on gas-fired equipment single-wall vents shall be of ventilated type. Type B gas vents through a roof shall be furnished with non-ventilated flashing as per NFPA Pamphlet 211.
5. Cast iron, steel, brass, and copper pipe, which terminate less than 18 inches above roof, shall be furnished with a combination counter-flashing and vandal-proof hood for protection against water, birds and foreign matter. Cast iron, steel, brass and copper pipe, which does not terminate within 18 inches of roof, shall be furnished with a counter-flashing sleeve. Pipe, which terminates more than 18 inches above roof, shall be furnished with protection against entrance of water, birds, and foreign matter.
6. Counter-flashing and combination counter-flashing sleeves and vandal-proof hoods shall be cast iron, vandal-proof, threaded, sealed or approved gas-heated sleeve type. Counter-flashing sleeves on each of these items shall extend down over flashing a minimum of 3/4 inch.
7. Flashing and flanges on ducts shall be installed waterproof at point of connection to the duct by riveting and soldering. Storm collars shall be securely screwed and installed waterproof around appliance vent pipe immediately above flashing.
8. Vent piping above roof shall be furnished with a combination counter-flashing sleeve and vandal-proof hood.

- T. Equipment Installation: Install roof or floor mounted equipment on level platforms, housekeeping pads or curbs and provide sound, vibration and seismic control measures per Section 23 0548, unless indicated otherwise whether indicated on drawings or not.

END OF SECTION

SECTION 23 0548

HVAC SOUND, VIBRATION AND SEISMIC CONTROL

PART 1 – GENERAL

1.1 SUMMARY

- A. Section Includes: Reduction or elimination of excessive noise or vibration within building due to operation of equipment, machinery, piping, and ductwork as specified.
 - 1. Vibration isolators.
 - 2. Seismic restraint devices.
 - 5. Lining and enclosing ductwork.
 - 8. Flexible ducts, conduits and piping.
- B. Related Requirements:
 - 1. Division 01: General Requirements.
 - 2. Section 01 4525: Testing, Adjusting, and Balancing for HVAC.
 - 3. Section 23 0500: Common Work Results for HVAC.
 - 4. Section 23 0513: Basic HVAC Materials and Methods.
 - 5. Section 23 2013: HVAC Piping.
 - 6. Section 23 3000: Air Distribution.
 - 14. Section 23 8000: Heating, Ventilating and Air Conditioning Equipment.

1.2 GENERAL REQUIREMENTS

- A. Provide vibration isolators to eliminate or reduce the transmission of vibration noise to any part of building and mitigate vibration frequency and load imposed by equipment. Vibration isolators, base frames, inertia bases and seismic restraints shall be of sufficient size, flexibility and load distribution configuration to assure that deflection, stability and seismic restraint requirements are met without permitting excessive movement when starting. For typical units, no fewer than four isolators shall be provided. Isolators shall be provided to deflect uniformly under operating gravity and equipment thrust loadings to within plus or minus 10 percent of specified deflection values.
- B. Static deflections specified are based on the anticipated equipment characteristics. In the event the equipment proposed by the Contractor has characteristics other than those indicated, particularly the rated rpm, the static deflection shall be re-evaluated and the proper mountings and other devices shall be provided.
- C. Where fabricated vibration isolator units are indicated, furnish manufacturer's standard catalog products with printed loading ratings or certified submittals

D. Seismic Requirements:

1. Provide seismic restraints for mechanical equipment or components specified. Where equipment is specified with proprietary names, design for seismic restraints is for first proprietary name listed.
2. Provide restraints, bracing and anchorage as required for the mechanical equipment, electrical equipment and components specified in the Contract Documents. Restraints, bracing and anchorage shall be installed to resist the total design earthquake or wind loads in any direction in accordance with CBC guidelines.
3. Provide restraints, bracing, and anchorage for the mechanical equipment and components.
4. For rigidly mounted liquid filled steel pipe, comply with the following:
 - a. Provisions of NFPA Pamphlet 13, section for sway bracing.
 - b. Provisions of NFPA Pamphlet 13, section for earthquake protection.
 - c. Hanger spacing as specified in Section 23 0513 under Hanger Spacing Schedule.

1.3 SUBMITTALS

A. Provide in accordance with Division 01.

1. Catalog cuts and data sheets on specific vibration isolators, seismic restraints, and anchors demonstrating compliance with the Specifications.
2. Shop Drawings for each piece of equipment including dimensions, structural member size, support point, vibration, and seismic restraints.
3. Written approval of frame design to be furnished by the equipment manufacturer.
4. Drawings indicating methods for suspension, support, seismic restraints, guides, etc., for piping, ductwork, etcetera.
5. Drawings indicating methods for isolation of pipes, ducts etcetera, piercing slabs, beams, etcetera.

B. Vibration Test Reports: At completion of installation, submit the following documents. Submission of these documents must be complete before final acceptance of vibration isolation systems is given. Assistance from the vibration isolation equipment Manufacturer may be required.

1. Complete tabulation showing for each vibration isolator:
 - a. Actual static deflection measured at the project.
 - b. Specified minimum static deflection.
2. Report certifying:

- a. Each piece of operative rotating mechanical equipment does not exceed the specified vibration displacement level.
- b. Each piece of isolated equipment or equipment component (ducts, pipes, conduit, etcetera) is not short-circuited by any means.
- c. Requirements of Part 2 are satisfied for equipment.

1.4 QUALITY ASSURANCE

- A. Standards and Codes: Comply with applicable codes and standards having jurisdiction including, but not limited to:
 - 1. NFPA, Pamphlet 13.
 - 2. ASHRAE Handbook: HVAC Systems and Equipment.
 - 3. California Building Code.
 - 4. VISCMA
 - a. Installing Seismic Restraints for Mechanical Equipment.
 - b. Installing Seismic Restraints for Duct and Pipe.
- B. Qualifications of Manufacturer and Installers: Comply with provisions as set forth in Section 23 0500: Common Work Results for HVAC.

PART 2 – PRODUCTS

2.1 GENERAL

- A. Furnish and install vibration dampers, sound isolation pads, flexible connections and similar equipment required to prevent sound of water flowing in pipes, vibration of motors, and motor operated equipment from being transmitted to building structure; and, in case of fans, from being transmitted along ducts. Piping shall be isolated from vibrating equipment by furnishing required flexible connectors.
- B. Pumps and similar motor operated equipment shall be installed on anti-vibration units.
- C. Fans, except curb-mounted roof-type exhaust fans and wall mounted propeller fans, shall be installed with anti-vibration units, whether indicated on Drawings or not. Fans built into air handling units may be furnished with independent anti-vibration mountings or whole unit may be installed on an external vibration isolation system.
- D. Other equipment shall be installed on anti-vibration bases, pads, or hangers, unless specifically noted otherwise on Drawings. Package units, furnished with built in anti- vibration bases, do not require unit bases unless otherwise specified.
 - 1. Unless specified otherwise, anti-vibration bases shall be Mason Industries, M.W. Sausse & Co., the VMC Group, or equal, of the Model Number specified or indicated on the drawings. Furnished base including sub-base, shall be manufactured by same company with fan and integral motor base. Seismic restraints may be incorporated into bases or furnished separately.

2. Inertia anti-vibration bases shall conform to requirements indicated.
3. Unless noted otherwise, furnished anti-vibration bases, including supporting units for inertia bases, shall be of the spring type.
4. Selection of bases or supporting units shall be in accordance with manufacturer's recommendations based on following installed minimum effective isolation efficiencies (where not provided with each piece of equipment):

a.	Centrifugal fans, packaged fan and coil units and cooling towers, less than 800 RPM	80 percent
b.	Centrifugal fans over 800 RPM	90 percent
c.	Centrifugal pumps	95 percent
d.	Reciprocating compressors	95 percent
- E. Flexible duct connections shall be provided at inlet and outlets of each fan or HVAC unit, except curb-mounted roof exhaust fans whether indicated on the drawings or not.
- F. Flexible pipe or conduit connections shall be provided at piping and conduit connections to HVAC units, pumps, compressors and other moving (reciprocating or rotating) mechanical or electrical equipment provided under this Section whether indicated on the drawings or not.
- G. Flexible connections for Freon piping shall be seamless flexible metal hoses of type and length recommended by manufacturer and suitable for system operating pressure.
- H. Flexible connections for all other piping shall be flexible metal hose or spool type with flanged ends, unless otherwise specified. Metal hose shall be covered with protective braiding in areas where physical abrasion may occur, or for personnel safety.
- I. Spool types shall be similar to American Rubber Co., Mercer Rubber Co., PROCO Products, Inc., or equal, and hose types shall be similar to DME, Inc., U.S. Flex, Pennflex, Anaconda Flexpipe, Keflex, or equal with any required modifications to meet specified requirements. Flanges shall be furnished with steel retaining rings. Units installed on discharge side of pumps shall be furnished for a suitable working pressure of not less than 100 psig, and those on suction side for working pressures of 50 psig or 30 inches Hg vacuum.
- J. Units installed in cold water lines (less than 125 degrees F) shall furnish a minimum temperature rating of 180 degrees F and those installed in hot water lines (above 125 degrees F) shall be constructed of special heat resistant materials and be furnished for a minimum temperature rating of 220 degrees F, continuous operation. Units shall be able to withstand a maximum lateral deflection of 3/8 inch. Temperature and pressure ratings shall be molded into body of each spool unit so they are easily identified. Spool types shall be for straight in flow only.
- K. Spool type units shall be furnished with control units comprised of a minimum of two tie-rods and anchor plates or internal guide sleeves to prevent excessive elongation or misalignment. Rubber washers shall be provided under bolt heads and rubber grommets in bolt holes to prevent any metal to metal contact between bolts and flanges.
- L. Where hose type units are furnished, restraining anchors or braces shall be provided if excessive or undesirable pipe movement occurs when system is operated.

2.2 GENERAL PROPERTIES OF VIBRATION ISOLATORS.

- A. Shall be provided with markings so that, after adjustment, when carrying their load, deflection under load can be verified; thus determining that load is within proper range of device and that correct degree of vibration isolation is being provided according to the design.
- B. Isolators to operate in direct proportion to their load versus deflection curve. Load versus deflection curves shall be furnished by manufacturer and must be linear over a deflection range of 50 percent above design deflection.
- C. Wave motion through isolator shall be reduced to following extent: Isolation above resonant frequency shall follow theoretical prediction based upon an un-dampened single degree of freedom system with a minimum isolation of 50 decibels above 150 cycles per second.
- D. Vibration isolator spring diameters shall be no less than their deflected height. Furnish spring with a 50 percent overload safety factor.
- E. Unless otherwise indicated, equipment installed on vibration bases shall provide a minimum operating clearance of one inch between structural steel base and floor or support base. Provide flexible connectors in piping and flexible conduit in power wiring to minimize transmission of vibration.
- F. Isolators and springs exposed to weather shall be hot-dipped galvanized or powder coated after fabrication and before installation. Hot-dipped zinc coating shall be not less than two ounces per square foot by weight complying with ASTM A123. In addition, provide limit stops to resist wind velocity.
- G. Where indicated, provide structural steel bases with height saving brackets, and minimum of three points of support. Isolators shall be furnished with a method for leveling.
- H. Design isolators and seismic restraints for positive anchorage against uplift and overturning.
- I. Provide and install, under this Section of the Specifications, structural steel required to properly support equipment and steel required to support horizontal thrust arrestors.

2.3 ISOLATOR TYPES

- A. Type A: Steel Spring Isolators: Un-housed steel spring isolators, laterally stable and unrestrained. Design springs so that ratio of horizontal to vertical spring (stiffness) constant is between 0.9 and 1.3. Natural frequency of isolator must be 1/3 to 1/4 of driving frequency that is to be controlled. Isolators to provide a minimum additional travel to solid equal to 50 percent of rated deflection. Isolators shall be furnished with built-in leveling bolts complete with sound isolation pads type B. Static deflection as specified.
- B. Type B: Sound Isolation Pad: Provide under each spring isolator a sound isolation pad, utilizing high quality durable neoprene pad material, loaded to 40 psi. Build sound pad up to 2 layers of 1/4 inch thick neoprene material; separate layers with a 16 gage galvanized sheet metal plate. Top layer shall provide a hardness of 40 durometers and the bottom layer shall be 40 durometers. Cold bond sound pads together and to isolator baseplate.
- C. Type C: Neoprene-in-Shear Isolators: Isolator shall be neoprene-in-shear type as recommended by manufacturer. Isolator shall provide a static deflection under rated load at 1/4 inch.

2.4 EQUIPMENT FRAMES

- A. Provide mounting frames and brackets to carry load of equipment without causing mechanical distortion or stress to the equipment.
- B. Type A Frame: Wide flange members, rigidized structural steel frame with brackets. Maximum allowable deflection at any point on load frame relative to unloaded frame shall be 0.005 inch. Members to be constructed of wide flange beams, with a depth of not less than 1/10 of length of span between isolators. Frame shall be M.W. Sausse & Co. type RMSB-W, as basis of design, or Mason Industries, Caldyn, or equal.
- C. Type B Frame: Channel members, rigidized structural steel frame with brackets. Frame to be constructed of channel steel with section depth equal to 1/10th length of longest structural member. Frame shall be M.W. Sausse & Co. type RMSB-C, as basis of design, or Mason Industries, Caldyn, or equal.
- D. Type C Frame: Steel gusset or bracket welded or bolted directly to machine frame in order to accommodate isolator. Frame shall be M.W. Sausse & Co. type RMSG, as basis of design, or Mason Industries, Caldyn, or equal.
- E. Type D Frame: Fabricated of rectangular channel steel forms for floating foundations to be filled with concrete on the Project site. Channel depth to be a minimum of 1/12th of longest dimension, but in no case less than 6 inches. Form shall include 1/2 inch reinforcing bars installed each way in a layer 1 1/2 inches above bottom and drilled steel members with sleeves mounted below holes to receive equipment anchor bolts. Weight of concrete and frame shall be two times or more than the weight of the unit it supports. Frame shall be M.W. Sausse & Co. type RMSBI, as basis of design, or Mason Industries, Caldyn, or equal.

2.5 MATERIALS AND CONSTRUCTION

- A. Duct Silencers: Provide factory fabricated duct silencers of tubular or rectangular type, for low or medium velocity service, with arrangements, sizes, and capacities as indicated on the Drawings.
 - 1. Construction:
 - a. Fabricate silencers of galvanized steel with casing seams sealed or welded to be airtight at a pressure differential of 8 inches water gage between inside and outside of unit, and stiffen or brace as necessary to prevent structural failure or deformation at same condition, or audible vibration during normal operation. Outer casings of rectangular silencer modules shall be made of 22 gage galvanized steel in accordance with ASHRAE Guide of recommended construction for high-pressure rectangular ductwork. Seams shall be lock formed and mastic filled. Outer casings of tubular silencers shall be made of galvanized steel in 18 to 22 gage. Internal acoustic elements of rectangular silencers shall incorporate integral die formed entry and exit to minimize pressure drop and self-noise. Interior partitions for rectangular silencers shall be fabricated of not less than 26 gage galvanized perforated steel. Interior construction of tubular silencers shall be compatible with the outside casings.
 - b. Filler material shall comply with the following:
 - 1) Fire Safety Standards: NFPA 90A and NFPA 90B.
 - 2) Temperature: ASTM C411.

- 3) Air velocity: ASTM C1071, UL 181.
 - 4) Fire Hazard Classification: ASTM E84, UL 723-Class 1, NFPA 255.
 - 5) Corrosion Resistance: ASTM C739, C665.
 - 6) Fungi Resistance: ASTM G21.
 - 7) Water Vapor Sorption: ASTM C1104, less than 1 percent by weight.
 - 8) Formaldehyde, Phenolic Resins or other Volatile Organic Compounds: 0 percent.
- c. Airtight construction shall be provided by furnishing a duct sealing compound installed on the Project site. Silencers shall not fail structurally when subjected to a differential air pressure of 8 inches w.g. inside to outside of casing.
2. Acoustic Performance: Silencer ratings shall be determined in a duct-to-reverberant room test facility, which provides for airflow in both directions through the test silencer in accordance with ASTM Standard E477. The test facility shall be accredited by the National Voluntary Laboratory Accredited Program for the ASTM E477 test standard. Data from a non-accredited laboratory is not permitted. The test set-up and procedure shall eliminate effects due to end reflection, directivity, flanking transmission, standing waves, and test chamber sound absorption. Acoustic ratings shall include dynamic insertion loss (DIL) and self-noise (SN) power levels both for forward flow (air and noise in same direction) and reverse flow (air and noise in opposite directions). Data shall be for test silencers no smaller than the following cross-sections:
- Rectangular, inches - 24 by 24, 24 by 30, or 24 by 36
Tubular, inches - 12, 24, 36, and 48
- a. Noise reduction values (dynamic insertion loss) in decibels reference 10-12 watts, shall not be less than (of the model, size and length) indicated on Drawings.
 - b. Self generated noise in decibels reference 10 to 12 watts, shall not be more than of the model, size and length indicated on Drawings.
3. Aerodynamic performance: Airflow measurements shall be performed in accordance with ASTM specification E477 and applicable portions of ASME, Air Movement and Control Association (AMCA), and Air Diffusion Council (ADC) airflow test codes. Tests shall be reported on the identical units for which acoustic data is presented. Air pressure drops shall not exceed those (of the model, size and length) indicated on Drawings.
4. Certification: With submittals, provide certified test data on dynamic insertion loss, self-noise power levels, and aerodynamic performance for reverse and forward flow test conditions. Test data shall be for a standard product. Rating tests shall be conducted in the same facility, shall utilize the same silencer, and shall be open to inspection if required by the Architect.
5. Rectangular silencers shall be Industrial Acoustics Company of the model number indicated on the drawing, as basis of design, or Vibro-Acoustics, Dynasonics, SEMCO Silentair, TranSonics, Inc., or equal.

- B. Duct Liner: As indicated in Section 23 0700: HVAC Insulation.
- C. Flexible Ducts: As indicated in Section 23 0700: HVAC Insulation.

PART 3 – EXECUTION

3.1 INSTALLATION

- A. Provide isolators, flexible pipe connectors, flexible electrical conduit and flexible duct connectors at all moving mechanical system components to prevent transmission of vibration noise to any part of building whether indicated on the drawings or not.
- B. Install isolators to suit imposed load and the vibration frequency to be absorbed. Isolator units shall furnish adequate strength and flexibility to exhibit proper resiliency under machine load and impact without permitting excessive movement when starting.
- C. Where commercial vibration isolator and seismic restraint units are specified, furnish manufacturer's standard catalog products with printed loading ratings, or provide substantiating calculations.
- D. Install vibration isolators and seismic restraints in accordance with manufacturer's printed installation instructions.
- E. Where equipment is belt driven and motor is not installed on equipment, install motor and driven equipment on unitized support, and install entire support isolators. Unitized support to be provided with adjustable slide rails sized for motor weight and frequency. Support shall be Mason Industries type WF, M.W. Sausse & Co., type RMSF, Caldyn, or equal.
- F. Do not install any equipment, piping, conduit, ductwork, etc., that makes rigid contact with building or its structural members, unless reviewed by the Architect.
 - 1. Coordinate Work with other trades to avoid rigid contact with building.
 - 2. Correct, before installation, any conflict with other Work that would result in solid contact to equipment or piping due to inadequate space.
 - 3. Obtain inspection from the Project Inspector for concealed Work before enclosure.
 - 4. Notify manufacturer before installation of vibration isolation devices so that manufacturer may instruct and demonstrate technique for proper installation.
- G. The furnishing or installation of vibration isolators must not cause any change of position or alignment of equipment, ductwork, or piping, resulting in stresses in piping or ductwork, connections, or misalignment of shafts or bearings. Equipment, piping, and ductwork shall be maintained in a rigid position during installation. Load shall not be transferred to isolator until installation is complete and under full operational load.
- K. Air Handling, Air Conditioning Units, Floor Mounted Fans, and Cabinet-Installed Fans: Install entire casing including filters, mixing box, fan section, coil sections, etc., on a continuous, integral, structural steel base, as indicated. Furnish type A, B, or C frames, reinforced as necessary to prevent distortion of frame. Furnish isolator type A; static deflection shall be a minimum of 1 ½ inches.

- L. Suspended Fans and Air Conditioning Unit Fan Coils and Unit Ventilators: Suspend each integral unit from overhead structure on steel spring and elastomer hanger isolators. Support deflection under rated load of 3/8 inch. Provide spring static deflection as follows:

Fan RPM	Min. Deflection
200 – 400	3 inches
400 – 700	2 inches
Above 700	1 inches

- M. Pipe Isolation: Where indicated and as required, furnish and support each pipe from an isolator. Isolator for the first five support locations away from vibrating equipment shall have the same deflection as the equipment isolators. After that, isolators shall be a neoprene-in-shear type of size as recommended by manufacturer; except where indicated on Drawings, pipe hanger rod shall be furnished with a steel spring isolator and elastomeric element, with lower rod capable of 30 degrees total misalignment without contact on spring housing.
- N. Seismic Restraints: Floor or pad mounted equipment that do not require vibration isolators, shall be bolted to floor or other support. Floor mounted equipment with vibration isolators shall be provided with lateral and vertical restraining devices on all sides of base to restrict displacement of equipment. On all sides of suspended equipment, provide bracing for rigid supports and provide aircraft cable restraints for resiliently supported equipment.
- O. Ductwork, duct acoustical lining, manual volume dampers and flexible ducts: Do not reduce length of duct runs, duct acoustical lining, manual volume dampers and flexible ducts for economy.
- P. Installation of flexible ducts at air inlets and outlets: Do not attach flexible ducts directly to air inlets and outlets unless a straight, smooth and uniform air flow can be achieved with sufficient space to make an elbow with a radius of at least three times the diameter of the duct. If sufficient space is not available to make such an elbow, provide a rigid elbow or a lined plenum.
- Q. Placement of Air Devices: Do not relocate air devices without the Architect's approval.

3.2

EXAMINATION

- A. Arrange for the services of a certified representative of isolation manufacturer to visit the Project site for inspecting installation of devices. In the event the isolators do not meet specified requirements perform necessary revisions. Submit a written report to the Architect, signed by above representative, indicating all devices are properly installed and are operating as specified or required by isolation manufacturer.

END OF SECTION

SECTION 23 0700
HVAC INSULATION

PART 1 – GENERAL

1.1 SUMMARY

A. Section Includes:

1. Condensate drain piping from air conditioning equipment.
2. Refrigerant piping.
3. Supply and return air ducts for heating and cooling systems air ducts.

B. Related Requirements:

1. Division 01: General Requirements.
2. Section 23 0500: Common Work Results for HVAC.
3. Section 23 0513: Basic HVAC Materials and Methods.
4. Section 23 0553: Mechanical Identification.
5. Section 23 3000: Air Distribution.
6. Section 23 8000: Heating, Ventilating and Air Conditioning Equipment.

1.2 REFERENCES

A. American Society for Testing and Materials International (ASTM):

1. ASTM C167 - Standard Test Methods for Thickness and Density of Blanket or Batt Thermal Insulations.
2. ASTM C209 - Standard Test Methods for Cellulosic Fiber Insulating Board.
3. ASTM C302 - Standard Test Method for Density and Dimensions of Preformed Pipe-Covering-Type Thermal Insulation.
4. ASTM C411 - Standard Test Method for Hot-Surface Performance of High-Temperature Thermal Insulation.
5. ASTM C518 - Standard Test Method for Steady-State Thermal Transmission Properties by Means of the Heat Flow Meter Apparatus.
6. ASTM C533 - Standard Specification for Calcium Silicate Block and Pipe Thermal Insulation.

7. ASTM C534 - Standard Specification for Preformed Flexible Elastomeric Cellular Thermal Insulation in Sheet and Tubular Form.
 8. ASTM C547 - Standard Specification for Mineral Fiber Pipe Insulation.
 9. ASTM D5116 - Standard Guide for Small-Scale Environmental Chamber Determinations of Organic Emissions from Indoor Materials/Products.
 10. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials.
 11. ASTM E96 - Standard Test Methods for Water Vapor Transmission of Materials.
 12. ASTM G21 - Standard Practice for Determining Resistance of Synthetic Polymeric Materials to Fungi.
 13. ASTM G22 - Standard Practice for Determining Resistance of Plastics to Bacteria.
- B. Underwriters Laboratories Inc.:
1. UL 181 - Standard for Factory-Made Air Ducts and Air Connectors.
 2. UL 723 - Standard for Test for Surface Burning Characteristics of Building Materials.
- C. National Fire Protection Association:
1. NFPA 90A - Standard for the Installation of Air-Conditioning and Ventilating Systems .
 2. NFPA 90B - Standard for the Installation of Warm Air Heating and Air-Conditioning Systems.
 3. NFPA 255 - Standard Method of Test of Surface Burning Characteristics of Building Materials.

1.3 SUBMITTALS

- A. Submit in accordance with Division 01 and Section 23 0500: Common Work Results for HVAC.
1. Complete material list of items to be furnished and installed under this Section.
 2. Manufacturer's specifications and other data required demonstrating compliance with the specified requirements.
 3. Shop Drawings, catalog cuts and manufacturer's data indicating insulation, jacketing, adhesives, and coating. Insulating materials shall be certified by manufacturer to comply with the California quality standards for insulating materials.
 4. Display sample cutaway sections.

5. Manufacturer's recommended method of installation procedures, which will become part of this Section.

1.4 QUALITY ASSURANCE

- A. Qualifications of Manufacturer and Installer, Materials, Fabrication, Execution, and Standard of Quality: Comply with provisions stated under Section 23 0500: Common Work Results for HVAC and Section 23 0513: Basic HVAC Materials and Methods.
- B. Test Ratings:
 1. Comply with provisions stated under Section 23 0500 and 23 0513 with emphasis on ASTM E84, NFPA 255, or UL 723. ASTM C167, ASTM C302, UL label or listing of satisfactory test results from the National Institute of Standards and Technology, or a satisfactory certified test report from an acceptable testing laboratory. Approval by the State Fire Marshal is required.
 2. Furnish labels, legibly printed with the name of the manufacturer or listings indicate that fire hazard ratings do not exceed those specified for materials proposed for installation. Flame spread index of not more than 25 and smoke developed rating not exceeding 50.
 3. Tests shall be performed on each item individually when insulation, vapor barrier covering, wrapping materials, or adhesives are installed separately at the Project site.
 4. Test insulation, vapor barrier covering, wrapping materials and adhesives as an assembly when they are factory composite systems.
- C. Regulatory Requirements: Insulation furnished and installed under this Section shall conform to the requirements of the California Building Code Parts 4, Mechanical Code, Part 5, Plumbing Code and Part 6, Energy Code.
- D. All chemically based products such as sealers, primers, fillers, adhesives, etc. shall meet the California air quality regulations.

1.5 PRODUCT HANDLING

- A. Protection, Replacement, Delivery and Storage: Comply with provisions stated under Sections 23 0500: Common Work Results for HVAC and 23 0513: Basic HVAC Materials and Methods.

PART 2 – PRODUCTS

2.1 MATERIALS

- A. General:
 1. Piping insulating material shall be fire resistant, non-corrosive, shall not break, settle, sag, pack or disintegrate under vibration, nor absorb more than 1 percent moisture by weight.

2. Piping insulating material shall be furnished with thickness indicated in Table 1, unless otherwise noted on the drawings, and shall furnish thermal resistance in the range of R-4.0 to 4.6 in accordance with inch at 75 degrees F. For any other value of R, insulation thickness shall be calculated accordingly and submitted for review.
3. Asbestos in any quantity in insulating material is not permitted.
4. Provide insulation materials, adhesives, coatings, sealants, fitting covers, and other accessories with a fire hazard rating not to exceed 25 for flame spread, 25 for fuel contributed and 50 for smoke developed, except for materials listed as follows:
 - a. Nylon anchors for installing insulation to ducts or equipment.
 - b. Treated wood blocks.
5. Flame-proofing treatments subject to moisture damage are not permitted.

TABLE 1 - MINIMUM PIPING INSULATION THICKNESS (1)

Insulation Thickness Required (in inches)
Space Heating Systems (Steam, Steam Condensate and Hot Water)

Piping System Type	Temp. Range (degrees F)	Run-outs up to 2 (2)	1 and less	1.25 to 2	2.5 to 4	5 to 6	8 and larger
Hi Pres Temp	Above 350	1.5	2.5	2.5	3.0	3.5	3.5
Med Pres Temp	251 to 305	1.5	2.0	2.5	2.5	3.5	3.5
Low Pres Temp	201 to 250	1.0	1.5	1.5	2.0	2.0	3.5
Hot Water	Up to 200	0.5	1.5	1.5	1.5	1.5	1.5
Steam Cond.	-	0.5	1.0	1.0	1.0	1.5	1.5

Service Water Heating Systems (recirculating, piping supply and return)

Hot Water	Up to 180	0.5	1.0	1.0	1.5	1.5	1.5
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Space Cooling Systems (Chilled water, Brine and Refrigerant)

Chilled Water	40-60	0.5	0.5	0.75	1.0	1.0	1.0
Refrigerant/Brine	Below 40	1.0	1.0	1.5	1.5	1.5	1.5
Condensate Drain	½-inch Minimum insulation thickness.	0.5	0.5	0.5	0.5	0.5	0.5
From Air Conditioning Equipment:	Insulate condensate drain lines within building, in room, inside walls and above ceilings.	0.5	0.5	0.5	0.5	0.5	0.5

NOTES:

- (1) For Underground HVAC Piping refer to section 23 2016 Underground HVAC Piping.
- (2) For piping exposed to ambient temperatures, increase thickness by 0.5 inch.
- (3) Run-outs to individual terminal units, not exceeding 12 feet in length.

- B. Lagging Adhesives: Shall be nonflammable and fire-resistant and shall have a maximum flame spread index of 25 and a maximum smoke developed index of 50 when tested in accordance with ASTM E84. Insulation finished with canvas shall be provided with laps adhered in accordance to manufacturer's recommendation. A finish coat of same material shall be applied to entire outer surface of lagging cloth at coverage specified by manufacturer.
- C. Canvas Jackets: Furnish 6 ounce in accordance with square foot minimum, 48 by 48 thread count canvas jacketing.
- D. Insulation Jackets:
 - 1. Exterior insulation exposed to weather shall be weatherproofed with Childers aluminum jacketing as basis of design, or Pabco, RPR, or equal. Jacketing shall be manufactured from 1100, 3105 or 5010 aluminum alloy with 3/16-inch corrugations. Smooth or embossed jackets may be permitted in special situations to match an existing installation. Jacketing shall be furnished with an integrally bonded moisture barrier over entire surface in contact with insulation. A minimum thickness of 0.016 aluminum jacketing is to be provided on ducts and piping. A minimum thickness of 0.020 shall be provided on tanks, equipment, and heat exchangers.
 - 2. Insulated elbows, of 90 degrees and 45 degrees, with a nominal iron pipe size of ½-inch to 8-inch shall be provided with Childers aluminum Ell-Jacs insulation covers as basis of design, or Pabco, RPR, or equal, manufactured from 1100 aluminum alloy of 0.024-inch thickness. Insulated elbows with a nominal pipe size of 10 inches to 18 inches shall be provided with Childers 4-piece aluminum Ell-Jacs as basis of design, or Pabco, RPR, or equal.
 - 3. Tees, Flanges, and Valve Insulation in Conjunction with Aluminum Jacketing: Furnish Childers Aluminum Special Fabrications Insulation Covers as manufactured by Childers Products Company, Pabco, RPR, or equal.
- E. Adhesives: Adhesives shall be water based, UL Classified, meet the requirements of NFPA 90A and NFPA 90B, have been tested according to relevant ASTM requirements, and be acceptable to the State Fire Marshal. Name, type and method of installation shall be submitted for review.
- F. Valve and Fitting Cover: When installed in conjunction with PVC jacketing, furnish Zeston 25/50 rated polyvinyl chloride fitting covers as manufactured by Johns Manville, Knauf Insulation, Speedline, or equal.

2.2 DUCTWORK AND PLENUM INSULATION

- A. General: Insulate ductwork and plenums with not less than the amount of insulation tabulated in Table 4, unless noted otherwise on the drawings. Insulation may be omitted under the following conditions:
 - 1. Exposed return air ductwork in conditioned space.
 - 2. Return air ductwork between wall studs inside an interior wall.

TABLE 4 - INSULATION OF DUCTS AND PLENUM

<u>Duct Location</u>	<u>Insulation Type</u>
Exposed interior round and oval supply air ductwork located at Gyms and MPR Stages	DW-1
Exposed interior rectangular supply air ductwork located at Gyms and MPR Stages	L-1
Exterior locations of Health Units and Clinics	DW-2
Exterior locations other than Health Units and Clinics	L-2
In walls, within floor/ ceiling spaces	F-1 or L-1 See note 3
Hot and cold plenums	F-2, DW-1 or L-2 See note 3
Attics, Garages, and Crawl Spaces, within unconditioned space or in basement	F-3 or L-2 See note 3

B. Insulation Types:

1. DW-1: 1-inch thick insulation sandwiched inside double-wall type ducts and fittings.
2. DW-2: 2-inch thick insulation sandwiched inside double-wall type ducts and fittings. Duct joints shall be waterproofed.
3. F-1: 1½-inch blanket fiberglass, factory-laminated with all-service jacket vapor barrier.
4. F-2: 2-inch blanket fiberglass, factory-laminated with all-service jacket vapor barrier.
5. F-3: 3-inch blanket fiberglass, factory-laminated with all-service jacket vapor barrier.
6. L-1: 1½-inch Internal duct lining.
7. L-2: 2-inch Internal duct lining.

C. Notes:

1. Minimum insulation provided shall be as required by the current California Mechanical Code Title 24 for the most restrictive condition.
2. Refer to the materials indicated in this section for external insulation & Internal Lining.
3. External insulation shall be replaced with internal duct lining (of equivalent thermal resistance value unless noted otherwise) where indicated on the drawings or specified elsewhere for sound attenuation.
4. Provide internal duct lining (1 ½-inch unless noted otherwise) where indicated on the drawings or specified elsewhere for sound attenuation.

5. All exterior insulated ductworks shall be water proofed at joints, seams and duct penetrations.

D. Materials:

1. Fire-Resistive Insulation Materials and Coatings: Submit State Fire Marshal pre-approved materials only.
2. Adhesives: See Paragraph 2.01.E for applicable products.
3. External Insulation: Provide glass fiber blankets that are factory-laminated with Foil Reinforced Kraft (FRK) vapor barrier facing; Johns Manville Microlite, Owens-Corning SOFTR Duct Wrap, Knauf Insulation Friendly Feel Duct Wrap, or equal. Provide a minimum installed R value as required by the CEC Building Energy Efficiency Standards; but not less than scheduled on Table 5:

TABLE 5
INSULATION OF DUCTS AND PLENUM INSTALLED
THERMAL RESISTANCE “R” VALUES

Type	Labeled Thickness (in inches)	Installed R Value (hr.ft ² .°F/Btu)
F-1	1 ½	4.2
F-2	2	5.6
F-3	3	8.3
DW-1	1	4.2
DW-2	2	5.6
L1	1 ½	6.0
L2	2	8.0

4. Internal Lining: Internal Lining shall be of the type that inhibits the growth of mold, mildew and fungi and shall not contain harmful VOC’s or contain glass fiber. Approved Material:

a. Polyester Duct Liner:

- 1) Polyester duct liner shall be an engineered nonwoven, thermally bonded Polyester with a smooth and durable FSK facing.
- 2) Polyester duct liner must be able to withstand a constant internal temperature up to 250°F must be compliant with Greenguard Environmental Institute and contain zero VOCs per ASTM D5116. Liner must comply with all applicable standards including ASTM E84, ASTM C411, ASTM C518, ASTM G21, NFPA 90A and 90B, and UL 181.
- 3) Approved Manufacturer: Ductmate Industries “PolyArmor” duct liner or approved equal.

b. Elastomeric duct liner:

- 1) Closed-cell, sponge- or expanded-rubber materials. Elastomeric liner must be able to withstand a constant internal temperature up to 300°F and must comply with all applicable standards including ASTM E84, ASTM E96, ASTM C209, ASTM C534 - Type II sheet materials, ASTM C411, ASTM C518, ASTM G21, ASTM G22, NFPA 90A and 90B, and UL 181.
 - 2) Approved Manufacturer: Armacell LLC “AP Armaflex FS” duct liner or approved equal.
- c. Duct liner must be attached per manufacturer’s requirements using a non-flammable, low VOC water-based adhesive. When applicable, apply a non-flammable, low VOC water-based lagging adhesive to the exposed leading edge of the insulation. Install fasteners per SMACNA HVAC Duct Liner installation instructions.
 - d. Duct liner must be installed per SMACNA Manual, “HVAC Duct Construction Standards, Metal and Flexible,” Third Edition unless otherwise specified.

PART 3 – EXECUTION

3.1 INSTALLATION

- A. Except as specified herein, install material in accordance with recommendations of manufacturer. Do not install insulation materials until tests specified in other sections are completed. Remove foreign material such as rust, scale, or dirt. Surfaces shall be clean and dry. Maintain insulation clean and dry at all times.
- B. On cold surfaces where a vapor barrier must be provided and maintained, insulation shall be installed with a continuous, unbroken moisture and vapor seal. Hangers, supports, anchors, or other projections that are fastened to cold surfaces shall be insulated and vapor sealed to prevent condensation.
- C. Surface finishes shall be extended in such a manner as to protect raw edges, ends, and surfaces of insulation.
- D. Pipe or duct insulation shall be continuous through walls, ceiling or floor openings, or sleeves; except where fire-stop or fire-safing materials are required.
- E. Metal shields shall be installed between hangers or supports and the piping insulation. Rigid insulation inserts shall be installed between the pipe and the insulation shields. Inserts shall be of equal thickness to adjacent insulation and shall be vapor sealed accordingly.
- F. Insulation shall not be installed in the following locations unless otherwise noted:
 1. On vacuum return lines less than 50 feet long.
 2. On unions, flanged connections or valve handles.

3. Over edges of any manhole, clean-out hole, clean-out plug, access door or opening to a fire damper, so as to restrict opening or identification of access.
4. Over any label or stamp indicating make, approval, rating, inspection, or similar data, unless provision is made for identification and access to label or stamp.

3.2 INSTALLATION OF HEATING PIPING SYSTEM INSULATION

- A. General: Space heating hot water, domestic hot water, tempered water supply and return piping and condensate return piping, after having been tested, shall be cleaned and insulated.
- B. Application: Insulate condensate return piping, hot water heating supply and return piping, steam and steam condensate piping, domestic hot water supply and return, including tempered supply and return piping in accordance with manufacturer's instructions and as specified herein.
 1. Install insulation on valve bodies up to valve bonnet. Fill void in saddles, in accordance with Section 23 0513: Basic HVAC Materials and Methods, with insulation and seal joints.
 2. Install insulating material to fittings, valves, and strainers and smooth to thickness of adjacent covering. Leave strainer clean-out plugs accessible. Covers fabricated from polyvinyl chloride shall be furnished.
- C. Insulation Jackets in Exposed Indoor Locations:
 1. Cover completed insulation with canvas jacket tightly pasted to covering with lagging adhesive. Lap jacket seams 1-1/2-inch minimum. Finish entire jacket with coating of undiluted adhesive.
 2. Equivalent factory applied pre-sized, glass fiber reinforced, or glass fiber jackets may be furnished. Seal jacket seams with adhesive in accordance with manufacturer's instructions.
 3. Johns Manville Zeston 2000, Knauf Insulation Proto PVC Fitting Cover, Speedline Polyco Smoke Safe, or equal, fitting covers may be furnished, with molded or segmented insulation equal to specified insulation applied to fittings. Secure covers in accordance with manufacturer's instructions.
 4. In addition to above requirements, cover exposed insulated piping within a distance of 8 feet above floors with 26 gage galvanized steel jacket. Omit jacket in areas accessible only to maintenance personnel, such as mechanical equipment rooms, utility corridors, accessible pipe tunnels and manholes.
- D. Concealed Indoor Locations: Cover insulation over fittings, valves, and strainers with canvas. Provide pipe insulation with factory or field applied standard jacket of 4-ounce minimum canvas, fiberglass cloth, or glass fiber reinforced jacket. Seal jacket laps with adhesive in accordance with manufacturer's instructions.
- E. Exposed Outdoors: In addition to canvas or fiberglass cloth cover, pipe insulation exposed to weather shall be provided with an additional 0.016-inch thick aluminum jacket with 2-inches lap connected with 1-inch hem overlap joint located on side of pipe and turned down

to shed water. Jacket shall be strapped 12-inch on center with ½-inch wide stainless-steel strapping and wing seals. Aluminum jacket shall be mitered to fit fittings.

3.3 INSTALLATION OF COOLING PIPING SYSTEM INSULATION

- A. General: Chilled water supply and return piping, refrigerant piping and condensate drain lines, after having been tested, shall be cleaned and insulated.
- B. Application: Insulation on chilled water lines, refrigerant suction lines and liquid lines, if indicated, and air conditioner interior drain lines shall be jacketed with fire-resistant vapor barrier of laminated aluminum foil consisting of 2 plies with glass-yarn reinforcing. Jacket joints shall be lapped and sealed with an approved adhesive. Insulation shall be secured with aluminum bands not less than 0.005-inch thick by ¾-inches wide, spaced not over 12-inch on centers, or as recommended by manufacturer.
 - 1. Longitudinal Seams: Butt hinged sections of covering tightly together and seal down jacket flap with adhesive, or with factory-applied, self-sealing lap with pressure-sensitive sealer protected with release paper.
 - 2. End Joints: Wrap joint with a 3-inch wide (minimum) self-sealing tape.
 - 3. Fittings and Valves: Fittings and valves shall be covered with same material of same thickness as pipe insulation, sealed with an approved, vapor-sealing tape or compound and covered with Johns Manville Zeston polyvinyl-chloride cover, Knauf Insulation Proto PVC Fitting Cover, Speedline Polyco Smoke Safe, or equal.
 - 4. Pipe hangers shall be insulated or attached to pipe by an insulating insert, butted between adjoining insulation sections.
- C. Additional Jackets:
 - 1. Exposed Indoor Insulation: Cover with 26 gage galvanized sheet metal jacket to 8 feet above floors, except in mechanical equipment rooms and accessible pipe tunnels.
 - 2. Exposed Outdoor Insulation: In addition to canvas or fiberglass cloth cover, provide 0.016-inch thick aluminum jacket with 1-inch wide aluminum bands and seals. Install appropriate jackets on valves and fittings.

3.4 INSTALLATION OF HIGH TEMPERATURE EQUIPMENT INSULATION

- A. General: Provide insulation over parts of heat exchangers and similar equipment requiring insulation having removable head or sections.
- B. Application:
 - 1. Equipment: Securely tie insulation on with copper clad wire. Install tack coat weather barrier coating at a thickness specified by manufacturer. While tack coat is still wet, a layer of 10 open weave glass cloth membrane shall be embedded with fabric seams overlapped a minimum of 2-inch. Install a finish coat fully covering membrane at coverage rate specified by manufacturer.

2. Boiler Breechings: Wire securely V-rib wire lath, 3/4-inch minimum depth to boiler breechings, connections and stacks inside boiler rooms, and cover with insulation and jacket as specified above.
3. Manholes and Hand Holes: Maintain accessible by beveling off permanent insulation around manhole and cover manhole plate with removable blanket.

3.5 INSTALLATION OF LOW-TEMPERATURE EQUIPMENT INSULATION

- A. General: Provide removable sections of insulation over parts of chillers and similar equipment requiring insulation and having removable heads or sections.
- B. Exterior surfaces of chilled water system expansion tanks and chilled water pumps shall be insulated with not less than 2-inch thick expanded polystyrene or fiberglass, as specified. Fill spaces between insulation and equipment with granulated polystyrene or urethane to eliminate voids. Insulation shall be secured with metal band, and covered with one inch, 20 gage hexagon galvanized mesh and 1/4-inch thick insulating cement troweled smooth. Cement surface shall then be covered with 0.002-inch aluminum foil applied smoothly and secured with suitable adhesive, and a layer of 6-oz. canvas.
- C. Coat joints of polyurethane insulation with neoprene based contact adhesive. Adhesives furnished shall be approved by insulation manufacturer. Fill and seal external voids and seams with non-shrinking sealant.
- D. Canvas Jacket: Cover completed insulation with canvas jacket tightly pasted to covering with lagging adhesive. Lap jacket seams a minimum of 1 1/2-inch. Finish entire surface of canvas jacket with one brush coat of diluted lagging adhesive, Childers CP-50A, Foster 30-36, Mon-Eco Industries (MEI) Eco-Lag Adhesive, or equal, and heavy final coat of undiluted adhesive.

3.6 INSTALLATION OF DUCTWORK AND PLENUM INSULATION

- A. External Covering:
 1. Before installing duct insulation, sheet metal ducts shall be clean, dry, and tightly sealed at joints and seams, inspected pressure tested, and accepted by Inspector.
 2. Duct exterior insulation shall be firmly wrapped around ductwork with joints lapped a minimum of 2-inch. Insulation shall be securely fastened with 18 gage copper-lined steel wire, or 16 gage soft-annealed galvanized wire spaced approximately 12-inch on centers and at loose ends, presenting a neat and workmanlike appearance. Where duct width is such that wiring will not fasten insulation firmly against duct an adhesive shall be furnished to fasten insulation to duct with wiring being installed at ends of insulation segment.
 3. Insulation on ductwork transporting conditioned air, both supply and return, and outside air intake ducts when pre-conditioned, shall be furnished with a factory-applied, fire-resistant vapor barrier.
 4. Exposed Ducts or Plenum:
 - a. Install insulation to ducts or plenum furnished with butt joints, without voids and with adhesive over entire surface of duct. Cover insulation with

canvas jacket, fastened tightly to insulation with lagging adhesive. Install 2 finish coats of undiluted adhesive.

- b. When installing jacket, finished covering shall be even and level, without humps, with constant diameters on round ducts maintained.

B. Interior insulation - lining:

1. Dimensions of ducts indicated are net inside dimensions and must include thickness of duct liners to obtain the required duct size.
2. Install insulation in square turns, where required, to cover interior surfaces before duct turns are installed.
3. Install lining material during fabrication of duct with sealed face only exposed to air stream.
4. Interior insulation in ducts or plenums shall not have exposed edges. Edges open to entering or leaving air streams shall be covered, secured in place and sealed with approved duct liner edge sealers.
5. Insulation shall be fastened to sheet metal with an approved fire-retardant adhesive, with minimum 90 percent coverage and edges firmly adhered.
6. Mechanical fasteners shall supplement the adhesive on top sections of ducts more than 12-inch wide and on sides of ducts more than 24-inch high and shall be spaced on 16-inch centers maximum. Fastener posts shall be cut off approximately ¼-inch from metal disc.

3.7 CLEANUP

- A. Remove rubbish, debris, and waste materials and legally dispose of off the Project site.

3.8 PROTECTION

- A. Protect the Work of this Section until Substantial Completion.

END OF SECTION

SECTION 23 3000

AIR DISTRIBUTION

PART 1 – GENERAL

1.1. SUMMARY

- A. Section Includes: Ductwork and appurtenances required for a complete air transmission and distribution system for the heating, ventilating, and air conditioning systems indicated on Drawings and as specified.
- B. Related Requirements:
 - 1. Division 01: General Requirements.
 - 2. Section 09 9000: Painting and Coating.
 - 3. Section 23 0500: Common Work Results for HVAC.
 - 4. Section 23 0513: Basic HVAC Materials and Methods.
 - 5. Section 23 0548: HVAC Sound, Vibration and Seismic Control.
 - 6. Section 23 0700: HVAC Insulation.
 - 7. Section 23 8000: Heating, Ventilating and Air Conditioning Equipment.

1.2. SUBMITTALS

- A. Provide in accordance with Division 01 and Section 23 0500: Common Work Results for HVAC.
- B. Manufacturer's Data:
 - 1. Complete list of items to be furnished and installed under this Section. Material lists that do not require performance data shall include manufacturer names, types and model numbers.
 - 2. Manufacturer's specifications and other data required to demonstrate compliance with specified requirements.
 - 3. Literature shall include descriptions of equipment, types, models, sizes, capacity tables or curves marked to indicate performance characteristics, electrical requirements, options selected, space requirements, including allowances for servicing, and other data. Data shall include name and address of nearest service and maintenance organization that regularly stocks repair parts. Listings of items that function as parts of an integrated system shall be furnished at one time.
 - 4. Submit complete acoustical test reports showing that proposed products have been tested in accordance with latest editions of relevant ASHRAE and AHRI Standards (ANSI/ASHRAE Standard 70 for air inlets and outlets; ANSI/ASHRAE Standard 130 and AHRI 880 for terminal units) and will be suitable for operation in Project spaces with specified maximum noise criteria (NC) requirements. The results of all testing shall be certified by an independent testing agency and submitted to the ARCHITECT for approval. The submittal shall include a complete description of the test conditions, methods and procedures.
 - 5. Submittals shall include a tabulation of proposed products, identification of Project spaces where proposed products are to be installed, maximum allowable NC for all Project spaces, and product NC (at specific design air volume) for all Project spaces.

6. Shop Drawings: Shop Drawings indicating methods of installation of equipment and materials, sizes and gages of ducts, and details of supports. Items to be covered shall include but not be limited to following:
 - a. Layout of ductwork and equipment drawn to scale to establish that equipment will fit into allotted spaces with clearance for installation and maintenance. Indicate proposed details for attachment, anchoring to, and hanging from structural framing of building. Indicate vibration isolation units, foundations, supports, and openings for passage of pipes and ducts.
 - b. Drawings indicating locations and sizes of sleeves and prepared openings for pipes and ducts.
 - c. Typical details of supports for equipment and ductwork.

1.3. QUALITY ASSURANCE

- A. Installer's and Manufacturer's Qualifications: Comply with provisions stated under Section 23 0500: Common Work Results for HVAC.
- B. Sound power level measurements and Manufacturers' NC value calculations shall be conducted in complete accordance with the latest version of ANSI/ASHRAE Standards 70 and 130 and AHRI 880.

1.4. DELIVERY, STORAGE AND HANDLING

- A. Comply with provisions stated in Section 23 0500: Common Work Results for HVAC.
- B. Ensure ducts are clean and free of dirt, dust, moisture, oils and other contaminants that can lead to poor air quality. Cover openings of ductwork with a self-adhering protective film. Film shall not leave a residue on metal after removal, and shall be highly resistant to tears and punctures.

1.5. COORDINATION

- A. Coordinate activities in accordance with provisions of Section 23 0500: Common Work Results for HVAC.

PART 2 – PRODUCTS

2.1. GENERAL

- A. Unless otherwise noted, provisions, including amendments thereto, of the latest edition of the HVAC Duct Construction Standards of Sheet Metal and Air Conditioning Contractor's National Association (SMACNA) and the California Mechanical Code (CMC), are hereby made part of this Section.
- B. Rectangular, round and flat oval ducts shall be manufactured and installed in accordance with requirements of the latest edition of the HVAC Duct Construction Standards – Metal and Flexible of SMACNA.
- C. Sheet metal ducts shall be fabricated from galvanized steel, aluminum or stainless steel.
- D. Galvanized steel ducts shall be fabricated of galvanized steel sheet, lock forming grade, conforming to ASTM A653 and A924.

- E. Galvanized steel ducts gage thickness and permissible joints and seams of ductwork shall conform to requirements of the latest edition of the HVAC Duct Construction Standards – Metal and Flexible of SMACNA and the CMC unless noted otherwise on the drawings. The more stringent requirements shall prevail.
- F. Button punch snap-lock seams, using Lockformer or equal, shall be permitted only in concealed areas using 20 and 22 gage galvanized steel ducts with screws added at the ends. Button punch snap-lock is not permitted for aluminum or duct lighter than 22 gage.
- G. Ducts shall be reinforced in accordance with the latest edition of the SMACNA HVAC Duct Construction Standards: Cross-broken Duct: Duct sizes 19 inches wide and larger which have more than 10 square feet of unbraced panel shall be beaded or cross-broken. This requirement is applicable to 20 gage or less thickness and 3 inches w.g. or less pressure. For details, refer to SMACNA manual.
- H. Round and Oval Galvanized Steel and Aluminum Ducts:
 - 1. Round Spiral Ducts and Fittings: Fabricated from galvanized sheet steel shall be machine-formed spiral pipe with sealed spiral locking joints. Fittings shall be furnished with continuous corrosion-resistant welds. Provide gages of ducts and fittings recommended by manufacturer.
 - 2. Details of seams and transverse joints for round duct and fittings shall conform to SMACNA standards.
 - 3. Flat oval ducts shall be provided as indicated on the Drawings. Reference standard details in SMACNA manual.
 - 4. Minimum duct wall thickness, and permissible joints and seams of ductwork for flat oval duct construction shall conform to requirements in the latest edition of the HVAC Duct Construction Standards – Metal and Flexible of SMACNA and the CMC. The more stringent requirements shall prevail.
 - 5. These provisions apply for ducts furnished for indoor comfort heating, ventilating and air conditioning service only.
- I. Flexible Ducts
 - 1. Flexible duct shall be non-metallic, insulated for conditioned air supply and return. The flexible ducts shall be factory fabricated with exterior reinforced laminated vapor barrier, 1 ½-inch thick fiber glass insulation (K = 0.25 at 75 degrees F), encapsulated zinc-coated spring steel wire helix and impervious, smooth, non-perforated interior vinyl liner and factory fabricated steel connection collars. For the composite assembly, including insulation and vapor barrier, comply with NFPA Standard 90A or 90B and tested in accordance with UL Standard, UL 181. Non-insulated metallic ducts shall be provided for exhaust only.
 - 2. Methods of installations, standards for joining and attaching, and supporting flexible duct shall conform to applicable provisions of SMACNA manual.
 - 3. Specifications herein shall not supersede installation requirements by flexible duct manufacturer if those are more stringent.
- J. Fittings and Other Construction Details: Details of fittings such as elbows, turning vanes, branch take-off and connections, duct access doors, connections for grilles, registers and ceiling diffusers, flexible connector at fan, etcetera, shall conform to applicable provisions of this Section or SMACNA manual.
- K. Duct Seam and Joint Sealant: Provide sealant for metal ducts at duct joints which are defined as transverse joints between duct sections including girth joints, branch and sub-branch intersections, duct collar tap-ins, fitting subsections, louver and air terminal connections, access doors and frames, and abutments to building structure. Also provide the same at duct

seams which are defined as longitudinal joint between duct sections. Spiral lock seams in factory fabricated round or oval ducts are excluded.

1. Sealant for low-pressure ducts shall be: Design Polymerics DP1010 or DP1020, Childers CP-145A/CP-146 Chil-Flex, Foster's 32-19 Duct-Fas, Miracle-Kingco Glenkote Seal-Flex, Ductmate Industries PROseal or FIBERseal, or equal.
2. Provide sealing material for medium-pressure ducts as described in the SMACNA manual for those pressures.
3. Sealant materials shall comply with the flame spread and smoke developed rating of current CMC when tested in accordance with ASTM E84.
4. Sealant for exposed to weather ducts shall pass the Weather Resistance Test per ASTM G154 at 2000 hours QUV.

L. Restrictions:

1. Zinc-coated steel duct shall not be installed for ductwork transporting moisture-laden air. Flexible duct may only be furnished where specifically indicated on Drawings. Aluminum ducts shall not be installed for internal pressures above 2 inches of water.
2. Fiberglass duct is not permitted as a substitute for sheet metal duct.

2.2. DAMPERS

A. Manually Operated Volume Control Dampers:

1. VD-1, Rectangular: Multi-blade type, opposed blade operation, 16 gage galvanized steel blades; center pivoted on 3/8 inch diameter steel trunnions; interlocking edges; dampers shall be in own angle frame, full duct size as indicated on Drawings; frame of minimum 16 gage steel channel construction. Provide with damper operator and axles positively locked to blade. Ruskin MD35, Pottorff MD-42, Greenheck MBD-15 or equal.
2. VD-2, Round: Frame shall be constructed of not less than 20 gage galvanized steel, blades of not less than 20 gage galvanized steel channel construction with factory neoprene seals, 1/2 inch diameter axle shafts and locking hand quadrant. Ruskin MDRS25, Greenheck MBDR-50, or equal.
3. VD-3, Oval: Frame shall be constructed of not less than 14 gage galvanized steel channels with factory blade seals of not less than 12 gage galvanized steel with not less than 1/2 inch diameter axle shafts. Provide Ruskin standard construction for frame, blade and axle size, thickness and material variation. Provide adjustable locking hand quadrant. Ruskin CDO25, or equal.

B. Motorized Volume Control Dampers:

1. MVD-1, Rectangular: Multi-blade type opposed blade operation, 16 gage minimum steel channel frame construction; 16 gage galvanized steel blades center pivoted on 1/2 inch diameter steel trunnions. Interlocking edges. Dampers shall be in own angle frame. Full duct size as indicated on the Drawings. Provide with matching two position motorized actuator with linkages, 24VAC by Belimo, Honeywell, Invensys, or equal. Ruskin CD35, Pottorff CD-42, Greenheck VCD Series, or equal.
2. MVD-2, Round: Butterfly type constructed with minimum 20 gage galvanized steel frame with steel angle reinforcement on above 20-inch diameter. Blade shall be 14 gage minimum thickness. Neoprene seal to ensure air tightness in closed position. Furnish with matching two position motorized actuator with linkage 24 VAC by Belimo, Honeywell, Invensys, or equal. Ruskin CDRS25, American Warming and Ventilating (AMV) VC-25, Air Balance, Inc. AC530, or equal.
3. Electronic Damper Actuators: Belimo, Honeywell, Invensys, or equal.
 - a. Sized for torque required for damper seal at load conditions.

- b. Coupling: V-bolt dual nut clamp with a V-shaped toothed cradle. Aluminum clamps or set screws are not acceptable.
- c. Overload Protection: Microprocessor or an electronic based motor controller providing burnout protection if stalled before full rotation is reached. Actuator shall be electronically cut off at full open to eliminate noise generation with the holding noise level to be inaudible.
- d. Power Requirements: As indicated on Drawings.
- e. Actuator Timing: Shall meet 15 seconds.
- f. Temperature Rating: Actuator shall have a UL 555S listing by damper manufacturer for 350 F.
- g. Auxiliary Switches: Provide for signaling, fan control, and position indications.

C. Automatic Fire Dampers:

1. FD, Fire Dampers: Shall conform to requirements of and be listed by State of California Fire Marshal and NFPA 90A. Dampers shall provide airflow resistance not to exceed 0.05 inch water gage static pressure at 900 fpm or 0.25 inch water gage at 2,000 fpm. Dampers shall be installed in required steel sleeve at each penetration of a rated partition.
 - a. Vertical-mounted fire dampers: Fire damper shall be curtain type with blades removed from the air stream to allow for maximum free area. Dampers will be provided in factory sleeves as tested and listed by manufacturer. Dampers shall be rated for 1 ½ hours for installation in one or 2-hour partitions. Provide UL listed fusible links of adequate size and temperature rating. Dampers will be installed according to the manufacturer's recommended installation instructions provided with units. Provide suitable access for inspection and servicing of each damper. Pottorff VFD-10/VFD-10D Series, Ruskin IBD/DIBD Series, Greenheck FD/DFD Series, or equal.
 - b. Ceiling fire dampers: Ceiling fire dampers shall be butterfly type with ceramic material to minimize heat radiation. Dampers shall be rated for one hour and shall be furnished as a part of an integral sleeve ceiling box that will accept air distribution, have a UL listed and pre-mounted hanger tabs. Dampers shall be installed according to the manufacturers recommended installation instructions. Pottorff CFD-15 Series, Ruskin CFD Series, Greenheck CRD-1 Series/CRD-2, or equal.
 - c. Combination fire and smoke dampers: Combination fire and smoke dampers shall be louver bladed type. Units shall be tested and listed under UL 555 and UL 555S. Rating 1 ½ hours for installation in one or 2-hour partitions. The seals shall be non-degradable steel to steel. Leakage shall not exceed 15 cfm/sq. ft. at one inch w.g. and shall be tested at 850 degrees F. Dampers shall be capable of being remotely controlled and reset for pressurization and smoke evacuation. Fire-releasing device shall be UL 33 listed melting fusible links. Dampers shall be provided in sleeves with pre-mounted non-stall motor actuators and dual-position indicators for remote annunciation, if required. The complete assembly shall be factory cycled and tested prior to shipment. Provide suitable access for inspection and servicing of each damper. Pottorff FSD-141 with non-stall motor, Ruskin FSD37 or FSD60 with electric fuse link Model EFL 200, with electric non-stall motor, Greenheck FSD Series, with non-stall motor, or equal.
2. Electronic Damper Actuators: Refer to Sub-paragraph 2.04.B.3.

- D. Relief Dampers: Parallel multi-blade, counter balanced type with adjustable counter weights. Constructed of 20 gage galvanized sheet steel or extruded aluminum with solid stops all around.

Bearings shall be dust proof, ball bearings. Damper shall open on a positive pressure of 0.01 inch within space and close to a backdraft. Interlocking edges shall prevent dust infiltration when closed. Air Balance, Inc., Pottorff, Ruskin, Metal Form Manufacturing Co. Inc., or equal.

- E. Duct Access Panels: Provide factory fabricated access panels in ducts where required for servicing fire or smoke dampers, and at other locations as specified in this Section. Units shall consist of removable panel, gasketed and pressure sealed by controlled spring tension locks. Construct unit, including interior parts, of same material as duct. Units shall be constructed to be suitable for installation in systems of up to 5 inches water gage static pressure.

2.3. AIR DISTRIBUTION DEVICES

A. General:

- 1. Grilles, registers, diffusers and appurtenances shall conform to requirements specified herein and shall be of type and sizes as specified and indicated on Drawings. Performance shall be in accordance with ANSI/ASHRAE Standard 70 including airflow velocity, pressure, temperature, and sound measurements.
- 2. Sponge neoprene, rubber, vinyl or felt border gaskets shall be provided for surface-mounted registers, grilles or diffusers.
- 3. The noise generating characteristics of all specified grilles, registers, and diffusers shall be tested to, and comply with, all requirements of this specification. Representative samples shall be subjected to tests in accordance with applicable standards and procedures in order to demonstrate such compliance. A special test for this project is not required if the manufacturer has previous certified test results that can be made applicable to this project. Maximum Sound Levels of diffusers, grilles and registers shall be as follows:

Administrative office area:	NC 30
Classrooms:	NC 20
Libraries and other noise sensitive areas:	NC 25
Gymnasiums, cafeterias, lockers areas:	NC 30
- 4. Provide suitable frame types to match the ceiling types as specified or indicated on the Architectural Drawings.
- 5. Ceiling diffusers shall be provided with equalizing grids.
- 6. Ceiling mounted grilles, registers and diffusers shall be provided with a factory applied, baked enamel, dull finish, bone white to match acoustical ceiling tile.
- 7. Grilles or registers mounted on painted walls or other surfaces shall be furnished with a baked prime coat and finish painted in accordance with Section 09 9000: Painting and Coating.
- 8. Do not provide opposed blade dampers at diffusers and registers to balance the airflow, as they tend to create noise. Provide a manual volume damper at each branch take-off and also at branch duct to each diffuser and register upstream of the flexible duct connections. Air throw patterns shall be as indicated on the drawings.
- 9. Diffusers, registers and grilles indicated or scheduled on the drawings to comply with special requirements shall take precedence over the standard items specified.

B. Ceiling Diffusers - Round, Square, Rectangular:

- 1. CD-1 For non-classroom areas of less than 10 feet ceiling height only. Units shall be square or rectangular modular core type as indicated on the drawings. Anemostat QC Series, Krueger Model 1240, Price SMCD Series, Titus MCD Series, or equal.
- 2. CD-2 For typical classrooms. Units shall be square plaque type. Anemostat PG Series, Krueger Model PLQ, Price SPD Series, Titus OMNI Series, or equal. The horizontal air discharge pattern shall be 360-degree radial type with factory

installed blank-offs for three way, two way corner, two way opposite, or one way discharge pattern.

3. CD-3 For non-classroom areas of higher than 10 feet ceiling height. Units shall be square or rectangular louver faced type. Anemostat D Series, Krueger Model SH, Price SMD/AMD Series, Titus TDC/TDC-AA Series, or equal.
4. CD-4: Units shall be round, adjustable pattern, and surface-mounted type. Anemostat C-27, Krueger RM Series, Price RCDE Series, Titus TMR Series, or equal.
5. CD-5: Units shall be adjustable linear slot type. Anemostat SLAD Series, Krueger Model 1900, Price AS Series, Titus FL Series, or equal.

C. Grilles - Return, Exhaust, Ceiling, Square, Rectangular:

1. GR-1 Acoustical Tile on Plaster Ceiling: Return and exhaust grilles shall be single deflection type with horizontal fixed face bars set at straight or 45 degree angle, ½ inch spacing and flush and flanged for surface mounting. Anemostat S3HD Series, Krueger Model S80/S85, Price 500/600 Series, Titus 350/355 Series, or equal.
2. GR-2 Prefabricated Acoustical Tile Ceiling with Inverted Exposed T-Bars: Return and exhaust grilles shall be with single deflection horizontal fixed face bars, set at straight or 45 degree angle, ½ inch spacing and flush, lay-in panel type with nominal overall dimension of 24-inch by 24-inch. Anemostat Type SAC3L Series, Krueger Model S80/S85, Price 500/600 Series, Titus 350/355 Series, or equal.

D. Registers, Supply, Return, Wall:

1. WR-1: Sidewall supply register shall be double deflecting type with loose key-operated opposed blade volume control. Anemostat S2 Series, Krueger Model 80/880, Price 500/600 Series, Titus 300 Series, or equal.
2. WR-2: Sidewall return register shall be single deflecting type with horizontal fixed face bars set at 45 degree angle flush and flanged for surface mounting and complete with loose key-operated opposed blade volume control. Anemostat S3 Series, Krueger Model S80/S85, Price 500/600 Series, Titus 350/355 Series, or equal.

2.4. SMOKE DETECTORS

- A. Refer to Section 28 3100: Fire Detection and Alarm.

PART 3 – EXECUTION

3.1. EXAMINATION

- A. Examine areas and conditions under which Work of this Section will be performed. Correct conditions detrimental to proper and timely completion of Work. Do not proceed until unsatisfactory conditions have been corrected.

3.2. DUCTWORK

- A. Construct ductwork according to details of fabrication and methods of support, as indicated in the SMACNA manuals and CMC, unless specified or indicated otherwise in this Section or on Drawings. In event of conflict, the most stringent requirement shall be provided.
- B. Unless otherwise required, construct ducts to conform accurately to dimensions indicated and to be straight and smooth on inside, with joints neatly finished.

- C. Duct dimensions indicated are net inside dimensions.
- D. Where aluminum is welded, provide a minimum thickness of 16 gage, and use gas inert tungsten process of welding.
- E. Anchor ducts to building structural slab, framing and roof decking and detail method of anchoring and fastening if not indicated on Drawings. Supports shall be seismically constructed as required by the latest edition of the SMACNA guidelines.
- F. Construct and install ducts to be completely free from vibration under operating conditions.
- G. Indicate on layout drawing, required for suspended ductwork, location of supports, loads imposed on each fastening or anchor, typical details for anchorage, and details for special anchorage for supports attached to metal roof decking.
- H. Attach supports only to building structural framing members and concrete slabs.
- I. Where supports are required between structural framing members, detail and install suitable intermediate metal framing.
- J. Ducts transporting air-conditioned or heated supply air shall be insulated in accordance with requirements of Section 23 0700: HVAC Insulation.
 - 1. Ducts exposed to weather shall be prefabricated double wall type from HVAC equipment through building envelope.
- K. Ferrous angles and structural members and joining collars specified for construction and support of ductwork and plenums shall be primed with one heavy coat of required asphaltic aluminum paint before installation or fabrication. Metal surfaces shall be thoroughly cleaned before installation of paint. Galvanizing may be provided instead of painting. Installed duct hanger rods concealed in furred ceilings and walls are not required to be primed or painted.
- L. Broken places in galvanized coating shall be acid washed and then completely soldered over or painted with galvanizing paint.

3.3. DUCT CONSTRUCTION

- A. Minimum ductwork gages, joints, reinforcing, and bracing of ductwork shall conform to SMACNA and CMC. The most stringent standards shall prevail. Additional bracing shall be provided to prevent objectionable panel vibration.
- B. Button punch snap-lock seams, using Lock-former or equal, shall be permitted only in non-accessible areas using 20 and 22 gage galvanized steel ducts with screws added at the ends. Button punch snap-lock is not permitted for aluminum or duct lighter than 22 gage.
- C. Provide longitudinal seams of the grooved snap lock, or Pittsburg and standing, sealed spiral or continuously welded.
- D. Ferrous angles and structural members and joining collars specified for the construction and support of ductwork and plenums shall be primed with one heavy coat of asphalt aluminum paint before installation or fabrication. The metal surface shall be thoroughly cleaned before application of the paint. Galvanizing may be provided instead of painting. Installed duct hanger rods concealed in furred ceilings and walls is not required to be primed or painted.

- E. Broken places in galvanized coating shall be acid washed and then completely soldered over or painted with galvanizing paint.
- F. S-type or drive-slip type girths or longitudinal seams shall not be furnished for ductwork installed outdoors or mounted on roofs.
- G. Broken places in galvanized coating shall be acid washed and then completely soldered over or painted with galvanizing paint.

3.4. DUCT ELBOWS AND TURNING VANES

- A. Duct elbows, including supply, exhaust, and return, shall be provided with a centerline radius of 1.5 times duct width parallel to radius whenever possible; centerline radius shall not be less than width of duct parallel to radius.
- B. Where space does not permit above radius, or where square elbows are indicated on Drawings, turning vanes shall be installed whether indicated on Drawings or not.
- C. Turning vanes shall conform to SMACNA and CMC.

3.5. DUCT JOINTS AND SEAMS

- A. Conditioned air supply ducts shall be furnished with joints and seams sealed, welded for air tightness, except spiral seam factory machine formed duct components. Spiral seam is exempted. Joints between slip-fit components may be assembled with all seams and joint connections fastened with screws.
- B. Other ducts shall be furnished with joints and seams sealed by using sealant, taping, soldering, or welding. Ducts for grease hood exhaust shall be furnished with grease-tight welding or brazing on external surface for joints and seams. Fiberglass ducts shall be provided with a thermally activated closure system, Johns Manville Fortifiber Therm-Lock with Automatic Bond Indicator dots, or equal.
- C. S-slip or drive-slip type girths or longitudinal seams are not permitted on exterior or exposed rooftop mounted ductwork.
- D. Caulking, taping, or other joint or seam treatment shall be provided in accordance with recognized standards.
- E. Seams around fan, coil housing and plenums shall be sealed with gaskets or sealing compound to provide an airtight assembly.
- F. Stainless steel ductwork connected to range hoods and fume hoods shall be provided with grease-tight, gas tight welded seams, and shall be constructed and installed so that grease or other material cannot become pocketed in any portion thereof, and system shall slope downward toward hood not less than 1/4 inch per lineal foot. Gasketed flanged joints with sealing compound shall be used only at fan and fume hood connections.
- G. Alternative duct connectors such as Ductmate Industries, Mez Industries, or equal may be used if the following conditions are met:
 - 1. One of the specifically listed connectors is submitted and approved by the ARCHITECT and OAR.

2. The correct size connector, application, and gage of material conform to SMACNA Standards.
3. The connector is installed per manufacturer's specifications.

3.6. DUCT TRANSITION

- A. Slopes in sides of transition pieces shall be no greater than 1 to 5. Abrupt changes or offsets in duct system are not permitted, except when reviewed by the ARCHITECT.

3.7. DUCT TEST HOLES

- A. Holes in ducts and plenums shall be provided for pilot or static tubes for obtaining air measurements to balance or check air systems. Holes shall be covered with neoprene gasketed sheet metal cover or plugged with a fitted neoprene plug chained to duct.

3.8. FLEXIBLE CONNECTIONS

- A. At points where sheet metal connections are installed to fans or air handling units, or where ducts of dissimilar metals are connected, a flexible connection of commercial grade, Duro Dyne Durolon, Ventfabrics Ventglas, Ductmate Industries Proflex, or equal, non-combustible material shall be installed and securely fastened by zinc-coated steel clinch-type bands or a flange type connection. Inlet and outlet openings shall be axially in-line, maximum deviation of centerline shall be less than 5 percent of diameter or shortest dimension of a rectangular inlet of fan or air handling unit, with system at rest. Duct end of connection shall be seismically restrained if more than 4 feet from last support.

3.9. AIR TERMINAL DEVICES

- A. General: Install supply devices after ducts, plenums, and casings have been cleaned and blown free of small particles, as specified. Devices shall be aligned to be parallel to ceiling construction or walls and ceiling surfaces, and shall be pulled tightly to compress gaskets and to fit neatly against surfaces.
- B. Diffusers: Support surface mounted ceiling diffusers from angles or channels resting on and fastened to ceiling construction. Do not support from ducts. Install lay-in diffusers on T-bar ceilings with hanger wires from each corner and not supported by ceiling structure. Provide sheet metal adaptor box above each diffuser to allow space for volume controller with round collars for connection to round ducts where indicated on Drawings. Fasten duct-mounted diffusers to duct collars.
- C. Registers and Grilles:
 1. Install wall supply registers at least 6 inches below ceiling, unless otherwise indicated. Locate return and exhaust registers 6 inches below ceiling unless otherwise indicated.
 2. Support ceiling diffuser type inlets, registers, and grilles as required above for ceiling diffusers.
 3. Fasten wall mounted and duct mounted registers and grilles to flanges of duct collars.

3.10. DAMPERS

- A. Manually operated dampers, gravity dampers, fire dampers, and motor operated dampers shall be furnished and installed as specified and indicated. Upon completion of installation, dampers

shall be checked, lubricated, and adjusted so that they operate freely, without binding. Dampers shall be of standard commercial manufacture, complete with damper frame. Where painting is required, they shall be shop finished unless otherwise noted.

1. Provide and install manual volume dampers per SMACNA standards to allow balancing per AABC, NEBB or TABB Procedures and Standards whether indicated on the drawings or not.
2. Balancing dampers shall be installed in main supply ducts from fan discharge plenums, where two or more ducts are connected to each plenum, although such balancing dampers may not be indicated. Each zone shall be provided with a manual volume damper. Sheet metal screws shall be installed through handles and into ducts to lock damper in place after test and balance.
3. Each supply, return, and exhaust branch shall be provided with manual volume dampers.
4. Do not provide opposed blade dampers at air inlets and outlets.
5. Each supply, return, and exhaust inlet or outlet shall be provided with a manual volume damper. This damper shall be a minimum of 5 feet upstream of the air outlet and inlets. An acoustic flexible duct should be provided between the outlet and inlet and the damper for concealed ducts.
6. Dampers installed in accessible locations shall be provided with locking and indicating quadrants. Ventfabrics Ventlok, Duro Dyne, Young Regulator Co., or equal.
7. Dampers installed in ductwork in furred ceiling spaces or in roof spaces with less than 30 inches of clearance below beams, joists, or other construction, and where access panels are not provided shall be furnished with damper rods extended below ceiling and terminated with a concealed damper regulation. Ventfabrics Ventlok, Young Regulator Co., Duro Dyne, or equal.
8. Dampers not identified as splitter, extractor, or butterfly dampers shall be of multi-louver type arranged for opposed blade operation. Damper shall be same dimension as adjoining duct and be tight closing. Blades shall not be greater than 9 inches. Dampers shall be not less than 18 gage steel.
9. Motor operated dampers shall be furnished by temperature control manufacturer as part of temperature control equipment and shall conform to requirements of Section 23 0900: HVAC Instrumentation and Controls.
10. Dampers shall be provided with accessible operating mechanisms. Where operators are exposed in finished portions of building, operators shall be chromium-plated with exposed edges rounded. Splitter dampers are not permitted unless specified and reviewed by the ARCHITECT.
11. Dampers shall not be installed in combustion air ducts.
12. Access panels shall be installed for access at each damper's operating mechanism.

3.11. FIRE AND SMOKE DAMPERS

- A. Fire dampers or combination fire and smoke dampers shall be installed and accessible at duct penetrations of rated walls and partitions and as required by State Fire Marshal and NFPA 90A, 92A, 92B, and 101.
- B. Fire dampers shall be sized, and adjoining duct enlarged, to assure full size air passage of connecting ductwork.
- C. Install smoke dampers as indicated on Drawings and as required in ducts penetrating smoke isolation separations.
- D. Fire dampers or combination fire and smoke dampers shall be electrically actuated, power open-fail close type, UL 555 and UL 555S classified for 1-1/2 hours.

- E. Provide a service disconnect switch for each and every combination smoke and fire damper.

3.12. DETECTORS

- A. Smoke detectors shall be installed in accordance with requirements of the California Mechanical Code.
- B. Smoke detectors shall be installed in systems of over 2000 CFM capacity to detect presence of smoke and automatically shut down air handling units or fans unless it has been verified with the electrical installer that Exception 1 to CMC 609.0: Automatic Shutoffs, regarding automatic shutdown of systems with total coverage smoke detection systems is applied.
- C. Smoke detectors shall be installed in supply system downstream of filters.

3.13. BACKDRAFT DAMPERS

- A. Backdraft dampers shall be installed at locations indicated in accordance with the State of California Building Energy Efficiency Standards, Title 24, CCR.

3.14. FLEXIBLE DUCT RUNOUTS

- A. Runouts from branches, risers or mains to air terminal units and outlets may be pre-insulated, factory fabricated flexible ducts complying with NFPA 90A. Flexible ductwork shall not exceed 7 feet in length. When required to suspend flexible ducts, furnish hangers of type recommended by manufacturers of pre-insulated flexible duct and install at intervals recommended. Method of attachment to other components of air distribution system for a vapor-tight joint shall be in accordance with printed instructions of flexible duct manufacturer. Bend radius shall be 1-1/2 times diameter of duct, measured from centerline. Bends greater than 90-degree angle are not permitted. Non-metallic flexible duct shall be permitted only in T-bar suspended ceilings.

3.15. DUCT HANGERS AND SUPPORTS

- A. Exposed or easily accessible ductwork: All exposed ducts shall be supported by all-thread Rod as a single hanger and or a trapeze support for rectangular duct work in accordance with requirements of the latest edition of the HVAC Duct Construction Standards – Metal and Flexible of SMACNA.
- B. Non-accessible ductwork: Non-exposed and hidden from sight during regular school operations ductwork, rigid round, rectangular, and flat oval metal ducts, shall be installed with support systems conforming to SMACNA Standards.
- C. Where ducts are installed one above the other, they shall be individually supported on a trapeze of steel angles with 3/8 inch supporting steel rods securely fastened to overhead construction. A minimum distance of 3 inches shall be maintained between ducts wherever possible, but in no event shall distance be less than 2 inches. Minimum sizes of steel angles shall be 1 ½-inch by 1 ½-inch by 1/8 inch for duct sizes through 60 inches in greatest dimension, 2-inch by 2-inch by 1/8 inch for duct sizes 61 inches through 84 inches, 2-inch by 2-inch by 3/16 inch for duct sizes 85 inches through 96 inches, and 2-inch by 2-inch by 1/4 inch for duct sizes over 97 inches.
- D. Ducts six square feet area and greater and or minimum 28” round or greater shall be seismically restrained. Refer to Section 23 0548: HVAC Sound, Vibration and Seismic Control.

- E. Hangers shall not be supported by, or fastened to, non-structural members including blocking. Toggle or Molly type bolts are not permitted.
- F. Vertical ducts shall be supported with suitable angles on each side of each duct located at each floor and at intervals not to exceed 8 feet. Angles shall be sized and installed according to SMACNA Standards for required span so that they will be rigid, without bending or sagging.
- G. Roof-mounted ductwork shall be installed a minimum 12 inches above roof and shall be supported by galvanized welded pipe, one on each side, fastened to roof structure, flashed and sealed to roof membrane. Install supports at each turn, unit connections, and each penetration, and space at maximum 6 feet off-center in general. Pitch pockets are not allowed.

3.16. ACCESS PLATES AND DOORS

- A. Access plates and doors shall be furnished and installed where stops, valves, fire dampers, fusible links, coils, damper operating mechanism, control equipment, lubrication fittings, air filters, air handling equipment and similar items normally requiring adjustment or servicing are installed in concealed spaces.
- B. Access plates and doors shall be located to permit convenient access to equipment sized to permit removal of equipment for servicing. Access plates shall be no less than 12-inch by 12-inch in clear opening. Proper servicing of equipment requires adequate access for maintenance personnel. Access doors shall not be less than 24-inches by 24-inch, unless otherwise detailed. Two or more valves shall not be located in same access area unless sufficient clearance is provided for operation, servicing and removal of each valve.
- C. Openings in ducts or plenums whose longer dimension does not exceed 12 inches may be covered by a plate of same material as duct, gasketed and fastened to duct or plenum with sheet metal screws.
- D. Access plates in floors shall not be less than 8-inch by 8-inch and shall be carborundum surface brass with cast brass frames anchored into concrete. Access plates in tile walls shall be chromium plated brass and polished. Serrated plates furnished as part of a clean-out assembly are permitted in floors instead of a separate plate.
- E. Access plates and doors in walls and ceilings of finished rooms and in locations normally accessible to students shall be furnished with continuous piano hinges, unless otherwise specified, and a special flush type spring-loaded latch requiring an Allen wrench to operate. Access devices shall be installed after plastering in plaster ground openings.
- F. Access panels or doors penetrating one-hour fire resistive ceilings shall meet code requirements for such openings.
- G. Access panels shall be fire-rated; Milcor, or equal. Access doors shall be as required for installation in openings penetrating one-hour fire resistive ceilings. Access doors shall be furnished with a flush, key-operated cylinder lock, furnished with two keys each, instead of Allen headlock for non-rated ceilings.
- H. Access panels that are part of an integrated ceiling are specified in Section 09 8433: Cementitious Wood Fiber Acoustical Units. Identification markers shall be affixed to adjacent supports, under this portion of Work, to indicate location and type of mechanical device to be serviced.

- I. Access panels installed in ducts or plenums located in heater or equipment rooms containing gas-fired equipment shall be furnished with heavy-duty spring closing hinges and refrigerator door type catches unless otherwise required. When these panels are intended for maintenance personnel access, catches shall be operable from both interior and exterior.
- J. Other access panels, except those specified above, shall be furnished with suitable hinges and one or more sash fasteners.
- K. Panels located in ducts and plenums shall be installed with gaskets made of synthetic rubber, felt, or similar material to provide an airtight installation. Panels shall be constructed and reinforced to prevent vibration.
- L. Label the words "FIRE DAMPERS" on panels over fire dampers and words "DO NOT OPEN - HEATER IS OPERATING" on panels located in heater or equipment rooms. Letters shall be approximately 3 inches high, if space is available.
- M. Furnish a key to operate latch access plates, one for each access plate, but not to exceed five keys for any one Project.
- N. Access plates and panels shall be furnished with manufacturer's name or trademark and model number cast or stamped thereon, or upon a label permanently affixed thereon.
- O. Provide duct through roof flashing as detailed in the SMACNA standards or as indicated on Drawings.
- P. Refer to SMACNA for access plate and door construction.

3.17. CLEANUP

- A. Remove rubbish, debris and waste materials and legally dispose off the Project site.

3.18. PROTECTION

- A. Protect the Work of this Section until Substantial Completion.

END OF SECTION

SECTION 23 8000

HEATING, VENTILATING AND AIR CONDITIONING EQUIPMENT

PART 1 – GENERAL

1.1. SUMMARY

- A. Section Includes: Air conditioning and air handling equipment including but not limited to:
 - 1. Split System Air Conditioning Units.
 - 2. Split System Heat Pump Units.
 - 3. Fans.
- B. Related Requirements:
 - 1. Division 01: General Requirements.
 - 2. Section 07 6000: Flashing and Sheet Metal.
 - 3. Section 22 1000: Plumbing.
 - 4. Section 23 0500: Common Work Results for HVAC.
 - 5. Section 23 0513: Basic HVAC Materials and Methods.
 - 6. Section 23 0548: HVAC Sound, Vibration and Seismic Control.
 - 7. Section 23 3000: Air Distribution.

1.2. DESIGN REQUIREMENTS

- A. Work of this Section is based on HVAC equipment units indicated as Basis of Design in Part 2 of this Section. Products from different HVAC equipment manufacturers listed are never identical, although equivalent in capacity, performance and quality. In the cases where dimensions, weight, configuration and utility requirements differ from the products used as a basis of design, the Contractor, at no additional cost to the Owner, shall coordinate and submit, for Architect review, revisions to the design.

1.3. SUBMITTALS

- A. Provide in accordance with Division 01 and Section 23 0500: Common Work Results for HVAC.
- B. For products listed that are not the basis of design, submit the following in addition to above requirements:
 - 1. Title 24 Calculations: Replace HVAC unit values in calculation files provided by the Architect and submit for review.

1.4. QUALITY ASSURANCE

- A. Provide submittals in accordance with Section 23 0500: Common Work Results for HVAC.

1.5. PROJECT RECORD DOCUMENTS

- A. Provide Owner instructions on equipment operation and maintenance procedures, as indicated in Section 23 0500: Common Work Results for HVAC.

1.6. WARRANTY

- A. Compressors shall be provided with manufacturer's five year warranty, replacement only.
- B. Manufacturer shall warrant parts, except heat exchangers, for a period of five years.
- C. Heat exchangers shall be provided with manufacturer's ten year warranty, replacement only.

PART 2 – PRODUCTS

2.1 EQUIPMENT

- A. Capacities of air conditioning equipment indicated on Drawings are net capacities actually required. Standard catalog ratings shall be adjusted to actual Project site environmental conditions.

2.2 HEAT PUMP AND FAN COIL UNITS

- A. Manufacturer: Daikin, Carrier, or equal.
 - 1. Basis of Design: DAIKIN
- B. Heat Pump matching indoor fan coil and Outdoor unit: Furnish heat pump, split type, air-cooled, roof or ground installation with ducted connections or free blow. Units shall be air-cooled heat pump/direct expansion fan coil combinations. Heat pump outdoor section shall be factory assembled and furnished with direct-drive Outdoor fans with horizontal or vertical air discharge, scroll type compressor, refrigerant coil, fan motors, pre-wired control panel. Unit shall also be provided with a fully piped refrigerant circuit, fully charged with an environmentally friendly refrigerant that is not scheduled for phase out. Provide additional refrigerant for extended lines. Indoor fan coil unit shall be furnished with horizontal discharge and will include Indoor coil, fan and motor, condensate pan with drain, thermal expansion valve, pre-wired control panel and remote thermostat control. Nominal unit cooling, heating capacities, electrical characteristics, and operating conditions shall be as indicated on Drawings.
- C. Quality Assurance:
 - 1. Cooling capacity rated in accordance with current AHRI Standard 210/240 and 270. Units shall be listed in AHRI.
 - 2. Unit construction shall comply with ANSI/ASHRAE 15, latest revision, and with NEC.
 - 3. Units shall be constructed in accordance with UL standards and shall carry UL/ETL label of approval.
 - 4. Units shall be listed in CEC directory.
 - 5. Unit cabinet shall be capable of withstanding ASTM B117 500 hour salt spray test.

6. Unit shall provide an EER/SEER/COP complying with CCR, Title 24, Building Energy Efficiency Standards and per the drawings.
- D. Indoor and Outdoor coils: Indoor and Outdoor coils shall be copper with mechanically bonded, smooth aluminum plate fins. Tube joints shall be brazed with copper or silver alloy. Coils shall be pressure-tested at factory. Protective metal guard for inlet and outlet of outdoor coil.
- E. Indoor and Outdoor Coils at locations within two miles from ocean shall be furnished with copper plate fins mechanically bonded to enhanced copper tubes with copper tube sheets and brazed joints and with factory applied Corrosion-Resistance Epoxy Coating. Field coated coils are not acceptable.
- F. Fans:
 1. Outdoor Fan and Motors: Outdoor fan shall be ECM type motor direct driven, propeller type arranged for horizontal or vertical discharge. Outdoor fan motors shall be furnished with inherent protection, and shall be permanently lubricated type, resiliently mounted for quiet operation. Each fan shall be furnished with a safety guard.
 2. Indoor fan section shall be furnished with ECM type motor centrifugal, forward curved, double width, double inlet fan or fans installed on a solid shaft. Fan shall be statically and dynamically balanced and shall rotate on permanently lubricated bearings.
- G. Unit Cabinets:
 1. Cabinets shall be fabricated of galvanized steel, bonderized and finished with baked enamel.
 2. Cabinet interior shall be insulated with minimum one inch thick foil face fiberglass.
 3. Outdoor unit compartment shall be isolated and have an acoustic lining to assure quiet operation.
- H. Compressor: Compressor shall be two stage or variable speed type hermetic scroll.
 1. Compressor shall be furnished with access valves and it shall be installed on rubber isolators to reduce sound vibration.
 2. Furnish with high and low-pressure protection.
 3. Each heat pump shall be furnished with factory installed suction accumulator. Field installed accumulators are not permitted.
 4. It shall be furnished with high and low-pressure protection, brass external vapor supply line service valves, vapor return line service valves with service gage connection port, service gage port connections on compressor suction and discharge lines with Schrader-type fittings with brass caps, filter drier, pressure relief, liquid line solenoid valves, thermostatic expansion valves, and a holding charge of refrigerant.
- I. Refrigeration Components: Refrigerant circuit components shall include brass external liquid line service valve with service gage port connections, suction line service valve with service gage connection port, service gage port connections on compressor suction and discharge lines with Schrader type fittings with brass caps,

accumulator, bi-flow filter drier, pressure relief, reversing valve, heating mode metering device, and a holding charge of refrigerant.

J. Controls and Safeties:

1. Compressor motor assembly shall be protected with high and low-pressure switches, internal overloads, internal thermostat, internal relief valve, and anti-recycle relay, or time cycle device to prevent rapid cycling of compressor after any off cycle.
2. Control panel shall be pre-wired in unit casing.
3. The control circuit shall incorporate a safety circuit to render refrigerant system (compressor and outdoor air motor) inoperative should there be a loss of refrigerant.
4. Units shall also be furnished with automatic Outdoor-fan motor protection, high condensing temperature protection, compressor motor current and temperature overload protection, high pressure relief and Outdoor fan failure protection.

K. Low Ambient Operation: Head pressure control shall be provided for operation at outside air temperature below 45 degrees F.

L. Safeties:

1. High condensing temperature protection.
2. Compressor motor current and temperature overload protection.
3. High pressure relief.
4. Outdoor fan failure protection.

M. Filters:

1. Filters shall be 2-inch standard size high capacity replaceable media type, MERV 13, installed in an external 2-inch rack filter section and complete with an access door.
2. An-line filter-drier shall be furnished with equipment and installed at Project site.

N. Economizer: Provide on units with capacities equal to, or larger than 4.5 tons nominal capacity, when the Prescriptive Compliance approach is utilized to comply with Energy Efficiency Standards or where necessary to achieve CHPS pre-requisite and/or CHPS building flush-out compliance. Economizer shall be manufacturer's standard; factory furnished and field installed. Economizer control shall maintain a fixed supply air temperature during free cooling operation by providing full modulation of operable outside and return air dampers.

O. Provide programmable digital thermostat with following features:

1. 7-day time clock.
2. Heat, cool, automatic changeover.
3. Occupied / Unoccupied modes.
4. Dry contact switch for input from an external device such as a central time clock, occupancy sensor, or a telephone activated device.
5. Robertshaw, Honeywell, Johnson Controls, Carrier, Schneider Electric, Viconics, or equal with built-in occupancy sensor. Refer to Section 23 0900 for areas with zone damper controls.

6. Remote sensors. School Areas that could be subject to vandalism or accidental impact damage such as Gymnasiums, Auditoriums, Multipurpose Rooms, Corridors and Lobbies shall be provided with thermostats with remote return air duct or room sensors. Verify remote location of sensors and thermostats with Architect.
- P. Demand Control Ventilation:
1. Units of 6.25 nominal tons and higher capacity shall be provided with Indoor Air Quality (CO2) Sensor and Accessory Electronic Expansion Boards.
 2. The unit shall have ability to provide demand ventilation indoor-air quality (IAQ) control through economizer when provided with an indoor air quality sensor and accessory expansion board.
 3. The IAQ sensor shall be duct mounted in return air main duct unless otherwise indicated on Drawings. The set point shall be adjustable.
 4. The IAQ sensor shall be powered through unit. If not, required control transformer shall be provided by manufacturer. Coordinate power requirements and location with Division 26.
 5. The IAQ sensor shall provide a 4 to 20 mA signal to expansion board.
- Q. Start-up: Factory test each unit before shipment to Project site. Performance test shall include full refrigeration start-up, fan and controls start-up. Each unit shall be provided with its own report with its own serial number. Non-tested units are not permitted to be delivered to Project site. Provide full start-up of units to include full refrigeration and provide a written report.
- R. Parts Availability: Submit proof in writing that majority (minimum 80 percent) of replacements parts are commonly available and not proprietary. Also, submit proof in writing that a local parts sales and service facility exists, where replacement parts will be warehoused in quantity. Guarantee timely availability for parts that are proprietary.

2.3 ROOF MOUNTED POWER EXHAUST VENTILATORS

A. RMEV-1:

1. Manufacturer:

CARNES	GREENHECK	LOREN COOK	PENNBARRY	TWIN CITY & BLOWER	OR EQUAL
VEDK Series	G Series	ACED	Domex - Direct Drive	DCRD	

2. Spun aluminum, roof mounted, direct driven, downblast centrifugal exhaust ventilator, with components as indicated and specified. Sizes, performances, and accessories shall be as indicated on equipment schedules on Drawings. Also, provide accessories for proper operation and balancing of fans in accordance with design intent and sequence of operation.
3. Certification: Fan shall be listed by Underwriters Laboratories Inc. (UL 705). Fan shall bear AMCA Certified Ratings Seals for Fan Sound and Air Performance.
4. Housing: The fan shall be of bolted and welded construction utilizing corrosion resistant fasteners. The spun aluminum structural components shall be constructed of minimum 18 gage Aluminum,

bolted to a rigid aluminum support structure. The aluminum base shall have continuously welded curb cap corners for maximum leak protection. The discharge baffle shall have a rolled bead for added strength. An integral conduit chase shall be provided through curb cap and into motor compartment to facilitate wiring connections. The motor shall be enclosed in a weather-tight compartment, separated from exhaust airstream. Unit shall bear an engraved aluminum nameplate.

5. Wheel: Wheel shall be centrifugal backward inclined, constructed of 100 percent aluminum, including a precision machined cast aluminum hub. An aerodynamic aluminum inlet cone shall be provided for maximum performance and efficiency. Wheel shall be balanced in accordance with AMCA Standard 204, Balance Quality and Vibration Levels for Fans.
6. Motor: Motor shall be heavy-duty ECM type with permanently lubricated sealed bearings and furnished at specified voltage, phase, and enclosure.

2.4 FILTERS

- A. Air filter media shall be minimum 2-inch thick, MERV 13 Class 2, 100% synthetic, high capacity, pleated, disposable type, with support grid and enclosing frame, continuously laminated on a supporting moisture resistant beverage board type frame that conforms to the configuration of the pleats. Media shall be glued to the frame along all four sides and glued horizontally & diagonally to grill members on both sides. The media shall be unaffected by water and humidity, be non-toxic, non-allergenic, and shall not support the growth of any fungi or bacteria. Filter shall have rigid outer frame that will not bend or distort under normal usage. Filter shall be UL 900 listed, Class 2.
- B. Filter media shall provide an average efficiency as specified on drawings per ASHRAE Standard 52.2.
- C. Initial resistance of air filters shall not exceed following limits for each efficiency level at face velocities indicated. Lower resistance requirements, if indicated on drawings shall have precedence.

85 percent (MERV 13)	0.30 inch water gage at 500 feet per minute
95 percent (MERV 14)	0.38 inch water gage at 500 feet per minute
- D. Use standard size Filter Medias only.
- E. Media support shall be a welded wire grid or a rigid frame with an effective open area of not less than 96 percent.
 1. Media support shall be bonded to filter media to eliminate possibility of media oscillation and media pull-away.
 2. Media support grid shall be formed in such a manner that it effectively forms a radial pleat design, providing total use of filter media.

- F. Enclosing frame shall be bonded to air entering and air exit side of each pleat, to ensure pleat stability. Inside periphery of enclosing frame shall be bonded to filter pack, thus eliminating possibility of air bypass.
- G. Holding frames shall be factory fabricated of 16 gage galvanized steel, or equivalent and shall be furnished with gaskets and spring type positive sealing fasteners. Fasteners shall be capable of being attached or removed without use of tools.
- H. Manufacturers: Camfil Farr, Koch, or AAF.
 - 1. LOUVERS, AIR CONDITIONING (use in conjunction with relief damper)
 - A. Standard steel louvers shall be furnished complete with frames, blades, finish and construction details per Drawings and manufacturer's recommendations.
 - B. Louvers shall be furnished with horizontal blades, 2 inches deep for air through wall installation in conjunction with gravity relief damper for backdraft protection that will open at 0.01-inch wc room static pressure as indicated on Drawings. Blades shall be 16-gage steel, spaced at 1 7/8-inch at 30 degrees angle, and with baked epoxy coating. Panel size shall be as indicated but not less than 24 inches width by 18 inches in height.

PART 3 – EXECUTION

3.1. GENERAL

- A. Examine areas under which Work of this Section will be performed. Correct conditions detrimental to proper and timely completion of Work. Do not proceed until unsatisfactory conditions have been corrected.

3.2. EQUIPMENT FOUNDATIONS

- A. Provide foundations (housekeeping pads, level platforms or curbs) for mechanical equipment whether indicated on drawings or not. Equipment foundations shall be of sufficient size and weight, and of proper design to preclude shifting of equipment under operating conditions, or under abnormal conditions imposed upon equipment.
- B. Provide foundations (housekeeping pads, level platforms or curbs) for mechanical equipment whether indicated on drawings or not. Foundations shall meet requirements of equipment manufacturer and, when required by Architect, obtain from equipment manufacturer, approval of foundation design and construction, for equipment to be installed. Equipment vibration shall be maintained within design limits, and shall be dampened and isolated. Isolators shall be bolted to a structural member so as to be readily removable.

3.3. EQUIPMENT DESIGN AND INSTALLATION

- A. Uniformity: Unless otherwise specified, equipment of same type or classification shall be product of same manufacturer.

- B. Application: Only provide equipment as reviewed by Architect.
- C. Equipment Installation: Equipment installation shall be in strict accordance with these Specifications, and installation instructions of manufacturers. Equipment installed on concrete foundations shall be grouted before piping is installed. Piping shall be installed in such a manner as not to place a strain on equipment. Flanged joints shall be adequately extended before installation. Piping shall be graded, anchored, guided and supported, without low pockets.
 - 1. Install equipment in a neat and skillful manner, properly aligned, leveled, and adjusted for satisfactory operation.
 - 2. Install so connecting and disconnecting of piping and accessories can be readily accomplished, parts are readily accessible for inspection, service and repair. Space shall be provided to readily remove filters, coils, compressors and fan wheels. Access doors shall be hinged with cam lock door handles.
 - 3. Provide flexible connections for duct, pipe and conduit connections at moving equipment.

3.4. REFRIGERANT PIPING INSTALATION

- A. Unless otherwise indicated, main liquid and suction lines from condensing unit to Indoor coil shall be of sizes specified by manufacturer.
- B. Refrigeration piping shall be refrigeration grade copper tubing, type L hard-drawn. In instances where refrigeration lines are installed in an inaccessible location and must be snaked through conduit or a trench, that portion of tubing required to complete connections through conduit or trench may be soft drawn. Maintain entire system clean and dry during installation. Pipe shall be sealed until installed.
- C. Refrigeration piping, both hard and soft-drawn, shall be straight and free from kinks, restrictions and horizontal runs shall be sloped towards compressor one inch to 10 feet wherever possible. Vapor line oil traps shall be installed on bottom of vertical risers and inverted oil trap shall be installed on top of vertical risers.
- D. Joints shall be installed with Sil-Fos 15, Silvaloy 15, or equal.
- E. Flare nuts required on suction lines shall be of short forged or frost-proof type. Other fittings shall be standard sweat-soldered type. Ells and return bends shall be long radius type. Install leak lock material.
- F. Refrigeration Piping: Joints shall be silver brazed and tested according to the section 23 0500 "Common Work Results for HVAC". Construct joints according to AWS's "Brazing Handbook," "Pipe and Tube" Chapter. Field fabricated lines shall be thoroughly deburred, flushed and cleaned before connection. Bleed nitrogen through lines during silver brazing, maintain Nitrogen flow rate of 1.75 cubic feet per minute or more using a pressure regulator. Cap and seal lines when not completed and connected to equipment.

1. Brazing or Debrazing shall always be conducted with nitrogen purging through the refrigeration system.
 2. Arrange a refrigerant piping pre-installation conference between Contractor, Architect, IOR, and OAR to review and confirm installation method.
 3. Do not charge refrigerant through the split system prior to testing procedure by contractor and acceptance by Owner.
- G. Sleeve penetrations of floors, walls and ceiling to allow for free motion of piping. Provide 24 gage galvanized iron pipe and chrome-plated escutcheon plates. Pack annular space between pipe and sleeve with incombustible material such as fiberglass and seal each end with mastic to provide a waterproof seal.
- H. Install insulated couplings at points of connection between dissimilar metals for cathodic protection. Insulate copper tubing from ferrous materials and hangers with 2-inch thickness of 3-inch wide strip, 10 mil polyvinyl tape wrapped around pipe.
- I. Support piping by iron hangers and supports. Hydra-Zorb cushion clamps, LSP Products Group Acousto Clamp, or equal, on non-insulated piping, and Klo-Shure coupling clamp on insulated piping, or equal.
- J. Provide saddles to protect pipe insulation.
- K. Provide connections of copper, copper plated steel, steel, and brass pipe and tubing with Harris Products Group Safety-Silv 56, Lucas-Milhaupt, Inc., or equal, complying with ANSI/AWS A5.8 and NSF 51.
- L. Insulate refrigerant suction lines.
- M. On split systems, insulate both vapor and liquid lines. For insulation materials, refer to Section 23 0700: HVAC Insulation.

3.5. NOISE AND VIBRATION

- A. Operation of Equipment: Mechanical equipment and piping systems shall operate without exceeding specified noise and/or vibration levels.
- B. Corrective Measures: If specified noise and/or vibration levels are exceeded, provide necessary changes to reduce noise and/or vibration levels to within specified levels.

3.6. FIELD TESTS AND INSPECTION

- A. General: Perform field inspections, field tests, and trial operations as specified in Section 23 0500: Common Work Results for HVAC. Provide labor, equipment and incidentals required for testing. The Project Inspector will witness field tests and trial operations as specified in Section 23 0500: Common Work Results for HVAC.
- B. Equipment and Material: Equipment and material certified as being successfully tested by manufacturer, in accordance with referenced Specifications and standards, will not require re-testing before installation. Equipment and materials not tested at place of manufacture will be tested before or after installation, as applicable or necessary, to determine compliance with reference Specifications and standards.

- C. Start-Up and Operational Test: System shall be started up and initially operated with components operating. During this test, various strainers or filters shall be periodically cleaned until no further accumulation of foreign material occurs. Adjust safety and automatic control instruments as required to provide proper operation and control sequence. Refer to Section 23 0500: Common Work Results for HVAC.
 - D. Extent of Field Tests: After installation and before completion, Work of this Section shall be subjected to required field tests, including those specified here and in Section 23 0500: Common Work Results for HVAC.
 - E. Operation and Maintenance Data: Provide required operation and maintenance data as specified in Section 23 0500: Common Work Results for HVAC.
- 3.7. CLEANUP
- A. Remove rubbish, debris and waste materials and legally dispose of off Project site.
- 3.8. PROTECTION
- A. Protect Work of this Section until Substantial Completion.

END OF SECTION

SECTION 26 0126

TEST AND ACCEPTANCE REQUIREMENTS

PART 1 - GENERAL

1.1 SUMMARY

- A. Principal items of work in this section include but are not limited to:
1. Ensure quality assurance, testing and final acceptance requirements for premises cabling installations comply with industry standards and Project Construction Documents.
 2. The school district/owner seeks to improve the quality of its network installations. In order to achieve this objective, the guidelines specified below are to serve as a technical reference for the Owner's infrastructure verification of the Installer's testing. The appendix of this section describes specific test procedures that the Owner shall perform during the acceptance testing, particularly those involving LAN, PABX, VTC, Convergence and WLAN equipment, and associated cable plants. The procedures provide a comprehensive series of visual, electronic, and optical tests to ensure the infrastructure installation complies with the standards set forth in the specifications. The successful culmination of these tests shall be used to document a physical configuration audit (PCA) as part of the Owner's Quality Assurance (Q/A) Report. Testing shall include physical Q/A review of installation and performance testing of components.
- B. Responsibilities for this specification are as follows:
1. Installer: The Installer shall follow CEC, CANSI/EIA/TIA and BICSI installation standards. The Installer shall perform horizontal cable installation including Category 5e and Category 6a unshielded twisted pair (UTP) cable runs terminated in the communications cabinet and cable terminations at each work area outlet, as well as vertical cable installation, including fiber optic cable runs and terminations. During installation the Installer shall perform tests as required by the Parent Specification and in compliance with testing standards found in Appendixes B, C, and D of this Section. The Installer shall notify the Project Inspector 48 hours in advance of any required testing so that the Project Inspector can notify the Owner's Quality Assurance Team to observe the Installer's test procedures. The Installer shall forward test documentation to the OAR prior to the Owner's formal acceptance testing.
 2. Contractor's Site Responsibilities during formal Owner's Quality Assurance: During formal Owner's Quality Assurance, the Contractor and his/her Subcontractor shall comply with testing standards and requirements detailed in Appendices A through F. Under the guidance of the Project Inspector and in coordination with the Owner's Quality Assurance Team, the Installer shall:
 - a. Verify LAN connectivity and WAN extension cabling to MDF.
 - b. Configure the router(s) and switch(es) in compliance with the Contract Documents.

- c. Aid the Owner's Quality Assurance Team with network cut over. (e.g., existing systems with internet connectivity and administration systems including but not limited to SIS and payroll)
 - d. Provide labor, materials, and testing equipment (e.g., Power Meter, OTDR) to correct any deficiencies with labeling, cable charts, terminations, and Installer supplied test results.
 - e. Provide keys and access to installed network equipment.
3. Owner's Quality Assurance Team Responsibilities: Using the procedures specified in the Appendixes of this guideline, the Owner's Quality Assurance Team shall verify that the infrastructure installed under the Contract complies with the installation standards detailed in the Specifications. Specifically, testing shall be performed by the Owner on vertical and horizontal cable (e.g., fiber optic, Category 5e UTP and Category 6a UTP) along with component installations performed under the scope of the overall infrastructure effort (e.g., Ethernet switches and routers). Generally, testing specifications and procedures cover the following:
- a. Q/A review of equipment rack installation; including placement in the communications cabinets, attachment to the floor, and seismic bracing.
 - b. Q/A review of fiber terminations, patch panel installation, cable labeling, and cable bundling.
 - c. Q/A review of Category 5e and Category 6a, T568B terminations, including cable end connections at the patch panel and work area outlets.
 - d. Q/A review of the Contractor's Redlines for accuracy.
 - e. Industry standard for fiber optic, Category 5e and Category 6a cable performance testing.
 - f. Network equipment performance verification.
 - g. Uninterruptible power supply performance verification.
 - h. Communications cabinet layout and facility drop count verification.

C. Related Requirements:

- 1. Division 01 - General Requirements.
- 2. Section 00 7000: General Conditions.
- 3. Section 01 7700: Contract Closeout.
- 4. Section 06 1000: Rough Carpentry.
- 5. Section 26 0500: Common Work Results for Electrical.
- 6. Section 26 0513: Basic Electrical Materials and Methods.

7. Section 26 0526: Grounding and Bonding.
8. Section 26 0533: Raceways and Boxes Fittings and Supports.
9. Section 26 2416: Panelboards and Signal Terminal Cabinets.
10. Section 26 5000: Lighting.
11. Section 26 5200: Emergency Power Systems.
12. Section 26 0536: Cable Tray.
13. Section 27 4113: Closed Circuit TV (CCTV) and Audio Surveillance Systems (New Facilities).
14. Section 27 4116: Closed Circuit TV (CCTV) and Surveillance Systems (Existing Facilities).
15. Section 27 1513: Communications Wiring.
16. Section 27 1514: Communications Wiring.
17. Section 27 5115: Public Address and Intercommunication Systems.
18. Section 27 5116: Public Address Systems (Small Gyms, Multipurpose Rooms)(ES).
19. Section 27 5117: Public Address Systems (Auditoriums, Performing Art, M-P Rooms)(MS and HS).
20. Section 27 5118: Public Address Systems (Gymnasiums).
21. Section 27 5119: Public Address Systems (Athletic Fields).
22. Section 27 1515: Television Systems – Coaxial Distribution.
23. Section 27 1516: Television Systems -Fiber Optic Distribution.
24. Section 28 1600: Intrusion Detection Systems.
25. Section 31 2323: Excavation, and fill(Utilities).

D. Acronyms:

dB	Decibel
IDF	Intermediate Distribution Facility
ITD	Information Technology Division
LAN	Local Area Network
LDC	Local Distribution - Classroom
LDF	Local Distribution Facility
MDF	Main Distribution Facility
MPOE	Minimum Point of Entry

NVP	Nominal Velocity of Propagation
OAR	Owner Authorized Representative
PA	Public Address
PBX	Private Branch Exchange
QA	Quality Assurance
UTP	Unshielded Twisted Pair
VoIP	Voice over Internet Protocol
WLAN	Wireless Local Area Network

2.1 SYSTEM REQUIREMENTS

- A. Will be found in Parent Specification.

3.1 SUBMITTALS

- A. Will be found in Parent Specification.

4.1 CODES AND STANDARDS

- A. Telecommunications Industry Association (TIA)/Electronic Industries Association (EIA)-568, Commercial Building Telecommunications Cabling Standard, current issue.
- B. EIA/TIA-569, Commercial Building Standard for Telecommunications Pathways and Spaces.
- C. ANSI/EIA/TIA-598-A, Optical Fiber Cable Color Coding, current issue.
- D. EIA/TIA-606 (2002), Administration Standard for the Telecommunications Infrastructure of Commercial Buildings.
- E. EIA/TIA-607, Commercial Grounding and Bonding Requirements for Telecommunications.
- F. EIA/TIA-OFSTP-14A, Optical Power Loss Measurements of Installed Multimode Fiber Cable Plant.
- G. ANSI/TIA/EIA-758, Customer-Owned Outside Plant Telecommunications Cabling Standard, current issue.
- H. EIA/TIA-OFSTP-7, Optical Power Loss Measurements of Installed Singlemode Fiber Cable Plant.
- I. American National Standards Institute (ANSI)/EIA/TIA-455-59, Field Testing
- J. FCC Part 68.50.
- K. National Electrical Manufacturer's Association (NEMA).
- L. National Fire Protection Association (NFPA), NFPA-70.
- M. CCR Part 3 - California Electrical Code (CEC).
- N. CCR Part 2 - Uniform Building Code (UBC).
- O. Building Industry Consulting Services International (BICSI) TDMM, most recent revision.
- P. Institute of Electrical and Electronic Engineers (IEEE).
- Q. Other Codes and Standards as defined in the Parent Specification.

5.1 SYSTEM DESCRIPTION

- A. System will be found in Parent Specification.

6.1 QUALITY ASSURANCE

- A. Will be found in Parent Specification.

7.1 WARRANTY

- A. Will be found in Parent Specification.

PART 2 - PROCEDURES

1.2 EQUIPMENT INSTALLATION

- A. The Installer is responsible for basic installation and cross connection of LAN equipment required by the Contract Documents. The Owner's Quality Assurance Team shall verify that basic installation is complete and functional.

2.2 PUNCH LIST

- A. Per OAR request, The Owner's Quality Assurance Team shall assist in the Punch List for IT and low voltage systems and provide it to the OAR.

3.2 CLOSEOUT DOCUMENTATION

- A. Will be found in Parent Specification.

4.2 QUALITY ASSURANCE

- A. Owner's Quality Assurance Test Schedule
 - 1. The Project Inspector shall schedule the Owner's Quality Assurance test after review of the Installers complete Test Results of the school.

PART 3 - EXECUTION AND INSTALLATION

1.3 INSTALLATION

- A. Will be found in Parent Specification.

2.3 OWNER'S QUALITY ASSURANCE CERTIFICATION AND TESTING

- A. Will be found in Parent Specification.

3.3 PROJECT RECORD DOCUMENTS

- A. Will be found in Parent Specification.

4.3 PROTECTION

- A. Will be found in Parent Specification.

5.3 CLEANUP

- A. Will be found in Parent Specification.

6.3 OWNER ORIENTATION

- A. Will be found in Parent Specification.

Quality Assurance Guidelines

APPENDIX A - QUALITY ASSURANCE PROCEDURES

A.1 Overview of Quality Testing Procedures

This appendix provides guidelines for visual Quality Assurance reviews of each site. The Owner's Quality Assurance Team shall examine the Work based upon the guidelines outlined in the following appendixes and their associated forms.

1. Communications Cabinet Review. Verify the design and compliance with contract documents. This may include: EIA/TIA and BICSI cabling practices, standard and specific labeling practices, and safe and logical equipment and wire management placement.
2. Cable Plant Review. Cabling from the Communications cabinet, at various points along the cable path, and in functional work areas for compliance with TIA/EIA installation specifications including TIA/EIA-568-B and TIA/EIA-569 and documents referenced therein and professional installation practices.
3. User Work Area Quality Assurance Review. Cabling at the user wall plate location in the functional work areas for compliance with TIA/EIA installation specifications including TIA/EIA-568-B and TIA/EIA-569 and documents referenced therein and professional installation practices.
4. Redline As-Built Documentation shall be compared to physical installation. Deviations shall be noted and the Quality Assurance procedure halted until discrepancies have been rectified.

A.2 General Quality Assurance Guidelines

The Owner's Quality Assurance Team visually reviews the installation to verify that cabling is supported properly. Cable trays or structural ties shall support cable. No cable shall have been installed in pathways near sharp edges or objects that might cause damage. Cable shall not be supported by, on, or attached to a dry wall ceiling, ceiling tiles, ceiling grid, routed over pipes, conduit, lighting fixtures, or other wiring. The Owner's Quality Assurance Team should be able to determine the total number of drops dispersed from each communications cabinet, the number of drops for each supported room, and the agreed-upon labeling scheme for the site. The Installer should have met the following general labeling guidelines:

1. Clearly labeled each drop number and Communications cabinet on the wall jack faceplate.
2. Label each horizontal cable jacket using a permanent label at the workstation end, inside the wall, and the patch panel end no more than two inches from each end.
3. At workstation end: communications cabinet, drop, and termination panel.
4. At patch panel end: drop and cabinet numbers.

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5. Label each patch panel port with drop number and cabinet number.

Because work area room numbers may have been modified since the design, the installer shall provide as built documentation for each communications cabinet; reflecting the room numbers used in the labeling scheme as a reference point. The Contractor and his/her Subcontractor shall use these working prints to produce post-installation as-built drawings.

A.3 Deficiency Reports

Before beginning any test, the Owner's Quality Assurance Team shall view any deficiency report(s) (DR) that have been filed with the OAR and Project Inspector. The Owner's Quality Assurance Team shall review the DR(s) as part of the Quality Assurance review to ensure the required corrective actions have been taken.

A.4 Quality Assurance Test Procedures

The Owner's Quality Assurance Team shall follow the acceptance test and performance criteria outlined in TIA 568B, OFSTP-14A, OFSTP-7 and shall conduct acceptance and performance testing following each manufacturer's specification on their respective network components to verify compliance with manufacturer's installation instructions.

The Owner's Quality Assurance Team shall also follow any specific local policy directives or instructions regarding installation practices and/or acceptance testing identified during the site orientation visit. The details for the design of a particular location shall also comply with any related State, County and Municipal standards.

A.5 Construction Quality Assurance of Work:

During the installation of low voltage systems, upon request by the OAR, the Owner's Quality Assurance Team shall examine the following:

1. General to Low Voltage Systems:
 - a. Conduit and raceway layout and installation for each low voltage system and verify that they meet project specifications.
 - b. Equipment rack installation, including placement in the communications room, seismic bracing, and attachment to the floor.
 - c. Cable punch-downs, patch panel installation, cable cross-connection, cable labeling, and cable bundling.
 - d. Verify proper equipment installation, cable cross connection, system configuration, and testing.
 - e. Verify system layout and device location(s) match the locations shown on the as-builds.

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- f. Active components, terminal cabinets, cross connects, splices, etc. are located in a secure interior location.
 - g. Verification of Uninterruptible power supply performance.
 - h. Verification of proper air conditioning in MDF and IDFs. Room temperature should maintain between 65 - 72 degrees 7 days per week, 24 hours per day.
 - i. Terminations punched down singly and cross-connected on 66 blocks. 66 blocks are primarily used in Public Address systems and Intercom. PBX cable plants are specified to use 110-blocks exclusively.
2. LAN, verify the following:
- a. Examine Category 5e and Category 6a, T568B terminations, including cable end connections at the patch panel and wall drop receptacles.
 - b. Examine fiber terminations and fiber termination boxes.
 - c. Examine Installer's basic network components installation and operation.
 - d. Review customized configuration and test results.
 - e. Test overall network operation to ensure it meets Owner's strategic planning and acceptable performance level.

A.6 Start Up

Start-up work is to be completed as a condition for Substantial Completion. Start-Up is to include the testing and commissioning of equipment and systems.

- 1. After start up has been completed but prior to Substantial Completion, the Project Inspector shall schedule the Owner's Quality Assurance Team site visit.
- 2. The Owner's Quality Assurance Team shall review documentation and test results for completeness.
- 3. The Owner's Quality Assurance Team shall visit the site and verify the Contractor's test results by the Quality Assurance procedures detailed herein.

A.7 Contract Completion and Process Review

The Quality Assurance Team shall review the entire Quality Assurance process and recommend changes to improve it on an as needed basis.

A.8 Test Procedures

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1. Visual Q/A Reviews
 - a. The Owner's Quality Assurance Team shall conduct a visual review of the installation including the communication cabinet, cable runs, and user work areas. Appendix A documents these Q/A review procedures.

2. Cable Performance Testing
 - a. The Owner's Quality Assurance Team shall test 100% of the fiber optic Backbone cable, a random sample of Category 5e and Category 6a UTP cable and the fiber optic Horizontal cable. Appendix C outlines these specific tests.
 - (1) Test Cable Sampling: The Owner's Quality Assurance Team shall randomly test 10% of installed horizontal cables from each communication cabinet on site. For example, if a communications cabinet has 100 drops, the Owner's Quality Assurance Team shall test a minimum of 10 drops for each cabinet. Where random testing shows a failure rate of more than 1% of the drops (2 in 10 of the random sample), an additional 10% of the installed horizontal cabling shall be tested. Appendix B outlines these specific tests.
 - (2) Cable Testing: The Owner's Quality Assurance Team shall perform the following industry-standard operational and performance cable testing detailed in TIA/EIA 568B.1:
 - (a) Wire map
 - (b) Length verification
 - (c) Insertion loss (attenuation)
 - (d) Near-end crosstalk (NEXT)
 - (e) Power sum near-end crosstalk (PSNEXT)
 - (f) Equal level far-end crosstalk (ELFEXT)
 - (g) Power sum equal level far-end crosstalk (PSELFEXT)
 - (h) Return loss
 - (i) Propagation delay
 - (j) Delay skew

3. Network Equipment Testing

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- a. The Owner's Quality Assurance Team shall perform network tests on hardware components for proper installation, per manufacturer's recommendations and configuration. Components shall be tested separately for initial power up and their ability to maintain system configuration. The specific test for network equipment components is described in Appendix D.

A.9 Acceptance Criteria

1. An overall Pass or Fail condition shall be determined by the results of the required individual test. Any Fail and Fail* shall result in an overall Fail. In order to achieve an overall Pass condition, individual results shall be Pass or Pass*. A Pass or Fail result for each parameter is determined by the allowable limits for that parameter. The test result of a parameter is marked with an asterisk (*) when the result is closer to the test limit than the accuracy of the field tester. The field tester manufacturer shall provide documentation as an aid to interpret results marked with asterisks.
2. Cable plant acceptance by the Owner requires 100% passing results for cable samples and corrected cabling deficiencies. Acceptance of other components is based upon satisfactory completion of a test configuration scenario, as defined in the appropriate appendix to this plan.

A.10 Corrective Procedures

1. EIA/TIA testing specification details a pass/fail criterion, i.e., if a fiber optic cable is outside of specifications, the test fails, The Owner's Quality Assurance Team shall identify any deficiencies found during Quality Assurance (e.g., a cable or component failing a test) to site personnel before the Owner's Quality Assurance Teams departure and shall document these deficiencies in the Quality Assurance Report. If the link attenuation for any fiber optic cable strand is outside acceptable loss as specified in TIA/EIA-568-B, the Installer shall re-complete the terminations required to reduce the amount of attenuation. If re-termination fails, the Installer shall be required to take steps up to and including the replacement of the cable to eliminate the testing deficiency. After corrective action, the Owner's Quality Assurance Team shall retest repaired fiber runs and document the results in the Quality Assurance Report.
2. The Owner's Quality Assurance Team shall identify to the Owner in writing any deviation from acceptable EIA/TIA specifications for cabling resulting in a test failure. The Owner may choose to accept the deficiency via a written waiver. For example, if a fiber optic connection exceeds the allowable termination attenuation by 0.1 decibels (dB), but the total link attenuation is within the length attenuation budget, the Owner may choose to waive the specification. Other components (e.g., switches or routers) must function according to the specified configurations in the final Work Plan for Owner LAN projects.

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A.11 Quality Assurance Reporting

1. Acceptance Recommendation
 - a. At the conclusion of testing, the Owner's Quality Assurance Team shall provide a recommendation to Owner to accept or not accept the installation.

2. Quality Assurance Report
 - a. The Owner's Quality Assurance Team shall deliver a Quality Assurance Report to the project OAR no later than seven (7) working days after completion of testing. This report shall include:
 - (1) A written test report for visual installation tests.
 - (2) Electronic test results of cable testing including verified cable lengths, test personnel, test date, and individual test description.
 - (3) Each detected deficiency with its correction date and retest results, if accomplished.
 - (4) Network operational test results for the switch(s) and router connections.
 - (5) Any condition(s) precluding strict adherence to NEC, EIA/TIA, and BICSI installations or Quality Assurance standards shall be marked for potential Owner waiver before system acceptance.
 - (6) A summary confirming the acceptance recommendation given.

A.12 Test Equipment

1. The Owner's Quality Assurance Team shall use the following test equipment or their equivalent during testing.
 - a. Fluke DSP 4300 Level III, or equal, tester with single-mode and multi-mode power meter and light source heads.
 - b. Fluke Optifiber Optical Time Domain Reflectometer (OTDR)
 - c. Personal computer with Transmission Control Protocol/Internet Protocol (TCP/IP) protocol stacks.
 - d. Thermometer

Quality Assurance Guidelines

Table 2.6.1 T & A Checklist for Owner’s Quality Assurance Team Projects

Site Location Code / Name _____ OAR _____

Network Engineer _____ Inspector _____

OAR Recommendation _____ Electrical Inspector _____

Review Item	Yes	No	N/A	Pass/Fail
Have deficiencies been cleared by the Project Inspector or OAR?				
Has the vendor provided cable charts in the cabinets?				
Are there any horizontal cables over 90m?				
Do the cable runs used agree with the cable routing drawings?				
Are the cables routed and terminated per specification?				
Are cable run penetrations terminated to preclude strain on the installed cable?				
Are the copper and fiber optic cables installed per the manufacturer’s recommendation?				
Is each cable clearly labeled at the user’s location?				
Is each port on the patch panel labeled with the corresponding user outlet location?				
Are cable and patch panel labels securely fastened and easily readable?				
Are the fiber cables in the fiber termination box labeled per the approved labeling scheme and immediately adjacent to each termination within the fiber termination box?				
Is the cable for each drop identified with the correct labeling scheme at or near the point of termination?				
Does the user outlet plate display the correct labeling scheme and match the distant end label?				
Are connectors free of exposed metal, loose connectors, or other problems?				
Is the cable jacket stripped back only as far as required to terminate on connecting hardware?				
Is the physical plant installed in accordance with specifications of this project?				
For traditional, hierarchical star cable plants following 25568 specifications, are there at least 50% spare Backbone strands, in multiples of 6 strands, to each IDF from the MDF ?				
For new fiber optics cable plant installations following 25569				

Quality Assurance Guidelines

specifications, are there at least 15 percent spare Backbone strands, in multiples of 6 strands, to each IDF from the MDF ?				
Does this site have an existing Local Area Network?				
Is the T1 line correctly installed and ready to cut over? Also, has the extension to the MDF been installed?				
Will the site reutilize an existing router? If yes, specify exact model / serial number.				
Is the router configured and ready for cut over?				
Are the required amounts of GB Uplinks provided to accommodate the equipment installed including port expansion?				
Are classroom and administration switches mounted, connected, and operational?				
Has the vendor provided inventory and the drop count been verified or has an Inventory document been completed? If so, please attach.				

A.13 Visual Q/A Review Worksheets

The following pages provide the three visual Quality Assurance worksheets:

1. Communications Cabinet Quality Assurance Review Form
2. Cable Routing Quality Assurance Review Form
3. User Work Area Quality Assurance Review Form

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A.13.1 Communications Enclosure Quality Assurance Review Form

Site _____ Date _____ Quality Assurance Rep(s) _____

Q/A REVIEW ITEM	PASS	FAIL
Is the cabinet ready for a Q/A review? If not, list discrepancies (e.g., debris, punch- list, or un-terminated cable).		
Is the installation performed in the planned communications cabinet?		
Are there clearly identified final or redlined drawings showing the “as-built” installation?		
With all devices operating, are ambient cabinet and room temperatures within 50-80° F? The temperature is: _____.		
Are heating, ventilation, and air conditioning (HVAC), lighting, and electrical outlets installed per contract? Are the requirements addressed in the Site Concurrence Memorandum or other documentation?		
Are cabinet rails and wire managers installed so as to preclude any space problems with the UPS?		
Are the cabinets seismically braced to the floor and/or wall?		
Is there adequate space around the racks and fiber termination panel for maintenance?		
Are patch panels, wire management panels, and network equipment properly affixed to the rack?		
Is debris cleaned from inside of cabinets?		
Are cable run penetrations installed so fire barriers are maintained in cabinet locations?		
Are cable run penetrations properly and securely fastened to supporting structures?		
Are cable run penetrations terminated to preclude strain on the installed cable in cabinet locations?		
Are cables routed and punched per specification and industry standards?		
Is each cable clearly labeled with the corresponding user location per specification?		
Is each port on the patch panel labeled with the corresponding user location per specification?		
Are cable and patch panel labels securely fastened and easily readable per specification?		
Is there ½-inch or less of untwisting on any cable pair at the termination point?		
Is the UTP cable jacket stripped back only as far as required to terminate on connecting hardware?		
Is a bend radius of at least 1-inch maintained for sheathed UTP cable?		
Is the fiber optic cable free from excessive strain or stress, sharp bends, or kinks?		
Are service loops in place at each end of the cable?		
Are the fiber cables in the fiber termination unit? Is the box labeled per the approved labeling scheme and immediately adjacent to each termination within the fiber termination		

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box?		
Is excess fiber optic cable coiled in the termination box so it does not exceed the minimum bend radius per manufacturer's recommendations and specifications?		
Are fiber optic patch cords neatly routed to the network equipment via wire management?		

A.13.2 Cable Routing Q/A Form

Site _____ Date _____ Q/A Rep(s) _____

Q/A REVIEW ITEM	PASS	FAIL
Are cable bundles either secured to the wall or to a non-electromagnetic interference-producing source or hung from the ceiling (e.g., suspended via cable trays, inner duct, J-hooks, D-rings, or ladder rack) per specification or best industry standards?		
Do the cable runs used agree with the redline drawings?		
If not, are accurate redlined drawings available showing the cable routing?		
Is debris from the cable run penetrations adequately cleaned up per specification?		
Is the fiber optic cable runs completely contained within inner duct? Where?		
Notes:		

Quality Assurance Guidelines

A.13.3 User Work Area Q/A Review Form

Site _____ Date _____ Q/A Rep(s) _____

Q/A REVIEW ITEM	PASS	FAIL
Are wall jack faceplates professionally installed and finished?		
Is cabling precluded from view on the external surface of walls (e.g., ducting used on solid core walls)?		
Does the user outlet plate display the correct labeling scheme?		
Is the cable for each drop identified with the correct labeling scheme and within 2 inches of termination per specification?		
Is the cable installed in a manner that precludes cable strain?		
Are connectors insulated from surrounding cable and objects (e.g., are cable barrel adapters, connectors, devices, and terminators insulated from any earth ground or current-conducting surfaces of the building structure)?		
Are connectors free of exposed metal, loose connectors, or other problems?		
Is there ½-inch or less of untwisting on any cable pair at the termination point?		
Is the cable jacket stripped back only as far as required to terminate on connecting hardware?		
Is a bend radius of at least 1-inch maintained for sheathed UTP cable?		
Is the 4 or 6 strand fiber secured properly in the LDFs and LDCs?		
Notes:		

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APPENDIX B - CATEGORY 5E AND CATEGORY 6 UTP CABLE PERFORMANCE TESTS

B.1 Overview of Cable Tests

This appendix provides guidelines for electronic testing of Horizontal Category 5e UTP wiring. The Owner's Quality Assurance Team shall meet the guidelines outlined in the following Q/A review and its associated forms.

- **Electronic Testing.** This testing verifies that the standard performance parameters for the UTP cable as outlined in TIA/EIA 568-B are within the specifications as noted below. TIA/EIA 568-B addresses specific field-tests for post-installation performance measurements of the designed cable plants. Owner only uses Category 5e, or Category 6a UTP cables for its LAN installations. Refer to Premise Wiring Specification.

B.2 Test and Support Equipment

1. The types of cable to be tested are as follows :
 - a. Category 5E UTP shall be tested based on TIA/EIA 568-B.1 section 11.2.3 specifications
 - b. Category 6a UTP shall be tested based on TIA/EIA 568-B.2-1

Note: Sections B2 through B6 address Category 5E related tests, requirements, and specifications. Sections B7 through B11 address Category 6a related tests, requirements, and specifications.

B.3 Electronic Tests

The Owner's Quality Assurance Team randomly selects cables for testing and every effort shall be made to avoid a typical testing pattern from communications cabinet to work area outlet, so that no testing pattern is discernible. The testing personnel shall inspect drops on the faceplate in multiple cases to ensure cables are labeled and no cross connects are visible, etc. The testing personnel shall perform a Q/A review of the cable termination(s) in the Communications cabinet(s) and the corresponding user location of selected cables (e.g., the faceplate labels or terminations behind the termination panel). The personnel must be consistent in testing selected cables.

The *permanent* link test configurations described in TIA/EIA 568-B.1 section 11.2.4.1, performance parameters include wire map, length, Insertion loss (attenuation), NEXT, PSNEXT, ELFEXT, PSELFEXT, Return loss, Propagation delay and Delay Skew for 100 W 4-pair Category 5e cabling. 568-B.1 section 11.2.4.3 thru .11 identifies acceptable ranges of test results, test equipment checks, diagnostic information, and specific test procedures.

TIA/EIA 568-B.1 section 11.2.4.1, also specifies laboratory measurement methods, component and field test methods and computation algorithms over the specified frequency range. To ensure verifiable equipment calibration, the Owner's Quality

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Assurance Team shall certify test equipment accuracy in compliance with 568-B.1 section 11.2.4.3 thru .10 each time a new list of tests is performed.

The Owner's Quality Assurance Team shall consider cable(s) and cabling components as pre-tested by the manufacturer to meet TIA/EIA-568-B Category 5e specifications. Therefore, individual testing of connectors and other cabling components is not required.

B.4 Data Accuracy

Tests shall be conducted on the premise that TIA/EIA-568-B and other applicable specifications were applied to the cable installation. Further, the Owner's Quality Assurance Team shall be provided the test result book to verify the Installer tested 100 percent of their work, so the sampling tests performed ensures system operability and customer satisfaction.

B.5 Data and Test Reporting

The Quality Assurance Report shall clearly identify the test environment, test equipment used, name of each tester, acceptable results (as specified in 568-B), and actual results for each test performed. If a failure occurs, the test shall proceed, with the failure reported to the responsible Installer for repair at test end.

B.6 Communications Wiring Electrical Tests

B.6.1 Wire Map

Wire Map shall report Pass if the wiring of each wire-pair from end to end is determined to be correct. The Wire Map results shall include the continuity of the shield connection if present.

B.6.2 Length

The field tester shall be capable of measuring length of all pairs of a permanent link or channel based on the propagation delay measurement and the average value for Nominal Velocity of Propagation (1). The physical length of the link shall be calculated using the pair with the shortest electrical delay.

This length figure shall be reported and shall be used for making the Pass/Fail decision. The Pass/Fail criteria are based on the maximum length allowed for the Permanent Link configuration (90 meters – 295 feet) plus 10% to allow for the variation and uncertainty of NVP.

B.6.3 Insertion Loss (Attenuation)

Insertion Loss is a measure of signal loss in the permanent link or channel. The term "Attenuation" has been used to designate "Insertion Loss." Insertion Loss shall be tested from 1 MHz, through the highest applicable frequency. It is preferred to measure insertion loss at the same frequency intervals as NEXT

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Loss in order to provide a more accurate calculation of the Attenuation-to-Crosstalk ratio (ACR) parameter.

Minimum test result documentation (summary results): Identify the worst wire pair (1 of 4 possible). The test results for the worst wire pair must show the highest attenuation value measured (worst case), the frequency at which this worst case value occurs, and the test limit value at this frequency.

B.6.4 NEXT Loss

Pair-to-pair near-end crosstalk loss (abbreviated as NEXT Loss) shall be tested for each wire pair combination from each end of the link (a total of 12 pair combinations). This parameter is to be measured from 1 through the highest applicable frequency. NEXT Loss measures the crosstalk disturbance on a wire pair at the end from which the disturbance signal is transmitted (near-end) on the disturbing pair. The maximum step size for NEXT Loss measurements shall not exceed the maximum step size defined in the draft standard as shown in Table 1, column 2.

Minimum test results documentation (summary results): Identify the wire pair combination that exhibits the worst case NEXT margin (2) and the wire pair combination that exhibits the worst value of NEXT (worst case).

Table 1

Frequency (MHZ)	Range	Maximum Step Size (MHz)
1 – 31.25		0.15
31.26 – 100		0.25
100 – 250		0.50

NEXT is to be measured from each end of the link-under-test. These wire pair combinations must be identified for the tests performed from each end. Each reported case shall include the frequency at which it occurs as well as the test limit value at this frequency.

B.6.5 PSNEXT Loss

Power Sum NEXT Loss shall be evaluated and reported for each wire pair from both ends of the link-under-test (a total of 8 results). PSNEXT Loss captures the combined near-end crosstalk effect (statistical) on a wire pair when other pairs actively transmit signals. Like NEXT this test parameter must be evaluated from 1 MHz through the highest applicable frequency and the step size may not exceed the maximum step size defined in the draft standard as shown in Table 1, column 2.

Minimum test result documentation (summary results): Identify the wire pair that exhibits the worst case margin and the wire pair that exhibits the worst

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value for PSNEXT. These wire pairs must be identified for the tests performed from each end. Each reported case shall include the frequency at which it occurs as well as the test limit value at this frequency.

B.6.6 ELFEXT Loss, pair-to-pair

Pair-to-pair FEXT Loss shall be measured for each wire-pair combination from both ends of the link under test. FEXT Loss measures the crosstalk disturbance on a wire pair at the opposite end (far-end) from which the transmitter emits the disturbing signal on the disturbing pair. FEXT is measured to compute ELFEXT Loss that must be evaluated and reported in the test results. ELFEXT measures the relative strength of the far-end crosstalk disturbance relative to the attenuated signal that arrives at the end of the link. This test yields 24 wire pair combinations. ELFEXT is to be measured from 1 through the highest applicable frequency and the maximum step size for FEXT Loss measurements shall not exceed the maximum step size defined in the draft standard as in Table 1, column 2. Minimum test result documentation (summary results): Identify the wire pair combination that exhibits the worst-case margin and the wire pair combination that exhibits the worst value for ELFEXT. These wire pairs must be identified for the tests performed from each end. Each reported case shall include the frequency at which it occurs as well as the test limit value at this frequency.

B.6.7 PSELFEXT Loss

Power Sum ELFEXT is a calculated parameter that combines the effect of the FEXT disturbance from three wire pairs on the fourth one. This test yields 8 wire-pair combinations.

Each wire-pair is evaluated from 1 MHz through the highest applicable frequency in frequency increments that do not exceed the maximum step size defined in the draft standard as shown in Table 1, column 2.

Minimum test result documentation (summary results): Identify the wire pair that exhibits the worst case margin and the wire pair that exhibits the worst value for PSELFEXT. These wire pairs must be identified for the tests performed from each end. Each reported case shall include the frequency at which it occurs as well as the test limit value at this frequency.

B.6.8 Return Loss

Return Loss (RL) measures the total energy reflected on each wire pair. Return Loss is to be measured from both ends of the link-under-test for each wire pair. This parameter is also to be measured from 1 through the highest applicable frequency in increments that do not exceed the maximum step size defined in the draft standard as shown in Table 1, column 2.

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Minimum test result documentation (summary results): Identify the wire pair that exhibits the worst case margin and the wire pair that exhibits the worst value for Return Loss. These wire pairs must be identified for the tests performed from each end. Each reported case shall include the frequency at which it occurs as well as the test limit value at this frequency.

B.6.9 Propagation Delay

Propagation delay is the time required for the signal to travel from one end of the link to the other.

This measurement is to be performed for each of the four wire pairs.

Minimum test result documentation (summary results): Identify the wire pair with the worst case propagation delay. The report shall include the propagation delay value measured as well as the test limit value.

B.6.10 Delay Skew

This parameter shows the difference in propagation delay between the four wire pairs.

Minimum test result documentation (summary results): Identify the wire pairs with the worst-case propagation Delay skew. The report shall include the Delay skew value measured as well as the test limit value.

B.6.11 ACR (Attenuation to crosstalk ratio)

This parameter is not required by TIA standards but may be expected in order to obtain the premise wiring manufacturer's warranty.

ACR provides an indication of bandwidth for the two wire-pair network applications. ACR is a computed parameter that is analogous to ELFEXT and expresses the signal to noise ratio for a two wire-pair system. This calculation yields 12 combinations – six from each end of the link. Minimum test result documentation (summary results): Identify the wire pair combination that exhibits the worst-case margin and the wire pair combination that exhibits the worst value for ACR. These wire pair combinations must be identified for the tests performed from each end. Each reported case shall include the frequency at which it occurs as well as the test limit value at this frequency.

B.6.12 PSACR

This parameter is not required by TIA standards but may be required in order to obtain the premise wiring vendor's warranty. The Power Sum version of ACR is based on PSNEXT and takes into account the combined NEXT disturbance of adjacent wire pairs on each individual pair. This calculation yields 8 combinations – one for each wire pair from both ends of the link.

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Minimum test result documentation (summary results): Identify the wire pair that exhibits the worst case margin and the wire pair that exhibits the worst value for PSACR. These wire pairs must be identified for the tests performed from each end. Each reported case shall include the frequency at which it occurs as well as the test limit value at this frequency.

B.7 Communications Wiring Electrical Test Form

Site _____ Date _____ Q/A Rep(s) _____
Building and Communications Room Numbers _____

MICROTEST SAVE ID	CABLE TESTED ROOM/DROP #	PASS/ FAIL	COMMENTS – IF FAILED (Wire Map, Length, Attenuation, Continuity, or NEXT Tests)

B.8 Electronic Tests

The Owner's Quality Assurance Team randomly selects cables for testing and every effort shall be made to avoid a typical testing pattern from communications cabinet to work area outlet, so that no testing pattern is discernible. The testing personnel shall inspect drops on the faceplate in multiple cases to ensure cables are labeled and no cross connects are visible, etc. The testing personnel shall perform a Q/A review of the cable termination(s) in the Communications cabinet(s) and the corresponding user location of selected cables (e.g., the faceplate labels or terminations behind the termination panel). The personnel must be consistent in testing selected cables.

The *permanent* link test configurations described in TIA/EIA 568-B.2-1, performance parameters include wire map, length, Insertion loss (attenuation), NEXT, PSNEXT, ELFEXT, PSELFEXT, Return loss, Propagation delay and Delay Skew for 100 W 4-pair Category 6a cabling. 568-B.2 identifies acceptable ranges of test results, test equipment checks, diagnostic information and specific test procedures as related to Category 6a cabling. TIA/EIA 568-B.2-1 also includes laboratory measurement methods, component and field test methods, and computation algorithms over the specified frequency range. The test equipment (tester) shall comply with the accuracy requirements for level III field testers as defined in TIA/EIA 568-B.2-1. The tester including the appropriate interface adapter must meet the specified accuracy requirements. The accuracy requirements for the permanent link test configuration (baseline accuracy *plus* adapter contribution) are specified in Table B.2 of Annex B of the TIA/EIA 568-B.2-1 standard. (Table B.3 in this TIA document specifies the accuracy requirements for the Channel configuration.)

The Owner's Quality Assurance Team shall consider cable(s) and cabling components as pre-tested by the manufacturer to meet TIA/EIA-568-B.2-1 Category 6a specifications. Therefore, individual testing of connectors and other cabling components is not required.

B.9 Data Accuracy

Tests shall be conducted on the premise that TIA/EIA-568-B.2 and other applicable specifications were applied to the cable installation. Further, the Owner's Quality Assurance Team shall be provided the test result book to verify the Installer tested 100 percent of their work, so the sampling tests performed ensures system operability and customer satisfaction. The tester interface adapters must be of high quality and the cable shall not show any twisting or kinking resulting from coiling and storing of the tester interface adapters. In order to deliver optimum accuracy, preference is given to a permanent link interface adapter for the tester that can be calibrated to extend the reference plane of the Return Loss measurement to the permanent link interface. The contractor shall provide proof that the interface has been calibrated within the period recommended by the vendor. To ensure that normal handling on the job does not cause measurable Return Loss change, the adapter cord cable shall not be of twisted-pair construction.

B.10 Data and Test Reporting

The Quality Assurance Report shall clearly identify the test environment, test equipment used, name of each tester, acceptable results (as specified in 568-B Category 6a related), and actual results for each test performed. If a failure occurs, the test shall proceed, with the failure reported to the responsible Installer for repair at test end.

B.11 Communications Wiring Electrical Tests

The test parameters for Category 5e and Category 6a are defined in TIA/EIA-568-B.2 standard. The test of each link shall contain of the following parameters as detailed below. In order to pass the test, measurements (at each frequency in the range from 1 MHz through 350 MHz) must meet or exceed the limit value determined in the above-mentioned standard.

B.11.1 Wire Map

Wire Map shall report Pass if the wiring of each wire-pair from end to end is determined to be correct. The Wire Map results shall include the continuity of the shield connection if present.

B.11.2 Length

The field tester shall be capable of measuring length of pairs of a permanent link or channel based on the propagation delay measurement and the average value for Nominal Velocity of Propagation. The physical length of the link shall be calculated using the pair with the shortest electrical delay.

This length figure shall be reported and shall be used for making the Pass/Fail decision. The Pass/Fail criteria are based on the maximum length allowed for the Permanent Link configuration (90 meters – 295 feet) plus 10% to allow for the variation and uncertainty of NVP.

B.11.3 Insertion Loss (Attenuation)

Insertion Loss is a measure of signal loss in the permanent link or channel. The term “Attenuation” has been used to designate “Insertion Loss.” Insertion Loss shall be tested from 1 MHz, through the highest applicable frequency. It is preferred to measure insertion loss at the same frequency intervals as NEXT Loss in order to provide a more accurate calculation of the Attenuation-to-Crosstalk ratio (ACR) parameter.

Minimum test result documentation (summary results): Identify the worst wire pair (1 of 4 possible). The test results for the worst wire pair must show the highest attenuation value measured (worst case), the frequency at which this worst case value occurs and the test limit value at this frequency.

B.11.4 NEXT Loss

Pair-to-pair near-end crosstalk loss (abbreviated as NEXT Loss) shall be tested for each wire pair combination from each end of the link (a total of 12 pair

combinations). This parameter is to be measured from 1 through the highest applicable frequency. NEXT Loss measures the crosstalk disturbance on a wire pair at the end from which the disturbance signal is transmitted (near-end) on the disturbing pair. The maximum step size for NEXT Loss measurements shall not exceed the maximum step size defined in the draft standard as shown in Table 2, column 2.

Minimum test results documentation (summary results): Identify the wire pair combination that exhibits the worst case NEXT margin (2) and the wire pair combination that exhibits the worst value of NEXT (worst case).

Table 2

Frequency Range (MHZ)	Maximum Step Size (MHz)
1 – 31.25	0.15
31.26 – 100	0.25
100 – 250	0.50
250-350	1.00

NEXT is to be measured from each end of the link-under-test. These wire pair combinations must be identified for the tests performed from each end. Each reported case shall include the frequency at which it occurs as well as the test limit value at this frequency.

B.11.5 PSNEXT Loss

Power Sum NEXT Loss shall be evaluated and reported for each wire pair from both ends of the link-under-test (a total of eight results). PSNEXT Loss captures the combined near-end crosstalk effect (statistical) on a wire pair when other pairs actively transmit signals. Like NEXT this test parameter must be evaluated from 1 MHz through the highest applicable frequency and the step size may not exceed the maximum step size defined in the draft standard as shown in Table 2, column 2.

Minimum test result documentation (summary results): Identify the wire pair that exhibits the worst case margin and the wire pair that exhibits the worst value for PSNEXT. These wire pairs must be identified for the tests performed from each end. Each reported case shall include the frequency at which it occurs as well as the test limit value at this frequency.

B.11.6 ELFEXT Loss, pair-to-pair

Pair-to-pair FEXT Loss shall be measured for each wire-pair combination from both ends of the link under test. FEXT Loss measures the crosstalk disturbance on a wire pair at the opposite end (far-end) from which the transmitter emits the disturbing signal on the disturbing pair. FEXT is measured to compute ELFEXT Loss that must be evaluated and reported in the test results. ELFEXT measures the relative strength of the far-end crosstalk disturbance relative to the attenuated signal that arrives at the end of the link. This test yields 24 wire

pair combinations. ELFEXT is to be measured from 1 through the highest applicable frequency and the maximum step size for FEXT Loss measurements shall not exceed the maximum step size defined in the draft standard as in Table 2, column 2.

Minimum test result documentation (summary results): Identify the wire pair combination that exhibits the worst-case margin and the wire pair combination that exhibits the worst value for ELFEXT. These wire pairs must be identified for the tests performed from each end. Each reported case shall include the frequency at which it occurs as well as the test limit value at this frequency.

B.11.7 PSELFEXT Loss

Power Sum ELFEXT is a calculated parameter that combines the effect of the FEXT disturbance from three wire pairs on the fourth one. This test yields 8 wire-pair combinations.

Each wire-pair is evaluated from 1 MHz through the highest applicable frequency in frequency increments that do not exceed the maximum step size defined in the draft standard as shown in Table 2, column 2.

Minimum test result documentation (summary results): Identify the wire pair that exhibits the worst case margin and the wire pair that exhibits the worst value for PSELFEXT. These wire pairs must be identified for the tests performed from each end. Each reported case shall include the frequency at which it occurs as well as the test limit value at this frequency.

B.11.8 Return Loss

Return Loss (RL) measures the total energy reflected on each wire pair. Return Loss is to be measured from both ends of the link-under-test for each wire pair. This parameter is also to be measured from 1 through the highest applicable frequency in increments that do not exceed the maximum step size defined in the draft standard as shown in Table 2, column 2.

Minimum test result documentation (summary results): Identify the wire pair that exhibits the worst case margin and the wire pair that exhibits the worst value for Return Loss. These wire pairs must be identified for the tests performed from each end. Each reported case shall include the frequency at which it occurs as well as the test limit value at this frequency.

B.11.9 Propagation Delay

Propagation delay is the time required for the signal to travel from one end of the link to the other.

This measurement is to be performed for each of the four wire pairs.

Minimum test result documentation (summary results): Identify the wire pair with the worst case propagation delay. The report shall include the propagation delay value measured as well as the test limit value.

B.11.10 Delay Skew

As defined in TIA/EIA-568-B.1; Section 11.2.4.11, this parameter shows the difference in propagation delay between the four wire pairs. The pair with the shortest propagation delay is the reference pair with a delay skew value of zero.

Minimum test result documentation (summary results): Identify the wire pairs with the worst-case propagation Delay skew. The report shall include the Delay skew value measured as well as the test limit value.

B.11.11 ACR (Attenuation to crosstalk ratio)

This parameter is not required by TIA standards but may be expected in order to obtain the premise wiring manufacturer's warranty.

ACR provides an indication of bandwidth for the two wire-pair network applications. ACR is a computed parameter that is analogous to ELFEXT and expresses the signal to noise ratio for a two wire-pair system. This calculation yields 12 combinations – six from each end of the link. Minimum test result documentation (summary results): Identify the wire pair combination that exhibits the worst-case margin and the wire pair combination that exhibits the worst value for ACR. These wire pair combinations must be identified for the tests performed from each end. Each reported case shall include the frequency at which it occurs as well as the test limit value at this frequency.

B.11.12 PSACR

This parameter is not required by TIA standards but may be required in order to obtain the premise wiring vendor's warranty. The Power Sum version of ACR is based on PSNEXT and takes into account the combined NEXT disturbance of adjacent wire pairs on each individual pair. This calculation yields 8 combinations – one for each wire pair from both ends of the link.

Minimum test result documentation (summary results): Identify the wire pair that exhibits the worst case margin and the wire pair that exhibits the worst value for PSACR. These wire pairs must be identified for the tests performed from each end. Each reported case shall include the frequency at which it occurs as well as the test limit value at this frequency.

APPENDIX C - FIBER OPTIC CABLE PERFORMANCE TESTS

C.1 Overview of Cable Tests

TIA/EIA-568-B.3 states, “The optical fiber cable construction shall consist of 50/125 mm or 62.5/125 mm multimode optical fibers or single mode optical fibers, or a combination of these media.” Multimode fiber shall have a graded-index optical fiber waveguide with nominal 50/125 μm for installations following specification 27 1514, or 62.5/125 μm core/ cladding diameter for installations following specification 27 1513. Primary and secondary backbone cable testing shall be equivalent to backbone cabling as defined in TIA/EIA-568-B.1 section 11.3.3, such as cabling interconnecting telecommunications closets, equipment cabinets, and entrance facilities. Therefore, the Owner’s Quality Assurance Team shall perform the following interrelated tests:

1. Verification of multi-mode fiber optic cable installations.
2. Verification of single-mode fiber optic cable installations.
3. Electronic measurement of the distance and equivalent attenuation per kilometer (km) to verify minimum data transmission capacity per specification.
4. Total link attenuation measurements.

C.2 Test Equipment

The following test equipment shall be used:

1. Fluke DSP 4300 Level III, or equal, tester with single mode and multi-mode power meter and light source heads
2. Fluke, or equal, OptiFiber Optical Time Domain Reflectometer (OTDR)

C.2.1 Cabling Distance

Section 27 1513 states that the maximum allowable multimode cable distance from MDF to IDF is 450 meters. The Multimode strands shall primarily be utilized by the network electronics up to 450 meters and testing shall conform to OFSTP-14A. The Singlemode strands shall be required where cabling the Backbone distance exceeds 450 meters and testing shall conform to OFSTP-7.

C.2.2 Cable Attenuation

The list below details the information presented in TIA/EIA – 568B.3 to illustrate the allowable attenuation per kilometer for 50/125, 62.5/125 and 9 μm fiber.

Table C.2.2-1. Maximum Cable Attenuation Coefficient for Backbone Fiber

MAXIMUM ATTENUATION RANGE	ALLOWABLE ATTENUATION
50/125 μm @ 850nm	3.5 dB/km

50/125 μm @ 1300nm	1.5 dB/km
62.5/125 μm @ 850nm	.5 dB/km
62.5/125 μm @ 1300nm	.5 dB/km
9 μm @ 1310 nm (indoor)	1 dB/km
9 μm @ 1550 nm (indoor)	1 dB/km
9 μm @ 1310 nm (indoor)	1 dB/km
9 μm @ 1550 nm (indoor)	1 dB/km

C.2.3 Connector Attenuation

Per ANSI/EIA/TIA-455-59, the maximum optical attenuation per connector pair shall not exceed 0.75 dB.

C.3 Test Procedures

For multi-mode fiber the Owner's Quality Assurance Team shall use the Omni Scanner 2 to test the length and total attenuation at both the 850 nm and 1300 nm wavelengths in each direction (bi-directionally). If the test fails, the Owner's Quality Assurance Team shall complete a repeat test using the OTDR to assess the failure point and address corrective actions. (See Methods A and B attached.)

For single-mode fiber, the Owner's Quality Assurance Team shall use a power meter and light source. The specific nanometer wavelength(s) at which the single-mode fiber shall be tested (i.e., 1310 nm and/or 1550 nm) shall be determined based on the length of the fiber cable being tested.

C.3.1 Cable Distance

Using the Omni Scanner 2 or OTDR, the Owner's Quality Assurance Team shall determine the overall fiber optic cable length to ensure the cabling distance is within the maximum allowable length.

C.3.2 Attenuation

TIA/EIA-568-B.1 section 11.3.3, states, "When installing components compliant with this standard, the single performance parameter necessary for performance testing is link attenuation." Also "The backbone optical fiber cabling link segment should be tested in one direction at both operating wavelengths, to account for attenuation deltas associated with wavelength.

1. 50/125 μm backbone links shall be tested at 850 and 1300 nm in accordance with ANSI/EIA/TIA-526-14-A, Method B, with One "Reference Jumper."
2. 62.5/125 μm backbone links shall be tested at 850 and 1300 nm in accordance with ANSI/EIA/TIA-526-14-A, Method B, with One "Reference Jumper."
3. 9 μm backbone links shall be tested at 1310 and 1550 nm in accordance with ANSI/EIA/TIA-526-7, Method A.1."

The Owner's Quality Assurance Team shall use the Omni Scanner 2 or OTDR to measure the attenuation due to fiber optic cable and connectors. The Owner's Quality Assurance Team shall test and record attenuation at both 850nm/1300nm for each Multi-mode and 1310nm/1550nm for Single-mode fiber optic strand respectively terminated under this initiative. These tests shall be performed at each communications cabinet and from the MDF cabinet, as required.

C.3.3 Information Transmission Capacity

The fiber optic cable is assumed to be within the allowable attenuation per kilometer as specified in TIA/EIA-568-B.1 section 11.3.3.4. The Owner's Quality Assurance Team shall presume the transmission capacity of the cable is within specification.

C.4 Data Reporting and Accuracy

The Owner's Quality Assurance Team shall report loss measurement results, with locations and wavelength identifications, to the Owner in accordance with EIA/TIA OFSTP-14 and OFSTP-

Figure C - Testing Methods A, B and Adaptive B

1. Diagrams and Explanations for testing

C.5 Fiber Optic Cable Installation Test Forms

The following pages provide the two fiber optic cable installation test forms:

1. Fiber Optic Cable Installation Test Form—OTDR
2. Fiber Optic Cable Installation Test Form—Power Meter and Light Source

Figure C - Method A, Method B and Adapted Method B Explained Solution

The testing of premises fiber optic cabling links requires precise methods for referencing to obtain accurate and valid test results. Loss testing for multimode fiber cabling is specified in ANSI/TIA/EIA-526-14A. This standard contains two test procedures: Method A and Method B. This article describes Methods A and B, and explains why Method B is the proper method for testing fiber links contained in premises networks.

This article also proposes a new test procedure as an adaptation to Method B to overcome some disadvantages associated with Method B. This new test procedure is the preferred method because it provides results conforming to Method B while offering installers more flexibility for testing fiber links with types of connectors, including Small Form Factor (SFF) connectors. This article also details other advantages of the Method B adaptation for simplifying the testing process and reducing the opportunity for errors.

Method A

Method A is used for testing links in which the total attenuation is dominated by the loss in the fiber cable, rather than the loss of the connectors, as is often the case for telecom networks. The referencing

procedure for Method A uses two patch cords and an adapter connector per fiber link to be tested (See Figure 1).

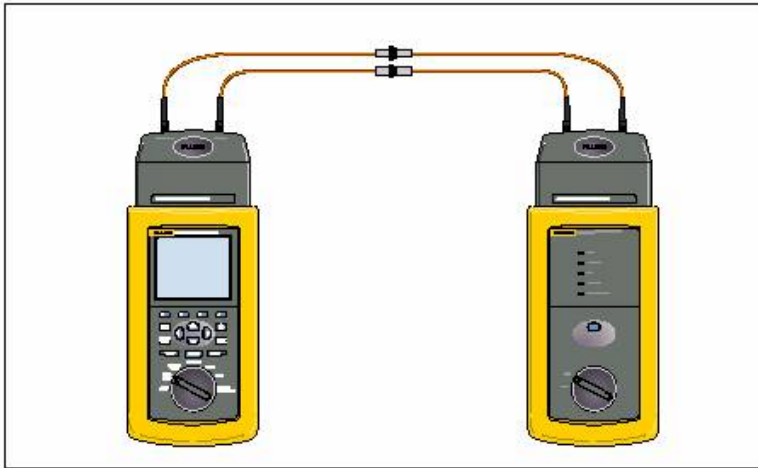


Figure 1 - Reference Configuration with a Dual Fiber Tester Simultaneously Testing Two Fiber Links

The two patch cords and one adapter connection are referenced out when the test is performed. Therefore, the test results include the loss of the fiber link under test plus only one connection (Note the blue section in Figure 2).

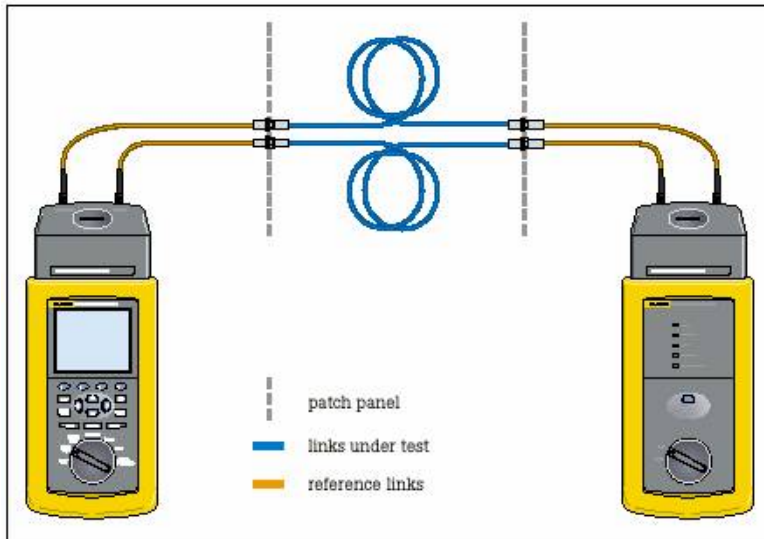


Figure 2 - Test Configuration with Dual Fiber Tester

While this method has been used effectively in the testing of long haul telecom fiber links, it is less precise than what is necessary for the premises market today. Because the network operation actually sees the loss of the fiber link plus the connections at both ends, Method A understates the power loss in the link since it includes only one connection. For long-haul telecom links, this is not an issue since the majority of the loss is in the long lengths of fiber with minimal loss in the precision connectors.

However, in premises applications, fiber lengths are very short and the amount of loss in the fiber cable itself is minimal. The majority of power loss is found in the connections at either end. The increasingly stringent power loss budgets of applications like Gigabit Ethernet require that the entire link loss be measured. That is where Method B becomes applicable.

Method B

Method B is used for testing links for which the connector loss is a significant portion of the total attenuation. This is the case for premises links. The referencing procedure for Method B uses one patch cord per fiber link to be tested (See Figure 3). (Note: This figure depicts a dual fiber tester that tests two fiber links at a time.)



Figure 3 - Method B Reference Configuration

Since only one patch cord (per link) is part of the reference, the test results shall include loss from the fiber cable under test plus the connections at BOTH ends (see blue section in Figure 4).

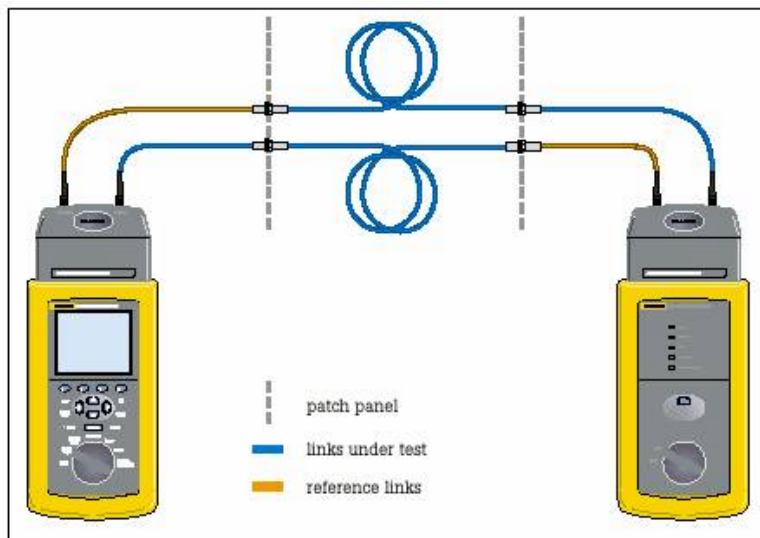


Figure 4 - Method B Test Configuration

Technically, it shall also include any loss in the additional patch cord but this is negligible because the length is so short.

For premises fiber networks, this method provides an accurate measure of the loss in the fiber link because it includes the fiber cable plus the connections at BOTH ends. However, when using Method B, be aware of the following shortcomings:

1. When going from the reference setup to the test setup, it is necessary to disconnect one end of the patch cords from the tester. It is very important never to disturb the connection at the OUTPUT or source end. If this connection is disrupted, the reference is lost, and proceeding without re-referencing shall seriously compromise the test results. Unfortunately, one could easily disconnect the patch cord from the source (OUTPUT) end instead of from the detector (INPUT) end.
2. Although you must disconnect the patch cords from the detector (INPUT) end of the tester, extreme care is required as dirt and other elements can cause damage to the detector.
3. To test Small Form Factor (SFF) connectors that have the transmit and receive fibers in the same connector, you are forced to disconnect from the source (OUTPUT) end in violation of proper referencing and test procedures.
4. Using Method B requires that you have the same type of connector on the tester as you shall be testing in the fiber link.

Presented in the next section is a new test procedure that is an adaptation to Method B, but provides the same test results and preserves integrity to testing Standards while overcoming the short-comings listed above.

Adaptation to Method B

A simple adaptation to Method B allows us to retain the accuracy (every measurement includes the cable and both connections) but avoid the major disadvantages.

The referencing procedure for this adaptation is performed using 2 patch cords and an adapter connector per fiber link to be tested (See Figure 5).

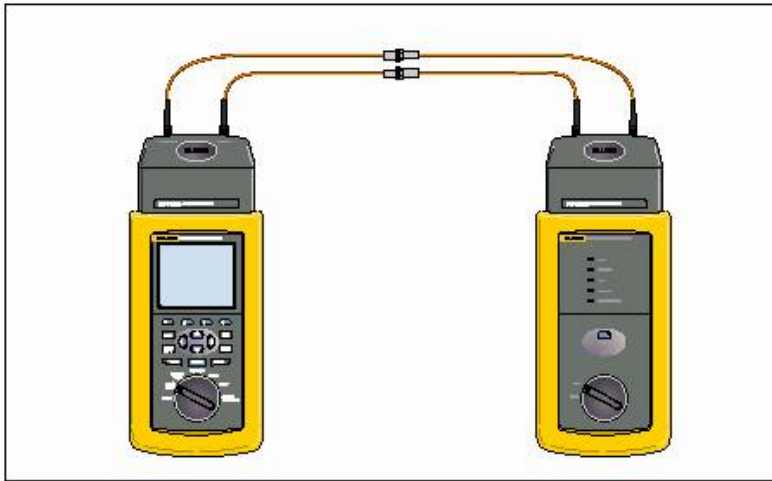


Figure 5 - Adaptation to Method B Reference Configuration

However, the test procedure is new, and is depicted in Figure 6.

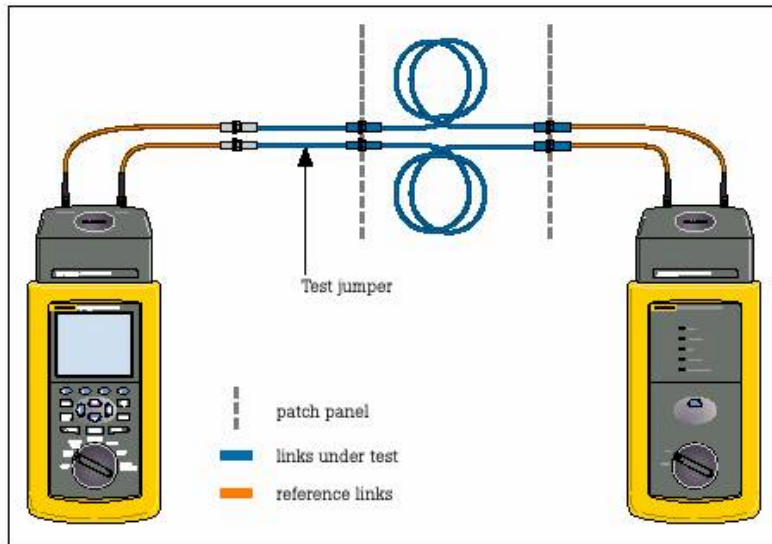


Figure 6 - Adaptation to Method B Testing Configuration

The test procedure includes the addition of a short test jumper with a connector so that the test results shall now be the same as the test results obtained with Method B. Just like Method B, the results contain the loss for the fiber cable plus the connections on BOTH ends (note the blue section in Figure 6). The two patch cords and one connection per link from the reference setup have been referenced out.

Make the Correct Loss Measurements

The Method B adaptation gives us several key advantages over the original Method B while preserving its accuracy:

The Method B adaptation gives loss results that conform to ANSI/TIA/EIA-526-4A, Method B. According to Method B, to measure the link loss correctly, the test path must have two more adapters in each fiber link than in the Set Reference path. The test procedure described in this article adheres precisely to this requirement. In this way, the measured loss shall be the loss of the fiber in a link plus the loss of a connection at each end of the link. This value of loss is the real value encountered by network application hardware.

The Method B adaptation allows the use of hybrid patch cables to connect test equipment to the links under test. This allows consistent testing of links with all types of connectors, including those that use small form-factor (SFF) connectors.

Preserve the Integrity of your Test

The adaptation to Method B makes it unnecessary to disconnect the patch cords from the test equipment, thereby reducing the possibility of errors caused by reinsertion of patch cords or by contamination or damage of test equipment fiber interfaces.

C.5.1 Fiber Optic Cable Installation Test Form—Omni Scanner 2 and OTDR

Site _____ Q/A Rep(s) _____ Date _____ Q/A Review Form: Pass / Fail

Omni Scanner2 Serial #: _____ Omni Scanner2 Location _____ Distant End Location _____

OTDR Serial #: _____ Near End TFBM Serial #: _____ Distant End TFBM Serial #: _____

Wave-length (nm)	Strand	Length (m)	Total Attn (dB)		Disk	Comments	Wave-length (nm)	Strand	Length (m)	Total Attn (dB)	
			↑	↓						↑	↓
850	1-blue						850	13-blue			
1300							1300				
850	2-orange						850	14-orange			
1300							1300				
850	3-green						850	15-green			
1300							1300				
850	4-brown						850	16-brown			
1300							1300				
850	5-slate						850	17-slate			
1300							1300				
850	6-white						850	18-white			
1300							1300				
850	7-red						850	19-red			
1300							1300				
850	8-black						850	20-black			
1300							1300				
850	9-yellow						850	21-yellow			
1300							1300				
850	10-violet						850	22-violet			
1300							1300				
850	11-rose						850	23-rose			
1300							1300				
850	12-aqua						850	24-aqua			
1300							1300				

C.5.2 Fiber Optic Cable Installation Test Form—Power Meter and Light Source

Site _____ Q/A Rep(s) _____ Date _____ Q/A Review Form: Pass / Fail

Power Meter Serial #: _____ Power Meter Location _____

Light Source Serial #: _____ Light Source Location _____

Wave-length (nm)	Strand	Length (m)	Total Attn (dB)		Disk	Comments	Wave-length (nm)	Strand	Length (m)	Total Attn (dB)		Disk	Comments
			↑	↓						↑	↓		
1310	1-blue						1310	13-blue					
1550							1550						
1310	2-orange						1310	14-orange					
1550							1550						
1310	3-green						1310	15-green					
1550							1550						
1310	4-brown						1310	16-brown					
1550							1550						
1310	5-slate						1310	17-slate					
1550							1550						
1310	6-white						1310	18-white					
1550							1550						
1310	7-red						1310	19-red					
1550							1550						
1310	8-black						1310	20-black					
1550							1550						
1310	9-yellow						1310	21-yellow					
1550							1550						

Wave-length (nm)	Strand	Length (m)	Total Attn (dB)		Disk	Comments	Wave-length (nm)	Strand	Length (m)	Total Attn (dB)		Disk	Comments
			↑	↓						↑	↓		
1310	10-violet						1310	22-violet					
1550							1550						
1310	11-rose						1310	23-rose					
1550							1550						
1310	12-aqua						1310	24-aqua					
1550							1550						

APPENDIX D - NETWORK EQUIPMENT PERFORMANCE TESTS

D.1 Overview of Equipment Tests

These equipment tests verify the operation of the network components (e.g., switches, and routers) either purchased or provided for use as part of the particular project. This plan addresses industry-standard TCP/IP tests that collectively address Network layer connectivity and IP packet path routing; it does not address network performance (i.e., total throughput capabilities) tests.

The Owner's Quality Assurance Team shall perform the following interrelated tests:

1. Spanning Tree Root Bridge identification test. Spanning tree protocol is one of the most important layer 2 protocols at work in switches. Spanning Tree ensures that no loops occur in a network by a designated root bridge. The root bridge is a central point of a spanning-tree configuration and it controls how the protocol operates. It is best practice to configure the core switch to be the root bridge. Run the following command on the core switch to identify it is set as the root bridge: Show spanning-tree summary.
2. Internet Control and Message Protocol (ICMP) Ping Test. This test verifies the Network layer for connectivity by using Ether-type frame pings to reach IP target addresses and obtain or verify four results—the target IP address, the local media access control (MAC), the number of responses, and the response time. The target IP addresses are the upstream and/or downstream gateway IP addresses based on the device's connectivity in the network. The source is the management console on the device. Each test includes two steps, if necessary, as follows:
 - a. Obtain the four results by performing an address resolution protocol (ARP) for the target IP address and verifying the ping.
 - b. If test 1 is unsuccessful, obtain the four results by executing an ARP for the default router, then use the acquired MAC address to determine the IP address, send an ICMP echo request and monitor for the ICMP reply.
3. Trace Route/Path Discover. This test determines the path IP packets follow, and reports each router encountered in the path. Testing elicits an ICMP TIME-EXCEEDED response from each router encountered. Each hop is tested three times to help identify changing routes.
4. Configuration Test. This test verifies that each new network port is operational. Perform an ICMP ping from each port not previously tested, ensuring each port has a link light indicating port operability.
5. VLAN configuration verification. Inspect VLAN configuration and port assignments to be matching the provided documentation. Inspect VLAN trunking, and verify forwarding state of required VLANs on VLAN trunks.

D.2 Test Equipment

The following test equipment shall be used:

1. Fluke 682 Enterprise LAN Meter or equivalent.
2. Computer with TCP/IP protocol stack, TELNET application and data capture software (optional).

D.3 Test Methodology

The basic test methodology is to verify connectivity from user access ports through and within the installed intra-network to the WAN Router. Overall connectivity is verified by testing to and from points in the network. Site testing reflects the specific switch(s) and router(s) implemented at the site.

D.4 Test Hierarchy for Connectivity (Pings, Trace Routes and Telnets)

Table D.4-1 contains the network equipment performance tests and corresponding descriptions.

Table D.4-1. Network Equipment Performance Tests

TEST	TEST DESCRIPTION
Ping from Wall outlet WAN or Internet location	Connect the computer into the network via the wall plate, obtain DHCP IP address and perform a ping to a known IP address or URL outside the campus network.

D.5 Network Equipment Configuration Verification and Performance Tests

The Owner’s Quality Assurance Team shall follow the test sequence shown. The following sample form lists tests to be performed at this site. For the set of Network Equipment Performance Test forms tailored to the individual communications cabinets, please see enclosed file Network Checklists.doc.

D.5.1 Network Equipment Configuration Verification Form

Site _____ Date _____ Tester(s) _____

Building and Communications Cabinet Numbers _____

Device Name/IP	Type of device	Type of Configuration verified	PASS	FAIL
	Ethernet Switch	VLAN / STP/ port activation/ Trunking		
	Ethernet Switch	VLAN / STP/ port activation/ Trunking		
	Router/ L3 switch	IP Routing/ SNMP/ Access-lists		

	Router/ L3 switch	IP Routing/ SNMP/ Access-lists		
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D.5.2 Network Equipment Performance Test Form

Site _____ Date _____ Tester(s) _____

Building and Communications Cabinet Numbers _____

(a packet loss in excess of 1% during ping test is not acceptable and is considered a FAIL)

TEST	SOURCE ADDRESS/LOCATION	DESTINATION ADDRESS/LOCATION	PASS	FAIL
Ping from Wall outlet to WAN Router location				
Trace route from Wall outlet to WAN Router location				

APPENDIX E - PHYSICAL CONFIGURATION AUDIT

E.1 Overview of Physical Connectivity Audit

A Physical Connectivity Audit is completed comparing the vendor supplied Equipment Inventory List (EIL) against the Cabinet Equipment Survey generated by the test team at Quality Assurance. This appendix provides the detailed audit of the physical equipment and materials installed under this expansion effort.

E.2 Physical Connectivity Audit Quality Assurance Review lists

The following sample form shows the general information to be documented for a standard Cabinet Equipment Survey.

Site _____ Date _____ Tester(s) _____

Building and Communications Cabinet Numbers _____

Location	Location Annotation	Number of Switches	Number / Type of UPS	Number of Fibers (MM/SM)	Number of Horiz. Copper drops	Number of Horiz. Fibers
MDF						
IDF1						
IDF2						
IDF3						
IDF4						
IDF5						
IDF6						
IDF7						
LDF1						
LDF2						
LDF3						
LDF4						
Notes:						

APPENDIX F - CABLE DOCUMENTATION SPECIFICATION

F.1 Documentation.

- F.1.1 The test result information for each link shall be recorded in the memory of the field tester upon completion of the test.
- F.1.2 Individual test reports shall be submitted in hardcopy and electronic format. Hand-written test reports are not acceptable.
- F.1.3 The test results records saved by the tester shall be transferred into a Windows™- based database utility, such as MS Access, or SQL, or MS Excel spreadsheet, that allows for the maintenance, review and archiving of these test records. A guarantee must be made that the measurement results are transferred to the PC unaltered, i.e., “as saved in the tester” at the end of each test and that these results cannot be modified at a later time.
- F.1.4 Hardcopy reports may be submitted in labeled 3 ring binders with an attached affidavit verifying passing execution of tests. For large installations electronic reports with hardcopy summaries are preferred. Hardcopy summary reports shall contain the following information on each row of the report: circuit ID, test specification used, length, and date of test and pass/fail result.
- F.1.5 Electronic reports are to be submitted in CD format. If proprietary software is used, disk or CD shall contain any necessary software required to view test results. If the results are delivered in a standard format like Excel, Access, CSV files, etc., then software to read these files is not needed. Electronic reports must be accompanied by a Certificate signed by an authorized representative of the Contractor warranting the truth and accuracy of the electronic report. Certificate must reference traceable circuit numbers that match the electronic record.
- F.1.6 Test reports shall include the test measurement information specified in Section 5 for each cabling element tested, in addition to:
- F.1.7 Cable manufacturer, cable model number/type and NVP.
- F.1.8 Tester manufacturer, model, serial number, hardware version and software Ver. 6.
- F.1.9 Circuit ID number.
- F.1.10 Auto test specification used.
- F.1.11 Identification of the tester interface.
- F.1.12 Overall pass/fail indication.
- F.1.13 Date and time of test.

Table F.2 Cable Test Parameter Preferences

When reading the printed test result output, the following parameters must be shown with the associated cable test.

Cable Testing Parameter Preferences								
Cable Test	NVP	Cable	Auto test	Fiber Type	GRI	Reference	Test Direction	Pulse Width
Level (IIE) Category 5 E Tester	69 – 72	Cat 5E	Cat 5E Perm link	n/a	n/a	n/a	n/a	n/a
Level (III) Category 6 Tester	69 – 72	Cat 6	Cat 6 Perm link	n/a	n/a	n/a	n/a	n/a
Power Meter Horizontal MM F/O @ 850nm/1300nm	n/a	62.5/125 Mnfr	568B Horizontal	Multimod e 50 or 62.5	1.4920 @ 1300nm	1 jumper method	Bi- Directiona l	n/a
Power Meter Backbone MM F/O @ 850nm/1300nm	n/a	62.5/125 Mnfr	568B Backbone	Multimod e 50 or 62.5	1.4920 @ 1300nm	1 jumper method	Bi- Directiona l	n/a
Power Meter Backbone SM F/O @ 1310nm/1550n m	n/a	SM Mnfr	1000 Base –LX	Single Mode	1.4640 @1300nm	1 jumper method	Bi- Directiona l	n/a
OTDR Horizontal MM F/O @ 850nm/1300nm	n/a	n/a	n/a	Single Mode	n/a	n/a	Uni- Directiona l	<50ns
OTDR Backbone MM F/O @ 850nm/1300nm	n/a	n/a	n/a	Single Mode	n/a	n/a	Uni- Directiona l	<50ns
OTDR Backbone SM F/O @ 1310nm/1550n m	n/a	n/a	n/a	Single Mode	n/a	n/a	Uni- Directiona l	<50ns

NOTE: The length of the cable is the variable of which the Power Meter and light source determines the expected dB loss for Backbone cable tests.

Table F.3 Allowable Distance per Fiber Length

Use this table as a guideline to compare references for dB loss in the installed Backbone Fiber. Total loss includes .75 dB loss per mated connector pair.

Fiber	Multimode	Singlemode	Fiber Cable	Multimode	Singlemode
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Cable Distance	dB Loss	DB Loss		Distance	dB Loss	DB Loss
100'	1.6	1.53		1200'	2.7	1.86
200'	1.7	1.56		1300'	2.8	1.89
300'	1.8	1.59		1400'	2.9	1.92
400'	1.9	1.62		1500'	3.0	1.95
500'	2.0	1.65		1600'	3.1	1.98
600'	2.1	1.68		1700'	3.2	2.01
700'	2.2	1.71		1800'	3.3	2.04
800'	2.3	1.74		1900'	3.4	2.07
900'	2.4	1.77		2000'	3.5	2.10
1000'	2.5	1.80		2100'	3.6	2.13
1100'	2.6	1.83		2200'	3.7	2.16

SECTION 26 0500

COMMON WORK RESULTS FOR ELECTRICAL

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section specifies the basic requirements for electrical installations and includes requirements common to more than one section of Division 26. It expands and supplements the requirements specified in sections of Division 01.
- B. Related Requirements:
1. Division 01 – General Requirements.
 2. Section 03 3000 – Cast-in-Place Concrete.
 3. Section 09 9000 – Painting and Coating.
 4. Division 14 – Conveying Equipment.
 5. Division 23 – HVAC.
 6. Division 26 – Electrical.
 7. Division 27 – Communications.
 8. Division 28 – Electronic Safety and Security.
 9. Division 31 – Earthwork.
 10. Division 32 – Exterior Improvements.
 11. Division 33 – Site Improvements.
- C. Related Industry Standards: The most current version of the following industry standards.
1. ASTM D 709 – Laminated Thermosetting materials.
 2. ANSI/NEMA FB-1 – Fittings, Cast Metal Boxes, and Conduit Bodies for Conduit, Electrical Metallic Tubing, and Cable.
 3. ANSI/NEMA 250 – Enclosures for Electrical Equipment (1000 Volts Maximum).
 4. California Electrical Code (CEC).
 5. IEEE C57.12.28 – Standard for Pad-Mounted equipment Enclosure Integrity.
 6. IEEE 1584 – Performing Arc-Flash Hazard Calculations.
 7. UL/ANSI 1 – Standard for Flexible Metal Conduit.

8. UL/ANSI 1242 – Standard for Electrical Intermediate Metal Conduit.
9. UL/ANSI 506 – Standard for Specialty Transformers.
10. UL/ANSI 6 – Electrical Rigid Metal Conduit-Steel.
11. UL/ANSI 6A – Electrical Rigid Metal Conduit-Aluminum, Red Brass, and Stainless Steel.
12. UL 797 – Electrical Metallic Tubing-Steel.
13. UL/ANSI 870 – Standard for Wireways, Auxiliary Gutters, and Associated Fittings.
14. UL/ANSI 891 – Standard for Safety Switchboards.

1.2 BASIC ELECTRICAL REQUIREMENTS

A. Quality Assurance:

1. Work shall be performed by CONTRACTOR'S personnel possessing the skills and experience obtained in performing work of similar scope and complexity.
2. Refer to related division(s) specifications for other requirements.

B. Drawings and Specifications Coordination:

1. For purposes of clearness and legibility, Drawings are essentially diagrammatic, and the size and location of equipment is indicated to scale whenever possible. Verify conditions, dimensions, indicated equipment sizes, and manufacturer's data and information as necessary to install the Work of this Division. Coordinate location and layout with other Work.
2. Verify final locations for rough ins with field measurements and with the requirements of the equipment to be connected.
3. Drawings indicate required size and points of termination of conduits, number and size of conductors, and diagrammatic routing of conduits. Install conduits with minimum number of bends to conform to structure, avoid obstructions, preserve headroom, keep openings and passageways clear, and comply with applicable code requirements.
4. Routing of conduits may be changed provided that the length of any conduit run is not increased more than 10 percent of length indicated on the Drawings.
5. Outlet locations shall be coordinated with architectural elements prior to start of construction. Locations indicated on the Drawings may be distorted for clarity; CONTRACTOR shall coordinate in the field prior to rough-in work.
6. Coordinate electrical equipment and materials installation with building components and the Work of other trades.
7. Equipment disconnects shall be readily accessible and free of obstructions.
8. When extending or intercepting existing electrical facilities, CONTRACTOR shall Coordinate and verify existing conditions.

- C. Terminology:
1. Signal Systems: Applies to clock, bell, fire alarm, annunciator, sound, public address, buzzer, telephone, television, inter-communication, elevator access controls, lighting control systems and security systems.
 2. Low Voltage: Applies to signal systems operating at 120 volts and less, and power systems operating at less than 600 volts. Medium voltage: Applies to power systems operating at more than 600 volts.
 3. UL: Underwriter's Laboratories Inc, Nationally Recognized Testing Laboratory (NRTL), or equal.
- D. Regulations: Work shall comply with the requirements of authorities having jurisdiction and the California Electrical and Building Codes. Material shall conform to regulations of the National Board of Fire Underwriters for electrical wiring and apparatus. Materials shall be new and listed by UL, or another NRTL.
- E. Structural Considerations for Conduit Routing:
1. CONTRACTOR shall provide DSA approved calculations and drawings as necessary for any construction and/or alterations requiring conduits to pass through or interfere with any structural members, or where notching, boring or cutting of the structure is necessary, or where special openings through walls, floors, footings, or other buildings elements, or where notches and bored holes in wood or steel are required. All work shall conform to CBC, Part 2, Title 24 requirements.
 2. Concrete encasement for underground conduits that abuts a foundation wall or underground structure shall rest on a haunch integral with wall or structure, or shall extend down to footing projection, or shall be doweled into structure unless otherwise indicated. Underground structures shall include maintenance holes; pull boxes, vaults, and buildings.
- F. Electrically Operated Equipment and Appliances:
1. Furnished Equipment and Appliances:
 - a. Work shall include furnishing and installing wiring enclosures and complete connections of electrically operated equipment, appliances and electrical control devices, which are specified to be furnished and installed in this or other sections of the Specifications. Wiring enclosures shall be concealed except where exposed work is indicated on the drawings.
 - b. Provide all connections necessary for installation of equipment.
 - 1) Equipment shall be tested for proper operation, including proper rotation of motorized equipment.
 - 2) If outlets are of incorrect electrical characteristics, or any specified equipment fails to operate properly, CONTRACTOR shall repair and/or replace the outlet and/or equipment.

- 3) Utility connections (electrical, controls, gas, etc.) to roof mounted mechanical equipment shall be made through the side of the equipment and not from beneath the unit to facilitate future replacement.
2. Equipment and Appliances Furnished by Others:
 - a. Equipment and appliances indicated on Drawings as "not in contract" (NIC), "furnished by others," or "furnished by the OWNER," will be delivered to the Project site. Required electrical connections shall be performed for such equipment and appliances. Motorized equipment will be furnished factory-wired to a control panel or junction box unless otherwise indicated. Appliances will be furnished equipped with portable cord and cap. Provide disconnect switches where required.
 - b. Connections to equipment furnished under this Division shall be part of the Work of this section. Work shall include internal wiring, installation, connection and adjustment of bolted drive motors in which the motor is supplied as a separate unit, and connections only for equipment furnished with factory installed internal wiring, except as further limited by Drawings and this Specification. Work shall include furnishing and installing suitable outlets, disconnecting devices, starters, push-button stations, selector switches, conduit, junction boxes, and wiring necessary for a complete electrical installation. Work shall also include furnishing and installing conduit and boxes for HVAC control systems, furnished under Division 23. Devices and equipment furnished shall be of same type used elsewhere on the Work or as specified.
 - c. Electrical equipment furnished under other sections, for installation and connection under Work of this section, will be delivered to the Project site ready for installation.
 - d. Mechanical equipment furnished under other sections, and requiring electrical connection under this section, will be set in place as part of the Work of the section furnishing such equipment unless noted otherwise.
 - e. Suitability and condition of equipment furnished under other sections shall be determined in advance of installation. Immediate notice of damage, unsuitability, or lack of parts shall be given to the entity providing such equipment.
 - G. Power Distribution System Reports: For fault current, coordinatization and Arc-Flash system report requirements refer to applicable electrical distribution equipment sections. for specific requirements.
 - H. Protection of Materials:
 1. Protect materials and equipment from damage and provide adequate and proper storage facilities during progress of the Work. Damaged materials and/or equipment shall be replaced.
 - I. Cleaning:
 1. Exposed parts of Work shall be left in a neat, clean, usable condition. Finished painted surfaces shall be unblemished and metal surfaces shall be polished.

2. Thoroughly clean parts of apparatus and equipment. Exposed parts to be painted shall be thoroughly cleaned of cement, plaster, and other materials. Remove grease and oil spots with solvent. Such surfaces shall be wiped, and corners and cracks scraped out. Exposed rough metal shall be smooth, free of sharp edges, carefully steel brushed to remove rust and other spots, and left in proper condition to receive finish painting.
3. Remove rubbish, debris, and waste materials and legally dispose of off the Project site.

J. WARRANTIES

1. Provide one-year warranty on all material and labor performed, unless noted otherwise in specific sections.

PART 2 - PRODUCTS - NOT USED

PART 3 - EXECUTION

3.1. GENERAL REQUIREMENTS

- A. Advise the Inspector before starting the Work of this Division.
- B. Exposed conduits shall be painted to match the surfaces adjacent to installation.
- C. Salvaged materials removed from buildings shall be removed from the Project site as required by the OAR.
- D. Trenches outside of barricade limits shall be backfilled and paved within 24 hours after being inspected by the Inspector. Provide traffic plates during the time that trenches are open in traffic areas and in areas accessible to students and staff.
- E. Where existing structural walls are cored for new conduit runs, separation between cored holes shall be three inches edge to edge from new or existing holes, unless otherwise required by the Architect. All coring to be laid out and reviewed by Architect prior to drilling. CONTRACTOR to verify location of structural steel, rebar, stress cabling or similar prior to lay out.
- F. Electrical equipment shall be braced and anchored for CBC Seismic Design requirements, or as otherwise indicated on the Drawings.

3.2. DELIVERY STORAGE AND HANDLING

- A. Deliver products to project site with proper identification, which shall include names, model numbers, types, grades, compliance labels, and similar information needed for District identification; all products and materials shall be adequately packaged and protected to prevent damage during shipment, storage, and handling.
- B. Coordinate deliveries of electrical materials and equipment to minimize construction site congestion.

3.3. CUTTING AND PATCHING

- A. Cutting and patching of electrical equipment, components, and materials shall include the removal and legal disposal of selected materials, components, and equipment.

- B. Do not endanger or damage installed Work through procedures and processes of cutting and patching.
- C. Repair or restore other work or surfaces damaged as a result of the work performed under this contract.

3.4. CLEANUP

- A. Remove rubbish, debris and waste materials and legally dispose off the Project site.
- B. Remove equipment and implements of service, and leave entire work area neat and clean, to the satisfaction of the OWNER Authorized Representative.

3.5. PROTECTION

- A. Protect the Work of this section until Substantial Completion.

END OF SECTION

SECTION 26 0513

BASIC ELECTRICAL MATERIALS AND METHODS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Boxes, enclosures, keys and locks.
2. Receptacles and switches.
3. Identifications and signs.

B. Related Requirements:

1. Division 01 - General Requirements.
2. Division 26 – Electrical.
3. Division 27 – Communications.
4. Division 28 - Electronic Safety and Security.

PART 2 - PRODUCTS

2.1 BOXES, ENCLOSURES, KEYS AND LOCKS

A. Outlet Boxes and Fittings:

1. Outlet boxes installed in concealed Work shall be galvanized steel, pressed, or welded type, with knockouts.
2. In exposed Work, where conduit runs change direction or size, outlet boxes and conduit fittings shall be cast metal with threaded hubs cast integral with box or fitting.
3. Fittings shall be cast metal and non-corrosive. Ferrous metal fittings shall be cadmium-plated, or zinc galvanized. Castings shall be true to pattern, smooth, straight, with even edges and corners, of uniform thickness of metal, and shall be free of cracks, gas holes, flaws, excessive shrinkage, and burnt-out sand.
4. Covers for fittings shall be galvanized steel or non-corrosive aluminum and shall be designed for particular fitting installed.
5. Light fixture outlets shall be 4-inch octagon, 4-inch square, 2 1/8-inch deep or larger, depending upon number of conductors or conduits therein. Plaster rings shall be furnished with round opening with two ears drilled 2 23/32 inches center to center.

6. For local device outlets provide 4-inch square 2 1/8-inch deep, boxes for single gang, 5-inch square boxes for two-gang, and special solid gang boxes with gang plaster ring for more than two switches.
7. For TV outlets, and horns and strobes provide manufacturer's supplied back box as needed. For television outlets, provide 4-gang deep boxes and 4-gang plaster rings.
8. Plaster rings shall be provided on flush-mounted outlet boxes except where otherwise indicated or specified. Plaster rings shall be same depth as finished surface. Install approved ring extension to obtain depth to finish surface.
9. In existing plywood wall or drywall construction, and where flexible steel conduit is fished into walls, single-gang and 2-gang outlets for wiring devices may be sectional steel boxes with plaster ears. Boxes shall be fastened to plywood with flat-head screws in each plaster ear screw hole. Boxes fastened to gypsum board shall be Raco, Appleton, Cooper, Bowers, or equal.
10. Factory made knockout seals shall be installed to seal box knockouts, which are not intact.
11. Where flexible conduit is extended from flush outlet boxes, provide and install weatherproof universal box extension adapters.

B. Junction and Pull boxes:

1. Junction and pull boxes, in addition to those indicated, shall only be used in compliance with codes, recognized standards, and Contract Documents.
2. Interior and non-weatherproof boxes shall be constructed of blue or galvanized steel with ample laps, spot welded, and shall be rigid under torsion and deflecting forces. Boxes shall be furnished with auxiliary angle iron framing where necessary to ensure rigidity.
3. Covers shall be fastened to box with enough machine screws to ensure continuous contact all around. Flush type boxes shall be drilled and tapped for cover screws if boxes are not installed plumb. Surfaces of pull and junction boxes and covers shall be labeled in black marker ink designating system, panelboard and circuit designation contained in box. In exposed Work, designation shall be installed on inside of pullbox or junction box cover.
4. Weatherproof NEMA 3R pull and junction boxes shall conform to foregoing for interior boxes with following modifications:
 - a. Cover of flush mounting boxes shall be furnished with a weather-tight gasket cemented to, and trimmed even with, cover all around.
 - b. Surface or semi-flush mounting pull and junction boxes shall be UL, or another Nationally Recognized Testing Laboratory (NRTL) listed as rain-tight and shall be furnished complete with threaded conduit hubs.
 - c. Exposed portions of boxes shall be galvanized and finished with one prime coat and one coat of baked-on gray enamel, unless already furnished with factory baked-on finish.

5. Junction and pull boxes shall be rigidly fastened to structure and shall not depend on conduits for support.

C. Floor Outlets:

1. Floor Outlets (except for extension outlets) shall be cast iron, watertight floor boxes with flush brass floor plates, and shall be set to finish flush with finish floor covering, whether it be carpeted, wood, resilient floor covering, or other finish materials.
 - a. Floor boxes shall be used in offices, classrooms, and in library areas only.
 - b. Approved Products: Harvey Hubbell Inc. B-2503, Thomas & Betts 640 series, Legrand Omnibox, or OWNER approved equal.
2. Telephones above floor outlets, where not subject to water, shall be provided with Harvey Hubbell Inc. SC-3098 pedestals with SC309T plates. Refer to other Division 26 sections. Floor boxes shall be used in offices, classrooms and in Library areas only.
 - a. Approved Products: Legrand 525 series, Thomas & Betts FPT-400 Series, or OWNER approved equal
3. Plugs above floor outlets where not subject to water shall be provided with pedestal s and device plates. Refer to other Division 26 sections. Floor boxes shall be used in offices, classrooms, and library areas only.
 - a. Approved products: Pedestals shall be Legrand 525 series, Thomas & Betts FPT-400 Series, Harvey Hubbell Inc. SC-3098; Device plates shall be Hubbell SS309D, or District approved equal.
4. Two gang and single box pedestal boxes shall be listed for wet locations where subject to water. Provide required cover plates.
 - a. Floor outlets shall be used in Cafeteria, Cafeteria serving areas, or any areas where floors are subjected to water.
 - b. Approved products: Single gang boxes - Hubbell SA-6687. Two gang boxes shall be Hubbell SA-6885, or OWNER approved equal.
5. Extension floor outlets shall be cast iron with cast iron covers, and 1/2-inch offset entries for above-floor conduit extensions; Boxes shall be designed to permit access to wiring without disturbing above-floor extensions and shall be set flush with finish floor.
6. Above floor service fittings for data outlets and surge suppression receptacles shall be faceplate interchangeable, die cast aluminum.
 - a. Approved products: Hubbell SC3098 with cover plates SS309DS, Legrand 525 series, Thomas & Betts FPT-400 Series, or OWNER approved equal.

D. Floor Pockets – Plugging Boxes:

1. Three-Gang floor lighting pockets shall be flush floor type recess floor mounted enclosure, with cast iron floor plate and hinged cast iron door notched for cables.

- a. Each floor pocket shall be provided with three 20-amp, 3 wire, 125-volt receptacles with matching caps.
- b. Approved products: Legrand or Hubbell Recessed Floor Boxes, C.W. Cole TLS 353-6, or equal, for wood floors and C.W. Cole TLS-353-6-C, or OWNER approved equal for concrete slabs.

2. Single Gang:

- a. Receptacle floor pockets shall be single gang, flush floor type, with cast iron floor plate, hinged cast iron door notched for cable and cast-iron box. Provide each pocket with a standard, single grounding type receptacle unless otherwise indicated.
 - 1) Approved Products: C.W. Cole TLA-362-1-FE, or OWNER approved Legrand or Hubbell recessed floor box, or OWNER approved equal. For wood floors provide C.W. Cole TLS-362-1, or OWNER approved equal.
- b. Microphone or projector floor pockets shall be single gang flush floor type with cast iron floor plate, hinged cast iron door, notched for cable and cast-iron box.
 - 1) Approved Products: Legrand or Hubbell recessed floor box, C.W. Cole TLA-362-3-FE, C.W. Cole TLS-362-3, in wood floors, or OWNER approved equal.

E. Keys and Locks:

- 1. Provide two keys with furnished door locks, including cabinet door locks and switchboard locks, two keys for lock switches on switchboards or control panels, and two keys with interlocks or other furnished lock switches. Deliver keys to OAR.
- 2. Special keys and locks shall only be provided where specified. Locks shall be keyed to Corbin No. 60 or 70 as follows:
 - a. Access to operate equipment shall be keyed to Corbin 60.
 - b. Access to service areas shall be keyed to Corbin 70.

2.2 RECEPTACLES AND SWITCHES

A. Receptacles:

- 1. Duplex receptacles shall be heavy-duty specification grade, grounding type. Terminal screws shall be wired on the side and back with internal screw pressure plates. Mounting strap shall feature heavy-duty brass construction. Receptacle back body shall be PVC. Receptacle face shall be ivory, impact resistant nylon. Receptacles shall have triple wipe brass power contacts.

a. Approved products:

<u>NEMA #</u>	<u>Pass & Seymour</u>	<u>Hubbell</u>	<u>Leviton</u>
(20 amps) NEMA 5-20	PS5362-I	HBL5362-I	5362-I
(15 amps) NEMA 5-15	PS5262-I	HBL5262-I	5262-I

Equal products approved by OWNER may be acceptable.

2. Duplex receptacles on circuits supplied by panel boards with integral surge suppression shall be Pass & Seymour model number PS5262BL (blue), Hubbell DRUBTVSS15, Leviton 5262-SBU, 15-amps, 120-volts, or OWNER approved equal.

3. Single receptacles shall be heavy-duty specification grade, grounding type. Terminal screws shall be back and side wire with internal screw pressure plates. Mounting strap shall feature heavy-duty brass construction. Receptacle back body shall be thermoplastic. Receptacle face shall be ivory, impact resistant nylon. Receptacles shall have triple wipe brass power contacts. For circuits consisting of one single receptacle only, ampere rating of receptacle shall be same as circuit breaker or fuse.

a. Approved products:

<u>NEMA #</u>	<u>Pass & Seymour</u>	<u>Hubbell</u>	<u>Leviton</u>
(20 amps) NEMA 5-20R	5361-I	HBL5361-I	5361-I
(15 amps) NEMA 5-15R	5261-I	HBL5261-I	5261-I

Equal products approved by OWNER may be acceptable.

4. Single 15 and 20-amps receptacles on circuits supplied by panel boards with integral surge suppression shall be blue in color.

a. Approved products: Pass & Seymour NEMA 5-20R model number 5361-BL (blue), NEMA 5-15R model number 5261-BL (blue), or OWNER approved equal.

5. Kiln and range receptacles, provide 3-pole, 4-wire, grounding type, rated 50 amps or as indicated on plans. Receptacle shall be rated 125/250 volts NEMA 14-50R. Provide 2-gang, stainless steel plates.

a. Approved products:

<u>NEMA #</u>	<u>Pass & Seymour</u>	<u>Hubbell</u>	<u>Leviton</u>
NEMA 14-50R	3894	HBL9450A	279
WALL PLATE	SS703	S703	84026

Equal products approved by OWNER may be acceptable.

6. Dryer receptacles. Provide 3-wire, non-grounding type, rated 30 amps at 125/250 volts, NEMA 10-30R, with 2-gang stainless steel plates. Coordinate location of junction box with the work of Section 10 2815, Hand and Hair Dryers.

a. Approved Products:

<u>NEMA #</u>	<u>Pass & Seymour</u>	<u>Hubbell</u>	<u>Leviton</u>
<u>NEMA 10-30R</u>	3860	HBL9350	5207
<u>WALL PLATE</u>	SS703	S703	84026

Equal products approved by OWNER may be acceptable.

7. Provide specification grade ground-fault circuit interrupter (GFCI) type receptacles in accordance with 2010 UL standards. GFCI receptacles shall have a trip indication light. Receptacle terminal screws shall be back and side wire with internal screw pressure plates. Test and reset buttons shall match device body and shall be ivory. GFCI receptacles shall be manufactured in standard configuration for installation with stainless steel smooth plates. Exterior mounted receptacles shall be mounted inside weatherproof enclosure.

- a. Approved products:

<u>NEMA #</u>	<u>Pass & Seymour</u>	<u>Hubbell</u>	<u>Leviton</u>
NEMA 5-20R	2095-I	GFR5352-IA	7899-I
NEMA 5-15R	1595-I	GFR5252-IA	8598-I

Equal products approved by OWNER may be acceptable.

8. Provide weatherproof receptacles, except where otherwise indicated or specified, consisting of GFCI receptacles, as specified herein, and metal plates with die-cast lockable hinged lids and weatherproof mats;

Tamper-resistant receptacles with thermoplastic dual mechanism shutter system to help prevent insertion of foreign objects. Receptacles shall have extra heavy-duty brass, one-piece mounting strap with integral ground. Receptacles shall be ivory color, impact resistant nylon face and back body.

- a. Approved products:

<u>NEMA #</u>	<u>Pass & Seymour</u>	<u>Arrow Hart</u>	<u>Leviton</u>
NEMA 5-20R	TR63-I	TR8300V	8300SGI
NEMA 5-15R	TR62-I	TR8200V	8200SGI

Equal products approved by OWNER may be acceptable.

9. Provide transient voltage surge suppression (TVSS) receptacles offering metal oxide varistors (MOVs) protecting normal and common modes, (L-N, L-G, N-G) with 500V suppressed voltage. TVSS devices shall offer 3-mode equal protection with 210 joules minimum per mode of energy absorption and 13,000-amp maximum surge capability. TVSS devices shall have 3 thermal fuses and two over-current protection fuses. TVSS devices shall have LED visual only surge status indicator to alert user to surge suppression circuit condition. Visual indicator will be illuminated (red) when power is on and surge suppression circuit is fully functional. Visual indicator will not be illuminated when power is off or unit experiences loss of surge suppression protection. Terminals shall be back and side wire including ground terminal. Color shall be blue.

- a. Approved Products

<u>NEMA #</u>	<u>Pass& Seymour</u>	<u>Hubbell</u>	<u>Leviton</u>
NEMA 5-20R	5352BLSP	HBL5360SA	5380B
NEMA 5-15R	5252BLSP	HBL5260SA	5280B

Equal products approved by OWNER may be acceptable.

B. Switches

1. Local Switches:

- a. Local switches shall be high strength thermoplastic toggle, industrial grade, rated 20 amps at 120-277 volts AC only, with plaster ears, external screw pressure plate back and side wired, and standard size composition cups which fully enclose mechanism. Switches shall be approved for installation at currents up to full rating on resistive, inductive, tungsten filament lamp and fluorescent lamp loads, and for up to 80 percent of rating for motor loads. Switches shall have oversized silver alloy contacts for long life and better heat dissipation.

Provide switches as single pole, double pole, 3-way, 4-way, non-lock type. Provide non-lock type switches with ivory handles;

	<u>Pass & Seymour</u>	<u>Hubbell</u>	<u>Leviton</u>
Single pole	PS20AC1I	HBL1221I	1221-2I
Double pole	PS20AC2I	HBL1222I	1222-2I
Three-way	PS20AC3I	HBL1223I	1223-2I
Four-way	PS20AC4I	HBL1224I	1224-2I

Equal products approved by OWNER may be acceptable.

- b. Lock type switches shall be specification industrial grade, 20 amp, 120-277 volts with metal or nylon key guides with on/off indication, and operable by same key. Key shall be District standardized vertically oriented, tamper resistant, forked key with two each 5/16-inch long forks, 5/32-inch spacing between forks and 5/16-inch width overall.

- 1) Approved products:

	<u>Pass & Seymour</u>	<u>Arrow Hart</u>
Single pole	PS20AC1L w/#500 Key-2L	1221L w/1201LK Key
Double pole	PS20AC2Lw/#500 Key	1222L w/1201LK Key
Three-way	PS20AC3L w/#500 Key	1223L w/1201LK Key
Four Way	PS20AC4L w/#500 Key	1224L w/1201LK Key

Equal products approved by OWNER may be acceptable.

- c. Rotary lock switches shall incorporate a tumbler type lock to prevent unauthorized operation. Lock shall be tumbler type by Corbin, keyed to a HH41 key. Lock switch to be installed with pin tumblers facing downward. Key shall be removable in all positions. Each device shall be complete with 2 keys. Keys shall be delivered only to the OAR. Switches shall be rated at 20 amps, 120-volt or 277-volt AC. Switch plates shall be of stainless steel, engraved with on and off positions indicated.

- 1) Approved products:

	<u>Arrow Hart</u>
Single pole	AH1191N
Double pole	AH1192N
Three-way	AH1193N

Equal products approved by OWNER may be acceptable.

- d. Pilot light switches shall be rated 20 amps and shall conform to specifications for local switches. Switches shall be furnished with red, Lexan handles that are lighted by LED lamps. Pilot light shall light when load is on. Pilot light 120-volt switches

- 1) Approved products:

	<u>Pass& Seymour</u>	<u>Hubbell</u>	<u>Leviton</u>
Single pole	PS20AC1-RPL	HBL1221-PL	1221-PLR
Double pole	PS20AC2-RPL	HBL1222-PL	1222-PLR
Three-way	PS20AC3-RPL	HBL1223-PL	1223-PLR

Equal products approved by OWNER may be acceptable.

2) 20 amps, 277 volts rated pilot light switches shall be single pole and shall conform to specifications for local switches, and the requirements of paragraph d above.

a) Approved Products:

<u>Pass & Seymour</u>	<u>Leviton</u>	<u>Hubbell</u>
PS20AC1-RPL	1221-7PR	HBL1221-PL7

e. Provide remote control switches for mechanically held contactors arranged for 3-wire control, toggle type, momentary contact, single pole, 3-position with center off position, rated 20 amps at 120-277 volts AC only, with plaster ears, binding screws for side wiring, standard size composition cups which fully enclose mechanism, and ivory handles.

1) Approved products:

<u>Pass & Seymour</u>	<u>Hubbell</u>	<u>Leviton</u>
1251-I	HBL1557-I	1285-I

Equal products approved by OWNER may be acceptable.

f. Provide remote control switches for magnetically held contactors arranged for 3-wire control, toggle type, maintained contact, single pole, 3-position with center off position, rated 20 amps at 120-277 volts AC only, with plaster ears, binding screws for side wiring, standard size composition cups which fully enclosed mechanism, and ivory handles.

1) Approved products:

<u>Pass and Seymour</u>	<u>Hubbell</u>	<u>Leviton</u>
1225-I	HBL 1385	1285-I

Equal products approved by OWNER may be acceptable.

g. Momentary Contact locking key type switch. 20A 120/277V center off. Key shall be District standardized vertically oriented, tamper resistant, forked key with two each 5/16" long forks, 5/32" spacing between forks and 5/16" width overall.

1) Approved products:

Arrow Hart AH1995L w/ AH2000 key

Equal products approved by OWNER may be acceptable.

h. Momentary Contact switch low voltage 1 pole 3A 24VAC 3 position center off. Key for locking switch shall be District standardized vertically oriented, tamper resistant, forked key with two each 5/16" long forks, 5/31" spacing between forks and 5/16" width overall.

1) Approved products:

Pass and Seymour Toggle 1081I, Locking 1081KGRY w/#500 Key

Equal products approved by OWNER may be acceptable.

2. Time Switches and Photoelectric Controls for existing construction.

- a. Provide time switches with a 7-day, solid-state, electronic type capable of fully automatic or manual operation and housed in a sheet steel enclosure unless built into a panel or switchboard. Resistive or inductive contacts rated for 25-amps, each pole 240-VAC; 5-amps tungsten or 277-VAC pilot duty, each pole 240-VAC. Time switches to contain a non-volatile clock and non-volatile memory with a built-in rechargeable super capacitor power carry-over system. Battery carryover is not acceptable. Provide a minimum of 15 on/off set points per week. Timing to be in one-minute increments with a minimum on or off time of one minute. Time switch digital displays to indicate days of week, hours, and minutes. Display to contain a load status light to indicate when equipment is in operation.
- b. Required :
 - 1) Liquid crystal display panel.
 - 2) Holiday scheduling: Up to 40 dates may be assigned special holiday schedules, up to one year in advance.
 - 3) Automatically adjusts to and from daylight savings time and for leap year.
 - 4) Contact ratings: 10 amp at 240 VAC.
 - 5) Safety override switch for each circuit to either provide shut down of circuit or to override on.
 - 6) Selective review: All or part of schedule shall be displayed at touch of a key.
 - 7) Super Capacitor for power carry-over system.
 - 8) Supply voltage: 120/277-Volt.
 - 9) 365-day advance scheduling.
- c. Approved products: Tork Model EW 101B series, Intermatic ET90000 series, or OWNER approved equal.
- d. Photoelectric control: Shall be rated 2,000 watts, 120V with single pole, single throw, normally closed contact, enclosed in a die-cast aluminum gasketed enclosure with 1/2-inch conduit fitting,
 - 1) Approved products: Tork series 2100, or OWNER approved equal.

3. Emergency Lighting Control Unit

- a. The Emergency Lighting Control Unit shall provide all required functionality to allow a standard lighting control device to control emergency lighting in conjunction with normal lighting in any area within a building.
- b. The emergency lighting control unit shall allow control of emergency lighting fixture in tandem with normal lighting in an area while ensuring that emergency lighting will turn on immediately to full brightness upon loss of normal power

supplying the control device. Emergency lighting operation shall be independent for each controlled area and shall not require a generalized power failure for proper operation.

- c. The device shall have normally closed dry contacts capable of switching 10-amp emergency ballast loads at 120-277 VAC, 60 Hz., 2-amp tungsten loads at 120 VAC, 60Hz., LED loads at 120-277V VAC, 60 Hz
- d. The device shall have universal rated voltage inputs provided for normal power sense and normal switched power at 120-277 VAC, 60 Hz.
- e. The device shall provide separate LEDs to indicate the presence of normal and emergency power sources. The LEDs shall indicate the unit's current operational mode (normal or emergency)
- f. The device's normal power input terminal shall be connected to the line side of the control device such that any upstream fault causing a loss of power, including the tripping of the branch circuit breaker, will force the unit into the emergency mode and turn on the emergency lighting.
- g. The unit shall automatically switch emergency lighting on and off as normal lighting is switched. When normal power is not available, the unit shall force and hold emergency lighting on regardless of the state of any external control device until normal power is restored.
- h. Approved products: WattStopper ELCU-100 Emergency Lighting Control Unit, LVS #EPC-PM Series, Lighting Control Design #GR 2001 series, or OWNER approved equal.

4. School Main Entrance Intercom Station: Refer to specification section 28 1000 – Access Control System.

2.3 IDENTIFICATION AND SIGNS

A. Identification Plates:

1. Provide identification plates for the following unless otherwise specified, for switchboards, unit substations, motor control centers, control panels, push-button stations, time switches, contactors, motor starters, motor switches, panelboards, and terminal cabinets.
2. Identification plates shall be of plastic stock and shall adequately describe function, voltage and phase of identified equipment. Where identification plates are detailed or described on Drawings, inscription and size of letters shall be as indicated. For lighting and power panels, identification plates shall indicate panel designation, voltage, and phase of panel. For terminal cabinets, identification plates shall indicate system contained in terminal cabinet.
3. Identification plates shall be black-and-white nameplate stock of bakelite with characters cut through black exposing white. Plates shall be furnished with beveled edges and shall be securely fastened in place with No. 4 Phillips-head, cadmium-plated steel, self-tapping screws. Characters shall be 3/16 inch high, unless otherwise indicated.

B. Markings:

1. Install identification markings to surface-mounted starters, switches, disconnect switches, contactors, and other devices controlling motors and appliances. Provide abbreviations required along with an identifying number. Markings to be provided with locking type stencils using paint of a contrasting color. Figures shall be 3/8 inch high unless otherwise indicated. Dymo Industries Inc., self-sticking plastic labels, with embossed characters made with a typewriter may be installed instead of stencils and paint; p-touch self adhesive plastic, or Brother P-Touch self sticking laminated plastic labels may be installed.
 2. High Voltage: High voltage switchboards, cabinets, boxes, and conduits exposed in accessible locations, including under buildings and in attics, are required to be marked "WARNING-HIGH VOLTAGE – ABOVE 600 VOLTS". Markings for switchboards shall consist of 18 gage steel, porcelain enamel sign of standard manufacture. Markings for boxes, cabinets, and conduits shall be by means of stenciling or printed self-adhesive markers, Westline Tel-A-Pipe, or equal. Provide letters of black on orange background and not less than 1-7/8 inches high. On conduit runs, install markings at intervals not exceeding 10 feet in any individual area. Markings shall be installed after other painting Work is complete.
- C. Warning Signs:
1. Provide a warning sign on outside of each door or gate to rooms or enclosures containing high voltage equipment. Signs required reading, "WARNING - HIGH VOLTAGE - KEEP OUT". Provide 2-inch high lettering.
 2. Provide a warning sign on each high-voltage non-load break disconnect and fused cutout (not oil filled). Signs required reading, "DO NOT OPEN UNDER LOAD". Provide 2-inch-high lettering.
 3. Provide signs of standard manufacture, 18 gage steel, with porcelain enamel finish. Provide red lettering on a white background.

PART 3 - EXECUTION

3.1 INSTALLATION AND SUPPORT OF BOXES

- A. Install outlet boxes flush with finished surface of wall or ceiling. Install plumb and securely fastened to structure, independent of conduit. Except where otherwise indicated, provide factory-fabricated adjustable attachment bar hangers between studs to support outlet boxes. When installation is performed in fire rated walls, maintain the wall's rating integrity by means of approved fire stop methods.
- B. Outlet boxes installed in suspended or furred ceilings with steel runner or furring channels shall be supported, except where otherwise indicated, by a Unistrut P-4000 Tessco A1200HS-10, Cooper B-Line B22s-HG, or OWNER approved equal channel spanning main ceiling runner channels. Each box shall be supported from its channel by a 3/8-inch 16 threaded steel rod with a Unistrut P-4008, Fastenal #48604, Copper B-Line 78101140346 or OWNER approved equal; nut and a Tomic No. 711-B Adapta-Stud, or OWNER approved equal. Rod shall be tightened to a jamb fit with channel and its nut. Box shall be locked to rod by means of a 1/2-inch locknut on stud and a 3/8-inch 16 hex nut locking stud to rod.

- C. Heights of outlets and equipment indicated on Drawings shall govern. In absence of such indications, following heights shall be maintained with heights measured to centerline unless otherwise noted:
1. Install wall-mounted switches at 48 inches above finished floor.
 2. Outlet boxes for fire alarm pull stations shall be mounted at a mounting height above finished floor that ensures that the operating handle of the initiating device is no higher than 48 inches from finished floor.
 3. Wall mounted fire alarm strobe or horn/strobe devices shall be mounted such that the entire lens is not less than 80 inches above finished floor. If ceiling heights allow, wall mounted appliances shall have bottom of lens a minimum of 80 inches but not more than 96 inches to the top of lens.
 4. Install outdoor fire alarm audible devices or fire alarm sprinkler flow bells at least 10 feet but not more than 12 feet above finished floor to center. Provide STI or other OWNER approved protective covers as required in plans.
 5. Voice evacuation speakers mounted indoors shall be mounted in ceiling space or if mounted on wall shall not be less than 10 feet to center above finished floor.
 6. Install clocks and speakers, in classrooms and offices, 8 feet above finished floor. Unless otherwise indicated.
 7. In rooms other than places of assembly such as, but not limited to, multipurpose rooms, auditoriums, and libraries, clock outlets and speakers in classrooms and offices shall be mounted 8 feet above finished floors. Other assembly areas such as gymnasiums shall be mounted 10 to 12 feet above finished floor. Provide STI, or equal protective covers for clocks when required.
 8. Install fire alarm strobe lights 80 inches to bottom of light above finished floor.
 9. Install outside bells and yard light outlets 4 feet above second floor level for 2 or more story buildings, 12 inches below top plate level for one story buildings without covered porch or arcade, and 12 inches below covered porch and arcade ceilings.
 10. Install desk telephones, power receptacle outlets, and data outlets 15 inches above finished floor.
 11. Install panelboards and terminal cabinets 6 feet 6 inches from finish floor to top of cabinet.
 12. Install television outlets at a height corresponding to location of television monitor, or as indicated on plans.
 13. The use of extension boxes shall be limited to not more than 1 times the original depth of junction box.

3.2 COVER PLATES

- A. Provide a plate on each switch, plug, pilot light, data, interphone, public telephone, and television outlet, and on existing and reset outlets where so indicated or required. Plates shall be of stainless steel unless otherwise specified.

- B. Flush wiring device and signal system outlets indicated to be blank covered, shall be covered with blank stainless-steel plates. Flush lighting outlets to be blanked shall be covered with Wiremold 5736 steel covers, or equal, painted to match surrounding finish. Provide stainless steel covers to blank indicated or required surface-mounted outlets.
- C. In the following cases, and at required locations. Switch and receptacle plates shall be engraved with the device(s), or fixtures being controlled, or as indicated:
 1. Three-gang and larger gang switches in locations other than classrooms.
 2. Lock switches.
 3. Pilot switches.
 4. Switches so located that operator cannot see fixtures, or items of equipment controlled while his hand is on the switch.
 5. Switches not in same room with fixtures or items of unit heaters, air curtains, fly fans, etcetera.
 6. Receptacles operating at other than 120 V shall be identified with the operating voltage.
 7. Switches operating on 277 V shall be identified with the operating voltage.
 8. Where indicated on Drawings.
- D. Designations shall be as indicated on Drawings or as specified by Architect.
- E. Standard GFI cover plates shall be Pass & Seymour 4600, Raco 5028-0, or equal. GFI cover plates shall be provided with a CAM lock mechanism with two keys or a padlock hasp that does not protrude through the face of the cover and will allow the shank of locks keyed Corbin No. 60 keys.

3.3 IDENTIFICATION OF CIRCUITS AND EQUIPMENT

- A. Provide descriptive nameplates or tags permanently attached to switchboards, motor control centers, transformers, panelboards, circuit breakers, disconnect switches, starters, pushbutton control stations and other apparatus installed for operation or control of circuits, appliances, fire alarm control panel(s), fire alarm annunciator(s), power supplies, terminal cabinets, energy management control units, and Information technology system backbone and distribution equipment points.
- B. Provide nameplates of engraved laminated plastic, or etched metal. Submit Shop Drawings denoting dimensions and format to Architect before installation. Fasten to equipment with escutcheon pins, rivets, self-tapping screws, or machine screws. Self-adhering or adhesive backed nameplates are not permitted.
- C. Fasten tags to feeder wiring in conduits at every point where runs are broken or terminated, including pull wires in empty conduits. Indicate circuit, phase, and function. Tag branch circuits in panel boards and motor control centers. Tags may be manufactured of pressure-sensitive plastic or embossed self-attached stainless steel or brass ribbon.
- D. Provide circuit identification cards and cardholders in all panel boards. Cardholders shall consist of metal frame retaining a clear plastic cover permanently attached to inside of panel door. List

of circuits shall be typewritten on a card. Circuit description shall include name or number of circuit's area and connected load.

- E. Junction and pull boxes shall have covers stenciled with box number when indicated on Drawings, or circuit numbers according to panel schedules. Data shall be lettered in a conspicuous manner with a color contrasting with finish.
- F. Name shall be correctly engraved, with a legend indicating function or areas, when required by codes or indicated on Drawings.

3.4 PROTECTION

- A. Protect Work of this section until Substantial Completion.

3.5 CLEANUP

- A. Remove rubbish, debris, and waste materials and legally dispose of off Project site.

END OF SECTION

SECTION 26 0519

LOW-VOLTAGE WIRES (600 VOLT AC)

PART 1 - GENERAL

1.1 SUMMARY

- A. Provisions of Division 01 apply to this section.
- B. Section Includes: Low-voltage wire, splices, terminations and installation.

1.2 SUBMITTALS

- A. Provide in accordance with Division 01.
- B. List of Materials: Submit a complete list of proposed materials.
- C. Shop Drawings: Provide detailed and dimensioned Shop Drawings indicating kind, weight and thickness of materials, insulation type, resistivity, conductivity, impedance, and conductance. Drawings shall contain sufficient information to assemble and install equipment at the Project site without further instructions.
- D. Prior to start of construction; provide letter from wiring and electrical cables manufacturer certifying that the products are qualified/ listed as low electromagnetic field products.

1.3 SUBSTITUTIONS

- A. Deviations/Substitutions from these requirements shall not be accepted without written approval from OWNER'S Design Standards Section and Maintenance and Operations Technical Unit. When deviating are proposed the following information shall be submitted:
 - 1. Substitution request form stating reasons and benefits to OWNER.
 - 2. OWNER'S approval shall be obtained for any equipment or materials substitutions.
 - 3. Proposed substitutions requests shall provide proof of compliance with OWNER'S requirements and applicable standards.
- B. Submittals must comply with contract general provisions.

1.4 QUALITY ASSURANCE

- A. Components and materials shall be listed and approved for the intended application by Underwriter's Laboratories (UL), or other Nationally Recognized Testing Laboratory (NRTL), and in compliance with applicable industry standards and codes.
- B. Wiring installation shall be performed under the supervision of state certified electricians. Contractor or Installer's electricians shall be certified in accordance with Labor Code sections 3099, and 3099.2 and section 209.0 of the California Code of Regulations.

- C. Contractor shall have adequate experience installing systems of similar size and complexity.
 - 1. Qualifications of Installer: Minimum five years of experience installing products and systems of similar scope and complexity.
 - 2. Installer shall have completed at least five projects of equivalent scope and complexity.
 - 3. Contractor shall have completed and commissioned a minimum of five service agreements that provide similar support services to those needed for this project.
 - 4. System startup and testing shall be performed under direct observation of the Project Inspector and OAR.
- D. The Project Inspector will observe installation of feeder cables. Notify the Project Inspector not less than two working days in advance of the proposed time of feeder installation.

1.5 WARRANTY

- A. Provide a one year labor warranty.
- B. Provide material warranty of no less than 10 years.
- C. Warranty period begins at substantial completion or project acceptance for beneficial occupancy.
- D. CONTRACTOR shall warranty all products and materials. Multiple warranty sources is not acceptable.

PART 2 - PRODUCTS

1.1 WIRES

- A. Pressure cable connectors shall be pre-insulated 3M Scotchlok, Ideal Wing Nut, O-Z/Gedney or equal.
- B. Wires shall be single conductor type THHN or THWN insulated with polyvinyl chloride and covered with a protective sheath of nylon, rated at 600 volts. Wires may be operated at a maximum continuous conductor temperature in dry locations of 90 degrees C. and 75 degrees C. in wet locations. Wires and cables shall be listed by Underwriter's Laboratories (UL) Standard 83 for thermoplastic insulated wires, and listed for installation in accordance with Article 310 of the California Electrical Code (CEC).
- C. Conductors shall be solid copper for 12 AWG and smaller conductors, and stranded copper for 10 AWG and larger conductors.
- D. Conductors shall be insulated with PVC and sheathed with nylon.
- E. Wires shall be identified by surface markings indicating manufacturer's identification, conductor size and metal, voltage rating, UL symbol, type designations and optional rating. Indentations for lettering are not permitted.

- F. Wires shall be tested in accordance with the requirements of UL standard for types THWN and THHN.
- G. Conductors shall be solid Class B or stranded Class C annealed uncoated copper in accordance with UL standards, or another Nationally Recognized Testing Laboratory (NRTL).

1.2 STANDARDS

- A. THWN/THHN wires shall comply with the following standards:
 - 1. UL 83 for thermoplastic insulated wires.
 - 2. UL 1063 for machine tool wires and cables.

PART 3 - EXECUTION

1.1 INSTALLATION

- A. Wires shall not be installed until debris and moisture is removed from conduits, boxes, and cabinets. Wires stored at site shall be protected from physical damage until they are installed and walls are completed.
- B. Wire-pulling compounds furnished as lubricants for installation of conductors in raceways shall be compounds approved and listed by UL, NRTL, or equal. Oil, grease, graphite, or similar substances are not permitted. Pulling of 2 AWG or larger conductors shall be performed with a cable pull machine. Any runs shorter than 50 feet are exempt. When pulling conductors, do not exceed manufacturer's recommended values
- C. At outlets for light, power, and signal equipment, pigtail splices with 8-inch circuit conductor leads for connection to fixtures, equipment, and devices.
- D. Pressure cable connectors, Yellow, Red, or Blue spring-loaded twist-on type, may be furnished in splicing number 8 AWG or smaller wires for wiring systems. Listed Push-in spring clamp wire connectors, Ideal In-Sure, or equal may be used in luminaires for fixture wiring.
- E. Joints, splices, taps, and connections to switchboard neutral, bonding or grounding conductors, conductors to ground busses, and transformer connections for wires 6 gage and larger shall be performed with high-pressure cable connectors approved for installation with copper conductors. Connectors shall be insulated with heavy wall heat shrink WCSM, or cold-applied roll-on sleeve RVS. Insulation level shall be a minimum of 600V and joints, splices, and taps shall be qualified to ANSI C 119.1, UL, NRTL, or equal listed mechanical pressure connections.
- F. Connections to any bussing and high-press cable connectors shall be securely bolted together with corrosion-resistant plated carbon steel, minimum grade five machine screws secured with constant pressure-type locking devices.
- G. Connection of any bonding or grounding conductors shall be securely bolted together with corrosion-resistant plated carbon steel, minimum grade five machine screws secured with constant pressure-type locking devices.
- H. Wire switchboards, panel cabinets, pull boxes, and other cabinets except public address, shall be neatly grouped and tied in bundles with nylon ties at 10-inch intervals. In switchboards,

panels and terminal blocks, wires shall be fanned out to terminals. If bundles are longer than 24 inches, a maximum of nine current carrying conductors may be bundled together.

- I. Install conductor lengths with a minimum length within the wiring space. Conductors must be long enough to reach the terminal location in a manner that avoids strain on the connecting lug.
- J. Maintain the conductor required bending radius.
- K. Neutral conductors larger than 6 gage, which are not color identified throughout their entire length, shall be taped, painted white or natural gray, or taped white where they appear in switchboards, cabinet, gutters or pull boxes. Neutral conductors 6 gage and smaller shall be white color identified throughout their entire length.
- L. Fire alarm and clock wiring shall be continuous from terminal cabinets or from equipment to each device. Splices are not permitted between devices and/or terminal cabinets at junction and pull boxes. Wiring shall be terminated at terminal blocks or devices only.
- M. Wiring systems shall be free from short circuits and grounds, other than required grounds. The contractor shall be responsible for the testing of feeder and branch circuit conductor's insulation resistance. The insulation of the conductors shall be tested prior to connections to any panelboards, switchboards, variable frequency drives, lighting control systems, ballasts, and wiring devices such as but not limited to GFI receptacles, TVSS receptacles, or equipment. Insulation testing of panelboards and switchboards shall be independently performed from the insulation testing of any conductors as specified in other sections of this specification.
 - 1. Utilize the services of an approved independent testing laboratory to perform megger time-resistance insulation testing of feeder conductors. Tests must be conducted with wires disconnected at both ends.
 - a. Provide calibration program records to assure the testing instrument to be within rated accuracy. The test equipment accuracy shall be in accord with the requirements stated by the National Institute of Standards and Technology (NIST).
 - b. Test equipment shall be provided with a label stating the date of last calibration. As a minimum the equipment shall have been calibrated within the past 12 months.
 - c. Test reports shall include the following:
 - 1) Identification of the testing organization.
 - 2) Equipment identification.
 - 3) Ambient conditions.
 - 4) Identification of the testing technician.
 - 5) Summary of project.
 - 6) Description of equipment being tested.
 - 7) Description of tests.
 - 8) Test results.

9) Analysis, interpretation and recommendations.

2. Utilize the services of an approved independent testing laboratory or a qualified contractor's employee (Technician certified in accordance with ANSI/NETA ETT-2000 Standard for Certification of Electrical Testing Personnel) to perform megger time-resistance insulation testing of branch circuit conductors. Tests must be conducted with wires disconnected at both ends.
 - a. Test equipment and report requirements stipulated under paragraph 3.01.N.1 apply to branch circuit testing.
3. Tests shall be performed in the presence of the Project Inspector.
4. Insulation resistance shall not be less than 100 mega-ohms.

1.2 COLOR CODES

A. General Wiring:

1. For phase and neutral conductors 6 gage or larger, permanent plastic-colored tape may be furnished to mark conductor end instead of coded insulation. Tape shall cover not less than 2 inches of conductor insulation within enclosure.
2. Color code conductor insulation as follows:

SYSTEM VOLTAGE		
Conductor	208Y/120	480Y/277
Phase A	Black	Brown
Phase B	Red	Orange
Phase C	Blue	Yellow
Neutral	White	Natural Gray

Neutrals shall be colored-distinguished if circuits of two voltage systems are used in the same raceway.

3. Where two voltage systems are combined in an enclosure; CONTRACTOR shall apply a permanent color code label where the circuits originate.

B. Signal Systems: Wires for signal systems shall be color-coded and installed under observation of the Project Inspector. Except where otherwise specified, color-coding shall be as follows:

<u>SYSTEM</u>	<u>COLOR CODE</u>
Clocks	Pink, Gray and Orange
Program Bells (some existing elementary schools)	White (Common)Black
Initiating Devices (Non-Addressable)	Red (+) and Black (-)
Program Bells (some existing secondary schools)	White (120 volt, common) Black (C.R. program) Blue (Shop program) Brown (Gym program) Yellow (Auditorium fire alarm)
Fire Alarm Horns	Pink (+) and Gray (-)
Fire Alarm Strobes	Orange (+) and Blue (-)
Un-Interruptible 24 Volt Power	Yellow (+) and White (-)

(Annunciator, Water Flow, and Audible Device)	Note: A single white wire may be common to both
Interruptible 24 Volt Power (4 wire smoke detectors, duct detectors)	Brown (+) and White (-) Note: A single white wire may be common to both
Switch-Leg Sprinkler Bell (Between water flow and audible device)	Violet (+) and White (-)
Door Holding Magnets (Non Power Limited)	Black (+) and White (-)

1.3 FEEDER IDENTIFICATION

- A. Feeder wires and cables shall be identified at each point the conduit run is broken by a cabinet, box, gutter, etc. Where terminal ends are available, identification shall be by means of heat shrink wire markers, which provide terminal strain relief. Markers shall be by Tyco Electronics, Panduit, Brady Perma-Sleeve, or equal. Identification in other areas shall be by means of wrap-around tape markers from Tyco Electronics, Panduit, Brady Perma-Code or equal. Markers shall include feeder designation, size, and description.

1.4 TAPE AND SPLICE KITS

- A. Splices, joints, and connectors joining conductors in dry and wet locations shall be covered with insulation equivalent to that provided on conductors. Free ends of conductors connected to energized sources shall be taped. Voids in irregular connectors shall be filled with insulating compound before taping. Thermoplastic insulating tape approved by UL, NRTL, or equal for installation as sole insulation of splices shall be furnished and shall be installed according to manufacturer's printed specifications.

1.5 PROTECTION

- A. Protect the Work of this section until Substantial Completion.

1.6 CLEANUP

- A. Remove rubbish, debris and waste materials and legally dispose of off the Project site.

END OF SECTION

SECTION 26 0526

GROUNDING AND BONDING

PART 1 - GENERAL

1.1 SUMMARY

- A. Provide and install an effective grounding and bonding system.
- B. Related Requirements:
 - 1. Refer to related sections for their system grounding requirements.
 - 2. Division 01 - General Requirements.
 - 3. Division 26 – Electrical.
 - 4. Division 27 – Communications.
 - 5. Division 28 - Electronic Safety and Security.

1.2. QUALITY ASSURANCE

- A. Reference Standards:
 - 1. IEEE 142 Green Book.
 - 2. Underwriter's Laboratories (UL).
 - 3. California Electrical Code.
 - 4. Building Industry Consultant Services International (BICSI).
 - 5. EIA/TIA (Signal and power).
 - 6. Nationally Recognized Testing Laboratory (NRTL).

1.3. SYSTEM DESCRIPTION

- A. Equipment, components, or materials that enclose electrical conductors, or are likely to be energized by electrical currents shall be effectively grounded.
- B. Metal equipment parts such as switchboards, panelboards, metal enclosures, raceways, equipment grounding conductors, and earth grounding electrodes shall be effectively bonded into a continuous grounding path.
- C. Metallic systems or electrically conductive materials shall be effectively bonded to the building's grounding electrode system.
- D. A separately derived AC system shall be grounded to the equipment grounding conductor and to a separate "made" electrode of building grounding electrode system.

- E. Provide effective electrical equipment bond continuity to all metal raceways and enclosures. Grounding shall be achieved through a code sized green insulated grounding conductor provided within each raceway.
 - 1. Each flexible conduit over six feet in length shall be provided with a green insulated grounding conductor of required size.
 - 2. Provide code sized equipment grounding conductor in all flexible conduits as required by CEC.
 - 3. The length of flexible conduit installations shall not be less than six feet.
 - 4. Effectively ground metal raceways and enclosures at each end.
- F. Cold water, or other utility piping systems, shall not be utilized as grounding electrodes. In addition to bonding to cold water pipe provide at least one of the following made grounding electrodes:
 - 1. A dedicated “made” electrode, fabricated of at least 20 feet of uncoated galvanized 1/2 inch diameter rebar encased by at least two inches of concrete, and placed next to the bottom of a concrete foundation, or footing in direct contact with earth. A welded extended portion shall surface at the location of the common grounding electrode bus bar and be extended by a 3/0 exothermic welded bare copper cable, or be welded directly to the bus. The exothermic weld shall be at least four inches above finished floor in a dry location. The main grounding electrode and associated grounding conductors shall be in an enclosure and in conduit.
 - 3. Concrete enclosed electrode, fabricated of at least 20 feet of No. 2 AWG, minimum size, bare copper conductor, encased by at least two inches of concrete, located within or near bottom of a concrete foundation, or footing, which is in direct contact with earth. Footing rebar shall be connected to copper wire with approved connectors.
 - 4. An external grounding electrode, as specified hereafter or as required by the CEC shall be installed and connected to foundation or footing rebar.
- G. Non-current carrying metal parts of high-voltage (1000 Volts or more) equipment enclosures, signal and power conduits, switchboard and panelboard enclosures, motor frames, equipment cabinets, and metal frames of buildings shall be permanently and effectively bonded to the grounding system. Provide a CEC sized equipment grounding conductor in every raceway.
- H. Metallic or semi-conducting shields and lead sheaths of cables operating above 1000 Volts shall be permanently and effectively grounded at each splice and termination.
- I. Neutral of service conductors shall be grounded as follows:
 - 1. Neutral shall be solidly grounded at only one point within the Project site for that particular service. Preferable location of grounding point shall be at the service switchboard, or main switch.
 - 2. Equipment and conduit grounding conductors shall be bonded to that grounding point.
 - 3. If other buildings or structures on the Project site are served from a switchboard or panelboard in another building, power supply is classified as a feeder and not as a service.

4. Equipment grounding conductor shall be installed from switchboard to each individual building. At building, grounding conductor shall be bonded with power equipment enclosures, metal frames of building, etc., to “made” electrode for that building.
 5. Feeder neutrals shall be bonded at service entrance point only; neutrals of separately derived systems shall be bonded at the source only.
- J. If there is a distribution transformer at a building the secondary neutral conductor shall be grounded to “made” electrode serving the building.
 - K. Within every building, the main switchboard or panelboard, shall be bonded to the cold water line. Metallic piping systems such as gas, fire sprinkler, or other systems shall be bonded to the cold water line.

1.4. SUBMITTALS

- A. Provide in accordance with Division 01.

PART 2 – PRODUCTS

2.1. MATERIALS

- A. Furnished yard boxes shall be precast concrete and shall be approximately 14 inches wide by 19 inches long by 12 inches deep or larger.
 - a. Boxes shall be furnished with bolt-down, checkered, cast iron covers and cast-iron frames cast into the yard boxes.
 - b. Yard boxes shall comply with District standard detail.
 - c. Provide yard boxes with hinged Frame Locking Cover.
 - d. Approved products include Brooks No. 36 HFL, Jensen Precast, Oldcastle Precast, Western Precast, Kistner, or equal.
- B. External ground electrodes shall be copper-clad steel ground rods, minimum 3/4-inch diameter by ten feet long.
- C. Clamps and fittings used in ground boxes below grade shall be listed for direct burial.

PART 3 - EXECUTION

INSTALLATION

- A. Grounding electrodes shall be installed in the nearest suitable planting area, where not otherwise indicated on Drawings, and each electrode shall terminate within a concrete yard box installed flush with finish grade. In planting areas, finish elevation of concrete yard boxes shall be two inches above planting surfaces.
- B. If concrete enclosed electrode is provided, grounding wire shall be terminated to a suitable copper plate with grounding lugs and must be enclosed in a raceway or box.

- C. Grounding rods shall be driven to a depth of not less than eight feet. Permanent ground enhancement material, (GEM) as manufactured by Erico Electrical Products, Loresco Powerset, Tessco Ultrafil or equal, shall be installed at each ground rod to improve grounding effectiveness. Install in accordance with manufacture's installation instructions.
- D. Grounding electrodes shall provide a resistance to ground of not more than 25 ohms.
- E. When installing grounding rods, if resistance to ground exceeds 25 ohms, two or more rods connected in parallel, or coupled together shall be provided to meet CEC grounding resistance requirements.
- F. Ground rods shall be separated from one another by not less than ten feet.
- G. Parallel grounding rods shall be bonded together with listed fittings and grounding conductors in galvanized rigid steel conduit, buried not less than 12 inches below finish grade.

3.1 TESTING

- A. Provide the services of an approved independent testing laboratory to test grounding resistance of "made" electrodes, ground rods, bonding of building steel, water pipes, gas pipes and other utility piping. Tests shall be performed as follows:
 - 1. Visually and mechanically examine ground system connections for completeness and adequacy.
 - 2. Perform fall of potential tests on each ground rod or ground electrode where suitable locations are available per IEEE Standard No. 81, Section 8.2.1.2. Where suitable locations are not available, measurements will be referenced to a known dead earth or reference ground.
 - 3. Perform the two-point method test per IEEE No. 81, Section 8.2.1.1 to determine ground resistance between ground rod and building steel, and utility piping - such as water, gas and panelboard grounds. Metal hand railings at building entrances and at handicapped ramps shall also be tested.
 - 4. Test shall be performed in the presence of the Inspector.
- B. Submit 3 copies of test results to the Architect. Test results shall be submitted on an official form from the independent testing laboratory recording Project location, test engineer, test conditions, test equipment data, ground system layout or diagram, and final test results.

3.2 PROTECTION

- A. Protect the Work of this section until Substantial Completion.

3.3 CLEANUP

- A. Remove rubbish, debris, and waste materials and legally dispose of off the Project site.

END OF SECTION

SECTION 26 0533
RACEWAYS, BOXES, FITTINGS, AND SUPPORTS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Raceways and wire ways.
2. Conduit installation.
3. Underground requirements.

B. Related Requirements:

1. Section 26 0500: Common Work Results for Electrical.
2. Section 26 0513: Basic Electrical Materials and Methods.
3. Division 27: Communications.
4. Division 28 - Electronic Safety and Security.

C. Applicable Standards and Codes.

1. EIA/TIA 569 Standards.
2. National American Standards Institute (ANSI).
3. National Electrical Manufacturer's Association (NEMA).
4. Nationally Recognized Testing Laboratory (NRTL).
5. California Electrical Code (CEC).
6. Uniform Building Code (UBC).
7. Underwriters Laboratory (UL).

1.2 SUBMITTALS

- A. Materials List: Provide in accordance with Division 01.

PART 2 - PRODUCTS

2.1 RACEWAYS

A. Conduit Materials:

1. Metallic conduit, and tubing shall be manufactured under the supervision of an UL, or another NRTL factory inspection and label service program. Each ten-foot length of conduit and tubing shall bear the UL or another NRTL label and manufacturer's name.
2. Rigid metallic conduit shall be rigid steel, heavy wall, mild steel, zinc-coated, with an inside and outside protective coating manufactured in accordance with ANSI C 80.1. Couplings, elbows, bends, conduits, bushings and other fittings shall be the same materials and finish as the rigid metallic conduit. Fittings, connectors, and couplings shall be threaded type, manufactured in accordance with ANSI C 80.1 and UL 6.
3. Electrical metallic tubing shall be steel tubing, zinc-coated with a protective enamel coating inside, manufactured in accordance with NEMA C 80.3. Fittings, couplings,

and connectors shall be gland compression type, set screw couplings and connectors not permitted. All parts shall be manufactured in accordance with NEMA C80.3 and UL 6A Electrical metallic tubing is designated hereinafter as EMT. Steel and rain tight fittings shall be approved and listed for the intended application.

4. Flexible steel conduit shall be of flexible interlocking strip construction with continuous zinc coating on strips, manufactured in accordance with UL 1.
 - a. Connectors and couplings shall be required fittings of the type, which threads into convolutions of flexible conduit.
 5. Liquid-tight flexible metal conduit shall be galvanized heavy wall, flexible locked steel strip construction, UV rated, with smooth moisture and oil-proof, abrasion-resistant, extruded plastic jacket. Connectors shall be as required for installation with liquid-tight flexible conduit and shall be installed to provide a liquid-tight connection.
 6. Non-metallic conduit shall be rigid PVC electrical conduit extruded to schedule 40 dimensions of Type II. Grade 1 high impact, polyvinyl chloride, sweeps, couplings, reducers and terminating fittings shall be listed under the UL, or another NRTL, and shall bear the manufacturer's listed marking.
 7. Multi-cell raceway shall be four inch PVC, Type 40, UL or another NRTL listed for underground use with optical fiber and signal system cables. Raceway shall be furnished with 3-1/2 inch factory installed inner ducts with required internal spacers, and required couplers, sweeps, and end bells. Multicell raceway shall be Carlon Multigard, or District approved equal.
 8. Metal Clad (MC) cable system is not allowed.
- B. Sleeves for Conduits: Sleeves shall be adjustable type by Carlon, U.S. Plastic, PEP Plastic or equal.
- C. Where conduit enters a building through a concrete foundation below grade, or ground water level, or where it is necessary to seal around a conduit where it passes through a concrete floor or wall, provide O-Z/Gedney Type FSK Thru Wall and Floor Seal, equivalent Cooper Crouse Hinds Thru-Wall, Legrand Thru-Wall, or equal.
- D. Expansion Joints-Seismic Separations between building(s) and other locations as indicated on drawings:
1. Provide Thomas & Betts XJG-TB, O-Z/Gedney. type AX with bonding strap and clamps, Cooper XJGD or equal. At exterior locations, provide Thomas & Betts XJG-TB, O-Z/Gedney type EX, Cooper XJGD, or equal. Provide O-Z/Gedney type AXDX, or equal combination deflection/expansion fittings at all seismic separations. Provide manufacture's internal and external bonding jumpers at all locations. Liquid-tight metal conduit or flexible metal conduit shall not be approved at expansion joints, separations between buildings or seismic separations.
 2. Provide expansion fittings at intervals not exceeding 100 feet in conduits exposed to direct sunlight. Fittings may be installed in the conduit run or where conduit attaches to junction or pull boxes. OZ/Gedney type AX, TX or EXE series, or equivalent by Thomas and Betts, Crouse-Hinds or approved equal.

E. Conduit Seal Fittings:

1. Provide conduit seal fittings where indicated on the Drawings. Conduit seals shall be of rigid galvanized steel. Seals in horizontal conduit installations shall be Thomas & Betts EYS, Appleton Type ESU, Crouse Hinds Type EYS, or equal. Seals in vertical conduit installations shall be Thomas & Betts EYD, Appleton Type SF, Crouse Hinds Type EYD, or equal, with continuous drain. When installing conduit seals make provision for percent fill space reduction in accordance with CEC.
2. Install sealing compound after wire has been installed. Ensure drain is not blocked in vertical seals when installing compound. Where conduit seals are installed in hazardous area applications, there shall be no conduit coupling, fitting, etc., between seal and boundary of hazardous area.

F. Surface Steel Raceway:

1. The surface steel raceway system for branch circuit wiring, data network, voice, video, and other low voltage wiring shall be as manufactured by the Wiremold Company, Hubbell, or Mono-Systems, Inc. or equal. The raceway system may be supplied pre-wired in accordance with all sections of these specifications and requirements herein, and shall be UL or another NRTL listed. Computer data installation shall be as required by other sections of this Division.
 - a. If furnished pre-wired, the system must be listed in accordance with UL or another NRTL for "Multiple Outlet Assemblies" and so labeled on interior of the assembly. The pre-wired installation must contain no extra wire splices in the raceway as compared to a contractor assembled installation assembled from components. The pre-wired steel raceway shall be Hi-Pot tested at the factory to prevent any potential bare wire or shot circuit defects.
2. The raceway base, cover, and device bracket shall be manufactured of steel and finished in ivory, gray enamel or custom colors suitable for field painting to match adjacent finishes.
3. The raceway shall be a two-piece design with a metal base and snap-on metal cover, except for the Wiremold V700 system, Hubbell HBL750 series and Mono-Systems Inc. S145-700 series that shall be a one-piece design. The base and cover sections shall be a minimum of 0.040 inch wall thickness. The base section shall be available in ten-foot lengths. A hand-operated cutting tool shall be available for the base and cover to ensure clean, square cuts. Wiremold V500, Hubbell V500, and Mono Systems inc. SM500 series are not permitted.
4. A full complement of fittings shall be furnished, including but not limited to, flat internal and external elbows, tees, entrance fittings, wire clips, cover clips, couplings, support clips, C-hangers and end caps. The fitting color shall match the raceway color. Fittings shall be supplied with a base where indicated and/or required. A take-off fitting shall be furnished as required to adapt to existing flush wall boxes.
5. Device brackets shall be furnished for mounting single or two-gang devices within the raceway. Devices shall be provided with the ability of mounting flush or in conjunction with standard steel, stainless steel, or manufacturer's metal faceplates.
6. The raceway shall be furnished with a complete line of connectivity outlets and modular inserts for unshielded twisted pair including category 5, fiber-optic, coaxial, and other cabling types with face plates and bezels to facilitate installation. Computer data installation shall be as required by other sections of this Division, and Division 27.

7. Raceway shall be furnished with corner elbows and tee fittings to maintain a cable bend radius which meets the requirements of fiber-optic and copper cables under EIA/TIA 569 for communications pathways.
- G. Factory Pre-Wired Surface Metal Raceway:
1. Furnish and install pre-wired surface metal raceways as indicated on Drawings and as specified.
 2. Metal Raceway shall be galvanized steel Wiremold V4000, Hubbell 4000 series, or Mono-Systems Inc. SMS-4000 series complete with raceway base, cover, fittings, receptacles and mounting plates required for a complete assembly. Raceway shall have two wiring compartments with integral dividing barrier for isolating the wiring compartments.
 3. Pre-wired assembly shall be UL, or another NRTL listed as a multi-outlet assembly and surface raceway as labeled on interior of assembly.
 4. Wiring devices and other components shall be factory installed, electrically wired and covers labeled as indicated on drawings. Each receptacle shall be identified with panelboard and circuit number from which it was fed. Grounding shall be maintained by means of factory installed grounding conductors.
 5. Where shown on Drawings, Raceway covers shall have provisions for mounting computer data outlets.
 6. Complete assembly is to consist of required fittings such as elbows, slide couplings for joining raceway sections, blank end caps and flat tees.
 7. Prewired assembly must contain no wire splices.
 8. Receptacles and wiring shall be as indicated on drawings and as specified.
 9. Where raceway is used for power and computer data outlets, installation of data outlets shall be as required by other sections of this specification.
 10. Prior and during installation, verify and comply with manufacturer's installation instructions.
 11. Entire assembly shall be tested for shorts, opens, ground faults, and wire insulation at factory and certified. Raceways shall be electrically continuous and bonded in accordance with California Electrical Code.
 12. Submit shop drawings for approval showing the complete layout of all components of each raceway, raceway lengths, each component description, location and circuit identification.
 13. All wiring devices shall be removable without requiring disassembly of wireway.
 14. Standard non OEM wiring devices shall be used as specified in District's specifications.
- H. Wireways shall be 16 gage galvanized steel enclosed hinge/screw wiring troughs, surface metal raceway, wireway, and auxiliary gutter designed to enclose electrical wiring. Wireway fittings shall be furnished with removable covers and sides to permit complete installation of conductors throughout the entire wireway run. Cover shall be furnished with keyhole slots to accept captive screws locking the cover securely closed. Wireways shall be UL or another NRTL listed, and shall be Square D Type LDB NEMA-1 enclosure for interior applications, or Type RDB NEMA-3R enclosure for exterior applications, or equal by Cooper B-line, Hoffman, Wire Guard, or Circle AW.
- I. Penetration in Fire-Rated Structures: Provide 3M, or equal, sealant and fire barriers for installing fire-rated seals around penetrations through floors, walls, and elevator hoistways. Fire stop

system must be UL, or another NRTL listed, and classified for through-penetration applications of metallic conduits and busways.

- J. Pull Wires: Install 1/8 inch polypropylene cords in empty or spare conduits.

PART 3 - EXECUTION

3.1 CONDUIT INSTALLATION

A. General Requirements:

1. Provide complete and continuous systems of rigid metallic conduit, outlet boxes, junction boxes, fittings and cabinets for systems of electrical wiring including lighting, power, and signal systems, except as otherwise specified.
2. EMT may be installed in interior concealed applications and in areas approved by owner. EMT shall not be installed in concrete, directly buried underground, outdoors, in boiler rooms, elevator pits, or where subject to damage.
3. Within buildings, flexible steel conduit may be installed instead of rigid steel conduit where permitted by code. Flexible steel conduit shall be installed:
 - a. For continuous lengths not exceeding more than 50 feet between pull points (pull boxes, outlet boxes, etcetera).
 - b. With no maximum total raceway length located within a building interior when the flex is located in concealed locations.
4. Flexible Steel conduit shall not exceed 1-1/2 inches in size.
5. Liquid-tight flexible steel conduit shall only be installed, except where otherwise specified, for final connection of motor terminal boxes, shop equipment, cafeteria equipment, HVAC equipment and other equipment, or for frequent interchange, and shall be of sufficient length, not exceeding 36 inches, to permit full travel or adjustment of motor on its base. Liquid-tight flexible conduit shall not be used for equipment not requiring adjustment or frequent interchange.
6. Connectors for flexible metal conduit shall be made of steel, and of the types which threads into convolutions of conduit. Connectors for watertight flexible metal conduit shall be as required for installation and shall be installed to provide a watertight connection.
7. Exposed conduit shall be installed vertically and horizontally following the general configuration of the equipment, using cast threaded hub conduit fittings where required and shall be clamped to equipment with suitable iron brackets and one hole pipe strap.
8. If connection is from a flush wall-mounted junction box, install an approved extension box.
9. Underground feeder distribution conduits for systems may be non-metallic conduit instead of rigid conduit except where otherwise specified or indicated.
10. Conduit shall be concealed unless otherwise indicated. Conduits exposed to view, except those in attic spaces and under buildings, shall be installed parallel or at right angles to structural members, walls, or lines of building. Conduits shall be installed to clear access openings.
11. Bends or offsets will not be permitted unless absolutely necessary. Radius of each conduit bend or offset shall be as required by ordinance. Bends and offsets shall be performed with standard industry tools and equipment or may be factory fabricated bends or elbows complying with requirements for radius of bend specified. Heating of metallic conduit to facilitate bending is not permitted. Public telephone conduit bends

and offsets shall be provided with a radius which is not less than ten times trade size of conduit unless otherwise permitted. Refer to underground installation, specified in this section, for radius of bends and offsets required for underground installations.

12. Running threads are not permitted. Provide conduit unions where union joints are necessary. Conduit shall be maintained at least six inches from covering of hot water and steam pipes and 18 inches from flues and breechings. Open ends of conduits shall be sealed with permitted conduit seals during construction of buildings and during installation of underground systems.
13. Expansion Joints/Seismic Separations/Separations between buildings/Locations Indicated: Provide Thomas & Betts XJG-TB, O-Z Electrical Mfg. Co. Inc. Type AX with bonding strap and clamps. Crouse Hinds XJGD, or equal. At exterior locations, provide Thomas & Betts XJG-TB, O-Z Electrical Mfg. Co. Inc. Type EX, Crouse Hinds XJGD, or equal. Provide Crouse Hinds, Thomas & Betts, or O-Z Electrical Mfg. Co. Type AXDX, or equal Combination Deflection/Expansion Fittings at all seismic separations. Provide manufactures internal and external Bonding Jumpers at all locations. Liquid-tight flexible conduit shall not be approved at expansion joints or seismic separations.
14. Where conduits are terminated in groups at panelboards, switchboards, and signal cabinets, etc., provide templates or spacers to fasten conduits in proper position and to preserve alignment. Conduits terminating at signal cabinets shall only enter cabinets in the following locations:
 - a. Conduits entering top, side, and bottom of cabinets shall be aligned in a single row, centered two inches from rear of cabinet.
 - b. Conduits entering back of cabinet shall be aligned in a single row centered two inches from top of cabinet.
 - c. Conduits shall not be spaced closer than three inches on centers.
15. Conduits above metal lath ceilings shall be rigidly suspended with pipe hangers or pipe racks or shall be secured to superstructure with factory fabricated pipe straps. Conduits in metal lath or steel stud partitions shall be tied to furring channels or studs. In ceiling spaces and in partitions, tie wires shall be spaced not more than 5 feet apart, shall fasten conduit tight against channels and studs at point of tie and shall not support any of conduit weight. Tie wire shall be 16 gage galvanized double annealed steel.
16. Where auxiliary supports, saddles, brackets, etc., are required to meet special conditions, they shall be fastened rigid and secure before conduit is attached.
17. Conduit in ceiling spaces, stud walls, and under floors, shall be supported with factory fabricated pipe straps or shall be suspended with pipe hangers or pipe racks. Pipe straps shall be attached to and shall fasten conduit tight at point of support against ceiling and floor joists, rafters, and wall studs, or two-inch x four-inch headers fitted between joists or wall studs.
18. Conduits installed on exposed steel trusses and rafters shall be fastened with factory fabricated conduit straps or clamps, which shall fasten conduit tight against supporting member at point of support.
19. Conduits installed under buildings shall be strapped with factory fabricated conduit straps to underside of concrete floor or joists, or wood floor joists, or shall be suspended with pipe hangers or pipe racks. Conduits under building are not permitted to be placed directly on grade; they shall be suspended from building or shall be buried below surface or ground. 1-1/4 inch and larger conduits under buildings shall be installed with conduit hangers or racks.

20. Pipe hangers for individual conduits shall be factory fabricated. Steel rods shall be 3/8 inch for two-inch conduit hangers and smaller and shall be 1/2 inch for 2 1/2-inch conduit hangers and larger.
21. Pipe racks for groups of parallel conduits and for supporting total weights not exceeding 500 pounds shall be trapeze type and shall consist of a cross channel, Steel City Kindorf B-900, Unistrut P-1000, equivalent Cooper B-Line or equal, suspended with a 3/8 inch minimum diameter steel rod at each end. Rods shall be fastened with nuts, top and bottom to cross-channel and with square washers on top of channel. Conduits shall be clamped to top for cross-channel with conduit clamps, Steel City Kindorf C-105 or Unistrut P-1111 through P-1124, equivalent Cooper B-Line, or equal. Conduits shall not be stacked one on top of another, but a maximum of two tiers may be on same rack providing an additional cross-channel is installed. Where a pipe rack is to be longer than 24 inches, or if the supported weight exceeds 500 pounds, submit Shop Drawings of installation to the Architect for review.
22. Conduits suspended on rods more than two feet long shall be rigidly braced to prevent horizontal motion or swaying. Installation shall meet zone 4 seismic requirements.
23. Factory fabricated pipe straps shall be one or two-hole formed galvanized clamps, heavy-duty type, except where otherwise specified.
24. Hangers, straps, rods, or pipe supports under concrete shall be attached to inserts set at time concrete is placed, or with approved concrete anchors. Under wood, install bolts, lag bolts, or lag screws; under steel joists or trusses, install beam clamps. Contractor shall submit size of anchors, bolts, screws, and installation method to Architect for approval prior to start of any work.
25. Conduits shall be supported at intervals required by code, but not to exceed ten feet. One inch and smaller exposed conduits shall be fastened with one-hole malleable iron straps. Perforated straps and plumber's tape is not permitted for the support of conduits.
26. Conduits stubbed up through a roof or an arcade shall be flashed with a waterproof flashing. Refer to Division 07 for additional requirements.
27. Bushings and locknuts for rigid steel conduit shall be steel threaded insulating type. Setscrew bushings are not permitted.
28. Flex conduits shall be cut square and not at an angle.
29. Routing of conduits may be changed providing length of any conduit run is not increased more than ten percent of the length indicated on Drawings.

B. Underground Requirements:

1. Conduits and multicell raceways installed underground shall be entirely encased in three inch thick concrete on all sides, except where otherwise specified. Provide required spacers to prevent any deflection when concrete is placed and to preserve position and alignment. Conduits and raceways shall be tied to spacers. Anchors shall be installed to prevent floating of conduits and raceways during placing of concrete. Provide red colored concrete to encase conduits of systems operating above 600 volts.
2. Underground conduits and raceways shall be buried to a depth of not less than 24 inches below finished grade to top of the concrete envelope, unless otherwise specified.
3. Assemble sections of conduit with required fittings. Cut ends of conduit shall be reamed to remove rough edges. Joints in conduits shall be provided liquid-tight. Bends at risers shall be completely below surface where possible.
4. Conduits and raceways in a common trench shall be separated by at least three inches of concrete. Electrical power and/or lighting conduit runs installed in a common trench

with conduits containing signal system wiring such as public address, telephone, intrusion detection, fire alarm, television, computer networking, and clock systems shall maintain a separation of a minimum of six inches from these types of signal system conduits and raceways. Electrical power, lighting and signal conduits and raceways installed in a common trench with other utility lines such as gas, water, sewer and storm lines shall maintain 12 inches separation from these types of utility lines.

5. The Inspector will observe underground installations before and during concrete placement. A mandrel shall be drawn through each run of conduit in presence of the Inspector before and after placing concrete. Mandrel shall be six inches in length minimum, and have a diameter that is within 1/4 inches of diameter of conduit to be tested.
 6. Non-metallic conduit installations shall comply with following additional requirements. Joints in PVC conduit shall be sealed by means of required solvent-weld cement supplied by conduit manufacturer. Non-metallic conduit bends and deflections shall comply with requirements of applicable electrical code, except that minimum radius of any bend or offset for conduits sized from 1/2 inch to 1 1/2-inch inclusive shall not be less than 24 inches. Bends at risers and risers shall be PVC-coated rigid steel conduit. Radius of curve of bends or offsets in non-metallic conduit for public telephone system shall be not less than ten times trade size of conduit, unless otherwise specifically permitted.
 7. Furnish and install a six-inch wide, polyethylene, red underground barrier type 12 inches above full length of concrete reading, "CAUTION ELECTRIC LINE BURIED BELOW".
 8. Underground conduit systems provided for utility companies shall be furnished to meet the requirements of the utility companies requiring service.
 9. Protect inside of conduit and raceway from dirt and rubbish during construction by capping openings.
 10. Add bell-end bushings for conduit stub-up including underground entries to pull boxes, and manholes. Under floor standing switchboards and motor control centers provide a four-inch galvanized nipple with ground bushing.
 11. Underground conduit for systems operating above 600 volts shall be a minimum size of four inches.
 12. At portable classroom all stub ups shall be installed with a coupling flush to finish grade.
 13. Underground conduits and raceways shall be swabbed prior to wire pull.
- C. Rooftop conduit shall be supported from channels, stands, clamps, trapezes, rollers, or structures mounted on 100% rubber, UV resistant rooftop supports with reflective strips, Dura-Blok, or equal. Roller type supports shall be provided below and above conduit to prevent its dislodgement. Bottom of conduits shall clear the roof surface by 10 inches.
1. At PVC roofing provide walk tread, polyester reinforced, UV resistant, with surface embossment at rooftop supports. Heat welding of walk pads shall only be done by manufacturer certified installers.
 - a. Sika-Sarnafil and Carlisle: Walk tread shall be no more than one inch larger than the plan area of the pipe support blocks and adhered to the roof membrane with Sika 1A or Carlisle Universal Single-Ply sealant, as applicable.

- b. Johns Manville: Walk tread shall be installed under the pipe support blocks and adhered to the blocks, if possible, and left loose laid on top of the PVC roof system. Walk-pad shall have a minimum of 4 inches of material past perimeter on all 4 sides of block.
 - 2. Built-up roofing: Provide APP granulated modified torch-down at each pipe support block. Torch-down shall extend 2 to 4 inches beyond the edges of the block and adhered by torch application over existing cap sheet membrane. This work shall be performed by a certified roofer.
- D. General Installation Requirements for Computer Network System Conduits:
1. Location of outlet boxes and equipment on Drawings is approximate, unless dimensions are indicated. Drawings shall not be scaled to determine position and routing of wireways, drops, and outlet boxes. Location of outlet boxes and equipment shall conform to architectural features of the building and other Work already in place and must be ascertained in the field before start of Work.
 2. The maximum pulling tensions of the specified cables shall not be exceeded and proper radius of cable bends shall be maintained.
 3. For computer network wiring, conduit types shall be limited to rigid metal conduit, electrical metallic tubing, schedule 40 PVC, multi-cell raceways, and flexible metallic conduit for lengths less than six feet.
 4. Interior section of conduit run shall be not longer than 100 feet and shall not contain more than two bends of 90 degrees between pull points or pull boxes.
 5. The inside radius of a conduit bend shall be at least six times the internal diameter of the conduit. When the conduit size is greater than two inches, the inside radius shall be at least ten times the internal diameter of the conduit. For fiber-optic cable, the inside radius of a conduit bend shall be at least ten times the internal diameter of the conduit.
 6. Conduit shall be sized in accordance with Table 4.4-1 of EIA/ TIA 569 standard.
 7. Splicing or terminating cables in pull boxes is not permitted.
 8. For indoor application, a pull box shall be provided in conduit run where:
 - a. The length is over 100 feet.
 - b. There are more than two bends of 90 degrees.
 - c. There is a reverse bend in the run.
 9. Boxes shall be provided in a straight section of conduit and shall not be installed in lieu of a bend. The corresponding conduit ends are to be aligned with each other. Conduit fittings shall not be installed in place of pull boxes.
 10. Where a pull box is provided with raceways, pull box shall comply with the following:
 - a. For straight pull-through, provide a length of at least eight times the trade-size diameter of the largest raceway.
 - b. For angle and U-pulls:
 - 1) Provide a distance between each raceway entry inside the box and the opposite wall of the box of at least six times the trade-size diameter of the largest raceway, this distance being increased by the sum of the trade-size diameters of the other raceways on the same wall of the box.

- 2) Provide a distance between the nearest edges of each raceway entry enclosing the same conductor of at least:
 - a) Six times the trade-size diameter of the raceway; or
 - b) Six times the trade-size diameter of the larger raceway if they are of different size.
 - c) For a raceway entering the wall of a pull box opposite to a removable cover, provide a distance from the wall to the cover of not less than the trade-size diameter of the largest raceway plus six times the diameter of the largest conductor.
 11. Drawings generally indicate Work to be installed, but do not indicate all bends, transitions of special fittings required to clear beams, girders or other Work already in place. Investigate conditions where conduits and wireways are to be installed, and furnish and install required fittings.
- E. Slabs on Grade:
1. Unless specifically reviewed by the Architect and DSA, conduits 1 1/4-inches and larger are not permitted to be installed in structural concrete slabs. Where conduits are permitted, and are installed in concrete slabs on grade, slabs shall be thickened at bottom where conduits occur to provide three inches of concrete between conduit and earth. Required excavation shall be part of the Work of this section.
 2. If concrete slab is five inches or more in thickness with a moisture barrier plastic sheet between earth and slab, one inch and smaller conduits shall be installed in the slab with a minimum of one inch concrete between earth and conduit.
- F. Concrete Walls, Beams, and Floors: Provide sleeves where conduits pierce concrete walls, beams, and floors, except floor slabs on grade. Sleeves shall provide 1/2 inch clearance around conduits. Sleeves shall not extend beyond exposed surfaces of concrete and shall be securely fastened to forms. Where conduits pass through walls below grade, seal with required sealant and backer materials between conduit and sleeve to provide a watertight joint. Sealant shall be as indicated in Section 07 9200: Joint Sealants.

3.2 STUBS

- A. Panelboard: Install two one inch conduits from each flush mounted panelboard to access under floor space and to access above ceiling space where these conditions occur. Cap conduits with standard galvanized pipe caps.
- B. Floor: At points where floor stubs are indicated in open floor areas, for connections to machines and equipment, conduits shall be terminated with couplings, tops flush with finished floor. Stubs shall extend above couplings the indicated distance. Where capped stubs are designated, couplings shall be closed with cast iron plugs with screw drive slots.
- C. Underground:
1. Underground conduit stubs shall be terminated at locations indicated, and shall extend five feet beyond building foundations, steps, arcades, concrete walks and paving. Rigid metallic conduit stubs and non-metallic conduit stubs shall be capped by installing a coupling flush in end wall of concrete encasement and plugging with a permitted plug. Project record drawings shall indicate location of ends of underground conduit stubs fully dimensioned and triangulated with reference to buildings or permanent landmarks. These dimensions, including depth below finished grade, shall be marked on project record drawings in presence of the Inspector before backfilling trench. Where extending existing concrete encased stubs, clean, chip and wire brush end of existing concrete and brush on a heavy coat of neat cement paste or epoxy bonding agent.

2. Over ends of individual underground conduit stubs or groups of conduit stubs, install four-inch by 18-inch deep PVC filled with concrete, flush with finished grade in asphaltic concrete or lawns, and two inches above finished grade in planting areas. Cast a three-inch by three-inch brass plate engraved "ELECT" flush in top of concrete. Secure plate to concrete with brass dowels or as indicated on drawings.

3.3 PROTECTION

- A. Protect the Work of this section until Substantial Completion.

3.4 CLEANUP

- A. Remove rubbish, debris and waste materials and legally dispose of off the Project site.

END OF SECTION

SECTION 26 0800

ELECTRICAL SYSTEMS COMMISSIONING

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Section Includes:
 - 1. General requirements for Commissioning (Cx) of lighting systems components, lighting controls and HVAC systems line voltage interconnection components, including installation, start-up, testing and documentation according to construction documents and Commissioning Plan (CxP).
 - 2. Standard procedures for the execution of commissioning work shall be in conformance with Division 1, Section 01 9113 General Commissioning Requirements. Coordinate work with the Commissioning Services Provider (CxSP).

1.2 RELATED REQUIREMENTS

- A. Division 01 - General Requirements.
- B. Section 01 9113: General Commissioning Requirements.
- C. Section 01 7900: Maintenance and Operations Staff Demonstration and Training.
- D. Section 23 8000: Heating, Ventilation, and Air Conditioning Equipment.
- E. Section 23 0800: HVAC Systems Commissioning.
- F. Section 23 0923: Environmental Control and Energy Management Systems.
- G. Section 23 0813: Environmental Controls and Energy Management System Commissioning.
- H. Section 26 0500: Common Work Results for Electrical.
- I. Section 26 0513: Basic Electrical Materials and Methods.
- J. Section 26 0526: Grounding and Bonding.
- K. Section 26 0519: Low Voltage Wires (600 Volt AC).
- L. Section 26 0586: Motors and Drives.
- M. Section 26 2419: Motor Control Center and Motor Control Devices.
- N. Section 26 5010: Solid State (LED) Lighting.
- O. Section 26 0923: Lighting Control Systems.
- P. Section 26 5563: Theatrical Lighting and Stage Dimming Systems (Middle and High Schools).
- Q. Section 26 5566: Theatrical Lighting and Stage Dimming Systems (Elementary Schools).
- R. Section 26 5568: Athletic Fields Lighting.

1.3 REFERENCES

- A. Applicable codes, standards, and references: inspections and tests shall be in accordance with the following applicable codes and standards:
1. National Electrical Testing Association – NETA.
 2. National Electrical manufacturer’s Association – NEMA.
 3. American Society for Testing and Materials – ASTM.
 4. Institute of Electrical and Electronic Engineers – IEEE.
 5. American National Standards Institute – ANSI.
 6. National Electrical Safety Code – NESC.
 7. California Building Code – CBC.
 8. California Electrical Code – CEC.
 9. California Green Building Standards Code (CalGreen).
 10. Conglomerate for High Performance Schools (CHPS).
 11. Insulated Power Cables Engineers Association – IPCEA.
 12. Occupational Safety and Health Administration – OSHA.
 13. National Institute of Standards and Technology – NIST.
 14. National Fire Protection Association – NFPA.
 15. California Electrical Code.
 16. ANSI/NFPA 70B – Electrical Equipment Maintenance.
 17. NFPA 70E – Electrical Safety Requirements for Employee Work Places.
 18. ANSI/NFPA 101– Life Safety Code.

1.4 SUBMITTALS

- A. Submittals shall include the following:
1. Submit required Cx submittals in accordance with Division 1 Specification Sections.
 2. Copy of the Architect’s reviewed and accepted submittals to the CxSP via the OAR.
 3. List of team members who will represent the CONTRACTOR in the Pre-functional Equipment Checks and Functional Performance Testing, at least two weeks prior to the start of Pre-functional Equipment Checks.
 4. Detailed manufacturer installation and start-up, operating, troubleshooting and maintenance procedures, checklist documentation and field checklist forms to be used by factory or field technicians, and a copy of full details of OWNER-contracted tests, full factory testing reports, if any, and Warranty information, including responsibilities of OWNER to keep Warranty in force, clearly defined.
 5. Detailed manufacturer’s recommended procedures and schedules for Pre-functional Equipment Checks, supplemented by CONTRACTOR’s specific procedures, and Pre-functional Tests, at least four weeks prior to the start of Pre-functional Performance Tests.

6. After facility's commission is complete, submit completed Pre-functional Equipment Checklists and Functional Performance Test checklists organized by system and by subsystem. Bind information in a single package. The results of failed tests shall be included along with a description of the corrective actions taken.

1.5 MEETINGS, SEQUENCING AND SCHEDULING

- A. Meetings: Attend (Cx) meetings as required under Section 01 9113 and the Cx Plan.
- B. Sequencing and Scheduling: The work described in this Section shall begin only after work required in related Division 26 Sections has been successfully completed, and tests, inspection reports and Operation and Maintenance manuals required in Division 26 Sections have been submitted and approved. The start-up and Pre-functional Equipment Checklists shall be completed and submitted to the OWNER's Authorized Representative (OAR) prior to the functional performance tests. Refer to the project's Cx Plan for more details.
 1. Coordinate electrical work with the work of other trades prior to scheduling of any Cx procedures.
 2. Coordinate the completion of electrical testing, inspection, and calibration prior to start of Cx activities.
 3. Cx activities shall be scheduled in accordance with project's Cx plan.

1.6 QUALITY CONTROL

- A. Comply with OWNER's Quality Control Specifications, Sections 01 4516 – 01 4519, as applicable.
- B. Incorporate manufacturer's recommended Cx procedures for the systems and equipment to be commissioned under this Section.

PART 2 - PRODUCTS

2.1 TEST EQUIPMENT

- A. Equipment to be utilized in the commissioning process shall meet the following requirements:
 1. Provide test equipment as necessary for the equipment and systems to be commissioned.
 2. Provide testing equipment and accessories that are free of defects and certified for use.
 3. Provide testing equipment with current calibration labels per NIST Standards.
 4. Testing equipment shall be UL Listed.

PART 3 – EXECUTION

3.1 COMMISSIONING PROCESS REQUIREMENTS

- A. Work to be performed prior to commissioning:
 1. Complete all phases of the work so the system(s) can be started, tested, adjusted, balanced, and otherwise commissioned.

2. Start-up services required to bring each system into full operational state and ready for functional performance testing:
 - a. Completion of authorized manufacturer representative's start-up procedures and recommendations.
 1. Provide Manufacture's start-up completed forms.
 - b. Completion of pre-functional checklists.
 - c. Copy of required manufacturer and field testing.
 - d. Motor rotation check.
 - e. Control sequences of operation.
 - f. Full and partial load performance.
 3. If modifications or corrections to the installed systems are required to bring the system(s) to acceptance levels due to CONTRACTOR's incorrect installation or defective materials, such modifications or corrections shall be made at no additional cost to the OWNER.
 4. Functional tests shall not start until each system is complete and the above items have been documented and submitted to the Engineer of Record, Cx Services Provider and OWNER for review.
- B. Pre-commissioning Responsibilities: Inspection, calibration and testing of the equipment and devices necessary to commission the following systems:
1. Electrical Lighting Systems.
 2. Lighting Controls.
 3. HVAC line voltage electrical components.
 4. Line voltage interface of Environmental Controls and Energy Management System with other systems.
 5. Photovoltaic Systems.
- C. Commissioning Process Requirements: Refer to Section 01 9113 General Commissioning Requirements, related sections and Cx Plan for information on meetings, start-up plans, Pre-Functional and Functional Performance Testing (FPT), operations and maintenance data, and other Commissioning activities.

3.2 PREPARATION

- A. Provide certified electricians and/or qualified personnel as required with adequate tools and equipment necessary to perform Cx activities.
- B. Provide all equipment required for the commissioning of equipment and systems indicated in article 3.01.B.
- C. Provide certified testing agency personnel or report(s) as required in the Cx Plan.

3.3 TESTING

- A. Testing documentation shall include the following minimum information:
 1. Test number.
 2. Equipment used for the test, with manufacturer and model number and date of last calibration.

3. Date and time of the test.
 4. Indication of whether the record is the first commissioning test, or a retest following correction of a previously identified issue.
 5. Identification of the system, subsystem, assembly, or equipment.
 6. Conditions under which the test was conducted, including (as applicable) ambient conditions, set points, override conditions, and status and operating conditions that impact the results of the test.
 7. Systems and assemblies test results, performance and compliance with contract requirements.
 8. Issue number and description of corrected issue that prompted retesting.
 9. Name and signature(s) of witnesses and the person(s) who performed the test(s).
- B. Test lighting and controls systems to verify performance, operation, functionality, light levels, energy usage, and compliance with construction documents.
1. Start up, test and document results under the observation of the CxSP.
 2. Execute the Functional Performance Test (FPT) under the observation of the CxSP.
 3. Provide completed and signed FPTs to CxSP for inclusion in the commissioning report.
 4. Functions and Testing Conditions:
 - a. Occupancy sensors and timer controls for lighting:
 - 1) Verify that specified functions and features are set up, debugged and fully operable at time of test.
 - 2) Verify that occupant override feature functions as intended in the contract documents.
 - 3) Verify that sensors response times/durations are set properly.
 - 4) Test the sequence of operation for features and modes and confirm that adjustable times match the design specifications and contract documents.
 - 5) Verify that sensors are located per manufacturer's recommendations.
 - b. Electric lighting dimming, photocells and controls:
 - 1) Test the dimming controls during daytime when conditions are such that controls should be dimming electric lighting.
 - 2) Verify that amperage changes in light fixtures are proportional to external light changes. Verify that dimmed light levels uniformity at the specified work plane remain within specified limits.
 - 3) Verify that delays and ramp times are set and functioning so that the speed of change of light fixture output is slow enough to not bother occupants, and in compliance with the specifications.
 - 4) Verify that dimming does not cause lower than specified light levels in adjacent "non-dimmed" spaces.

- 5) Verify that the controls and sensors cannot be easily overridden or disabled by occupants.
 - 6) Verify that dimming systems in places of assembly are interfaced with the Central Fire Alarm system.
 - 7) Verify that dimmed lighting in these areas shall come back to full bright during a fire alarm or emergency condition.
- c. Illumination Levels, Night Conditions:
- 1) Verify that lighting throughout the building is operating automatically.
 - 2) Test with doors closed (to simulate actual occupancy) and after finishes are complete.
- d. Illumination Levels, Day Conditions:
- 1) Verify that lighting levels comply with average maintained foot-candle levels shown on plans.
 - 2) Verify that lighting throughout the building is operating automatically.
 - 2) Test with doors closed (to simulate actual occupancy), after finishes are complete, and room is furnished.
 - 3) Test at different times during the day, or under OWNER-approved simulated conditions, to ensure proper system response and to determine that lighting levels are within specified requirements.
 - 4) In classrooms and educational spaces test the system for the different pre-determined settings. Quiet time, AV mode, all on/off, up/down dimming, and standard operations.
- e. Lighting Power Density: Verify building lighting power density. Perform the test with interior lighting turned on and any manual or automatic controls temporarily overridden. Provide statement of compliance with 100% design energy report. Measurements shall be taken at least one minute after lights are turned on.
- f. Emergency Lighting System: Verify that the system operates automatically under any condition, without human intervention, and that it resets back to normal operations after the power failure or emergency condition is over or cleared.
5. Acceptance Criteria:
- a. Lighting Controls: For the conditions, sequences and modes tested; dimming, occupancy, photocell, and timing controls, integral components and related equipment shall respond to changing conditions and parameters defined in the Contract Documents.
 - b. Illumination Levels: Average light levels in the tested space at the work plane elevation shall be in the range of plus or minus 10% of the specified light level range for the space.

- c. Lighting Power Density: Average instantaneous lighting power density shall be within plus or minus ten percent of that indicated in the Construction Documents.
 - d. Power factors on lighting circuits shall be greater or equal to 0.95, or as required by lighting fixture specifications.
 - e. Electrical system total harmonic distortion shall be smaller than 20%.
 - f. Electrical equipment AIC ratings shall be as indicated in construction drawings.
 - g. Feeders % voltage drop. Flag feeders with voltage drop greater than 3%.
6. Sampling Strategy for Identical Units:
- a. Lighting Controls: Test all automatic interior lighting controls.
 - b. Illumination Levels: Test all spaces, zones and rooms to verify as proper light levels.
- C. HVAC Electrical Component Testing
- 1. Document HVAC Division 23 electrical components using the startup procedure submitted by CONTRACTOR and accepted by the CxSP.
 - 2. Complete and submit Start-up, Pre-functional, and Functional Checklists.
 - 3. Verify the following information prior to HVAC system equipment startup.
 - a. Voltage.
 - b. Phase.
 - c. Motor Size.
 - d. Lock Rotor Amperage.
 - e. Full Load Amperage.
 - g. Minimum and Maximum Circuit Ampacity.
 - h. Feeder protection or branch circuit protection, breaker or fuse size as applicable.
 - 4. Coordinate and check corresponding unit electrical protection.

3.4 ADJUSTING

- A. Incorrect installations, including improper adjustments may result in additional work being required for Cx acceptance.
 - 1. Perform work required to correct installations not meeting contract requirements at no additional cost to the OWNER.
- B. Corrective work shall be completed in a timely manner to permit completion of the Cx process.
 - 1. Refer to the Cx Plan for retesting requirements necessary to achieve required system performance.
 - 2. If the systems' Cx deadline, as defined in the Cx Plan, goes beyond the scheduled completion of commissioning without resolution of the problem, the OWNER reserves the right to obtain supplementary services or equipment to resolve the problem.

- a. The cost of additional and/or supplementary services inquired by OWNER as a result of CONTRACTOR's lack of performance, or inability to resolve identified issues will be solely the responsibility of the CONTRACTOR.

3.5 TRAINING

- A. Provide training and documentation as required in construction documents.

END OF SECTION

SECTION 26 0923

LIGHTING CONTROL SYSTEMS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Low-voltage lighting control system.

B. Related Requirements:

1. Division 01 - General Requirements.
2. Section 26 0500 – Common Work Results for Electrical.
3. Section 26 0513 – Basic Electrical Materials and Methods.
4. Section 26 0519 – Low-Voltage Wires (600 Volt AC).
5. Section 26_0526 – Grounding and Bonding.
6. Section 26 0533 – Raceways, Boxes, Fittings, and Supports.
7. Section 26 0800 – Electrical Systems Commissioning.
8. Section 26 2416 – Panelboards and Signal Terminal Cabinets.
9. Section 26 5000 – Lighting.
10. Section 26 5010 – Solid State (LED) Lighting.
11. Section 26 5200 – Emergency Power.

1.2 SUBMITTALS

A. Provide in accordance with Division 01.

B. Submit a complete one-line diagram of the proposed system configuration for Architect/Engineer's review. The riser diagram shall identify but not be limited to wiring, equipment, components, interconnection with other systems, and location and type of raceways.

C. Manufacturer's Data: Submit catalog cuts and description of each system component.

D. Provide wiring diagrams and installation details for lighting control equipment.

E. Provide a complete sequence of operation and system interface requirements with fire alarm, and other applicable systems as depicted in construction documents.

F. Shop Drawings: Submit a complete set of detailed Shop Drawings for the entire lighting control system; the shop drawings shall include but not be limited to relay panels with

designations and dimensions, day light sensors locations based on manufacturer's recommendations, and system components with manufacturer's part numbers.

- G. Installation Instructions: Submit manufacturer's written installation instructions, wiring diagrams. Instructions shall include recommendations for handling of equipment and parts, and protection and storage requirements.
- H. Software flow diagram of and complete sequence of operation.
- I. Software licenses and electronic keys, and list of assigned passwords.
- J. Supplemental local or factory training schedule for post warranty support.
- K. A complete list of recommended spare parts with pricing for the OWNER's use in keeping the environmental control system downtime to a minimum.

1.3 SUBSTITUTIONS

- A. Deviations from these requirements shall not be accepted without written approval from OWNER'S Design Standards and Maintenance and Operations Technical Units. Substitutions requests shall be accompanied with the following information:
 - 1. Substitution request form documented with substantiating reasons for the deviation and proposed benefits to the OWNER.
 - 2. Provide proof of compliance with characteristics indicated in this specifications section.
- B. Documentation must comply with contract general provisions.

1.4 QUALITY ASSURANCE

- A. Components shall be listed and labeled by Underwriter's Laboratories (UL), or another Nationally Recognized Testing Laboratory (NRTL).
- B. Lighting control system and peripheral devices with IP addresses shall be UL listed in compliance with UL-2900-1 – Standard for Safety, Software Cybersecurity for Network-Connectable Products.
- C. Lighting Control Systems shall comply with the state of California Building and Electrical Codes, and Title 24 energy requirements in effect at time of submittal for building permit.
- D. Conduct a coordination meeting with the lighting control contractor, electrical contractor, EOR, Manufacturer Representative, Commissioning Agent, and the OAR to validate the location of lighting control system components, including daylight, vacancy, motion sensors. Sensors shall be located based on manufacturer's recommendations.
- E. Systems components shall be Title 24 compliant and listed as California Energy Commission approved products.

1.5 COMMISSIONING

- A. A Commissioning Services Provider (CxSP) retained by the OWNER will lead and provide Commissioning (Cx) of the lighting control system, including submittal review, installation,

testing, documentation, and training as indicated in section 26 0800 – Electrical Systems Commissioning.

- B. CONTRACTOR shall follow the commissioning responsibilities stated in Section 01 9113, General Commissioning Requirements.
- C. CONTRACTOR shall provide all tools and personnel, and perform start-up, prefunctional and functional performance testing in the presence of the OWNER's Commissioning Services Provider.

1.6 WARRANTY

- A. Lighting control system shall be warranted to be free from defects in materials and fabrication for a period of three-years from the date of substantial completion.
- B. Installer shall provide a two-year installation warranty.
- C. Warranty exclusions for third party components is not acceptable.

1.7 TRAINING

- A. Provide a competent instructor who is factory trained and has comprehensive knowledge of system components and operations to provide full instructions to designated personnel in the system operation, maintenance, and programming. Training shall be specifically oriented to installed equipment and systems.
- B. Training shall include system overview, time schedules, override commands, emergency operation, and programming and report generation for school based non-technical personnel.
- C. Provide an eight hours OWNER's school-based personnel and Maintenance and Operations technical employees training session; this training session shall cover and provide the following:
 - 1. As-built drawings of System layouts and point to point connection diagrams.
 - 2. System components cut sheets.
 - 3. Operations and maintenance data.
 - 4. Programmer and maintenance training: database entry; trend logs application programs, diagnostic routines, reporting, failure recovery and calibration, and expose the trainees to system's features, components, system architecture, operations, programming, report generation, communications, reading and interpreting alarms, and any other pertinent information required for the operations and maintenance of the system.
 - 5. Training sessions shall accommodate a minimum of 20 persons and be facilitated at CONTRACTOR's training facility, which should be no more than 50 miles from the Project Site.
 - 6. Obtain OWNER's approval for training locations exceeding 50 miles. In such cases, the CONTRACTOR shall be responsible for transportation expenses.
 - 7. CONTRACTOR shall provide training computers for all attendees. Computers shall be ready for live training sessions.

8. Instructor(s) shall give the trainees the opportunity to practice on simulated and actual (installed) systems.
- D. The training session shall have an itemized agenda covering all aspects of the training to be covered in the sessions. CONTRACTOR shall obtain agendas approval from OWNER and Commissioning Agent.

PART 2 - PRODUCTS

2.1 SYSTEM REQUIREMENTS

- A. The lighting controls shall be a centralized system furnished with digital room controllers, capable of working as a network system that communicates via common data line (s).
- B. The system shall be furnished with transformers, control electronics, hardware, resident software and complete programming, occupancy sensors, constant light controllers, exterior light sensors, photocells, digital and analog switches, dimmer switches, conduit and wiring for a complete and functional installation.
 1. Software shall be resident within the lighting control system.
 2. System shall provide local access to programming functions at the master Lighting Control Panel (LCP) and remote access to programming functions via computers or other intelligent communication devices running an industry standard internet browser.
 3. System software shall provide real time status of all components and ancillary devices.
 4. For on-site access, the lighting control system shall have a built-in touchscreen allowing authorized access to localized control and programming.
- C. Areas controlled by a motion sensor; such as rooms with one luminaire and emergency fixtures designed to operate 24 hours a day, seven days a week shall be programmed accordingly.
- D. The system shall have a server built into the master LCP. The server shall effectively work/operate through HTML pages from any authorized workstation.
 1. WEB front end shall be accessible over an OWNER provided Ethernet 10/100 Mbps to the local area network.
 2. Protocol shall be TCP/IP and allow either http (hypertext transfer protocol) or https (hypertext transfer protocol secured) connections.
- E. Desktop computers are not part of this section and will be provided by others. Non-networked, non-digital, non-server capable systems are not acceptable.
- F. Lighting control system shall be able to be monitored and take commands from a remote Personal Computer (PC); should the remote PC go off-line system programming uploaded to the lighting control system shall continue to operate as intended. Systems requiring an on-line PC or server for normal operation are not acceptable
- G. Devices shall be factory pre-addressed but be able to be field addressable also. Systems requiring field addressing only are not acceptable.

- H. Programs, schedules, time of day, etcetera, shall be held in non-volatile memory at power failure. At restoration of power, lighting control system shall implement programs required by current time and date.
- I. System shall be capable of flashing lighting OFF/ON for any relay or lighting zone prior to the lights being turned OFF. The warning interval time between the flash and the final lights off signal shall be definable for each zone. Occupant shall be able to override any scheduled OFF sweep using local lighting zone override switches within the zone or occupied space. Occupant override time shall be pre-programmed not to exceed two hours, or current California Title 24 requirements.
- J. The system shall be capable of implementing ON, OFF, Raise (dimming), and Lower (dimming), and preset commands, group or zone by means of devices connected to programmable inputs in the lighting control system.
- K. Programming and scheduling shall be done at the master LCP and/or remotely via the Internet. Remote connections shall function in real time control and real time feedback.
- L. System may consist of centralized relay panels, room controllers, digital switches, analog switches, photocells, motion sensors, lumen control devices, dimmer switches, and various digital interfaces. All system components, including remote and centralized room controllers, digital switches, etc. shall operate and be integrated as a network.
 - 1. Remote Room Controllers (RRC) shall control lighting fixtures in that area or space.
 - 2. The RRC shall provide power to ancillary and control devices, such as occupancy sensors, and take input from controlling devices, such as daylight and occupancy/vacancy sensors.
 - 3. RRP's shall be capable of taking inputs from OWNER specification line voltage type switches.
- M. RRC, switches, photocells and occupancy sensors, and ancillary devices and components shall be integrated per lighting control manufacturer's instructions.
- N. Location of devices and relay panels or relay controllers installed above ceilings shall be identified with a printed label attached to ceiling elements. Locate label directly below equipment location.

2.2 LIGHTING CONTROL OVERVIEW-BY AREA CONTROLLED

A. Classrooms:

Classrooms shall be controlled by a combination of vacancy sensors, daylight controllers and dimmers switches.

- 1. The vacancy sensor is to automatically switch lights OFF when the room is not occupied for 15 minutes.
- 2. Daylight controls shall automatically adjust light intensity according to the natural light level in the room to maintain a uniform level of lighting in the range of 30-50 foot-candles.
- 3. The daylight sensors shall be enabled and disabled by the vacancy sensors to ensure daylight-controlled lights never automatically turn ON when room is unoccupied.

The lighting control system shall allow an authorized person to disable the daylight sensors and dimming controls.

4. Wall switches, and dimmers are to manually switch lights ON and OFF. Switches shall comply with the operational requirements of the current T24, and include location of device, accessibility and override capability.
5. Quiet time switch is to temporarily bypass the occupancy sensors for a pre-programmed period of one hour, or as indicated on drawings.

B. Corridors and Open Areas:

Corridors and other common areas are to be controlled by a combination of programmable low voltage keyed switches and time schedules supplied by the networked lighting control system.

1. Low voltage keyed switches to manually switch lights ON and OFF.
2. The central timer is to automatically sweep lights OFF after hours and provide scheduling capability where and when occupancy sensors are not used.
3. Interior corridors require occupancy sensors.

C. Custodial, Unsupervised and Equipment Rooms:

Provide occupancy sensors with automatic on-off capability in addition to manual switches, and programming features indicated on plans. These sensors shall turn off the lights in the room via 15 minutes pre-set programmable interval after the room has been vacated.

D. Exterior Security Lights:

Program exterior wall packs and security lights to be controlled via exterior light sensors, and time switches as indicated on drawings.

1. Program lights to ON state when natural lighting is below 5 foot-candles
2. Program lights to OFF when natural light level is greater than 5 foot-candles.

E. Exterior, Non-Security Lights:

Exterior non-security lighting in parking lots, corridors and pathways, and decorative lights shall be controlled via exterior light sensor working in conjunction with programmable controlled time schedules via the lighting control system.

1. Program lights to ON state when natural lighting is below 5 foot-candles, and when scheduled time is set to ON.
2. Program lights to OFF state when natural light level is greater than 5 foot-candles, and when scheduled time is set to OFF.

F. Restrooms:

1. Student Restroom Lighting and Exhaust Fans (Fans interlocked with lights):
 - a. Restroom lights shall be controlled from the lighting control panel via assigned relays.
 - b. Provide by-pass lock type, vandal resistance key operated switch adjacent to the door, and ceiling mounted occupancy sensors for on/off controls.

- c. The sensor shall turn off the lights via a programmable pre-set 15 minutes interval, after the room has been vacated.
2. Staff Restrooms Lights and Exhaust Fans (Fans interlocked with lights):
- a. Restrooms lights and fan shall be controlled from the lighting control panel via assigned relays.
 - b. Provide ceiling mounted occupancy sensors, and by-pass toggle switches for system override adjacent to the door.
 - c. The sensor shall turn off the lights via a programmable pre-set 15 minutes interval, after the room has been vacated.

G. Emergency Lighting:

- 1. Provide emergency lighting controls circuitry to achieve override or bypass of manually operated switches, lighting control systems, dimmers and occupancy sensors during power failures.
- 2. Each area of luminaries or groups of luminaries shall be equipped with and be controlled by a UL924 listed emergency lighting control unit to allow the detection of localized power failures.

2.3 CENTRAL LIGHTING CONTROL PANELS

A. Central Lighting Control Panels (CLCP) shall be in electrical closets.

B. Panels shall be surface or flush mounted type as indicated on Drawings, with a hinged door assembly. Doors shall be furnished with flush type locks, spring latching, Corbin locks for metal doors, keyed to Corbin No. 60 keys. Panels shall include the following components or features:

- 1. Shall be preprogrammed and preassembled with control equipment and relays as indicated on the lighting plans.
- 2. Shall be equipped with suitable dividers separating Class 1 and Class 2 compartments, 120v and 277v compartments as well as “normal and emergency” compartments.
- 3. Lighting control relays as indicated on Drawings. Provide 10 percent spare relays for centralized relay panels up to the maximum capacity of panel.
- 4. Shall be equipped with a neatly typewritten schedule with number and name of rooms or areas served by the relay circuits. Room numbers and names used shall be determined at the Project site and may not be those indicated on Drawings. Schedule shall indicate panel designation and voltage and shall be mounted in a frame under transparent plastic 1/32-inch-thick on inside of panel cabinet.
- 5. Each panel shall be rated for 120 or 277 VAC.
- 6. Shall be preassembled, preprogrammed and include relays capable of switching 20 amps lighting loads for 120 or 277 VAC.
- 7. Central lighting control panels, remote lighting control panels, relays, low voltage switches, interior light sensors, exterior light sensors, and associated control

electronics shall be furnished by Lighting Control and Design (LC & D), Douglas Lighting Controls, or equal.

8. Approved products: Douglas Dialog Series, LC & D #GR-2400 series, or equal.

2.4 REMOTE ROOM CONTROLLERS

- A. Remote Room Controllers (RRC) shall be mounted in the ceiling space as indicated on plans.
 1. Each RRC shall be connected to the network lighting control system using manufacturer's recommended wiring method and configuration.
 2. Provide a printed label "RLCP" to the T-bar grid below the RRC".
 3. Approved products: LC&D GR-2404 Series or Douglas WRC-4244.
- B. Each RRC shall contain the following hardware features:
 1. Digital dataline switch inputs.
 2. 12 VDC and 24 VDC inputs for occupancy sensors requiring DC voltage for analog occupancy sensors, or Digital dataline type inputs for occupancy and light sensors.
- C. Switches shall be capable of switching individual relays, local groups of relays within the panel or global groups of relays system wide. Each switch shall be configured to be ON, OFF, RAISE, LOWER, or Toggle.
- D. The RRC shall digital dataline occupancy sensors. The sensors shall be configured for OFF only or ON/OFF switching scenarios.
- E. Photo sensor shall be linked with occupancy sensing so that when light levels are high enough, the occupancy/vacancy sensor will not switch the photo-controlled relays ON.

2.5 RELAYS

- A. Relays shall be warranted for a minimum of three-years.
- B. Relays shall be individually added or replaced. Lighting control systems incapable of replacing individual relays are not acceptable.
- C. Each lighting control relay shall be capable of controlling incandescent, fluorescent, LED sources, and HID lighting loads. Relays not rated for all types of lighting loads are not acceptable.
- D. Approved Products:
 1. Single Pole: Douglas WR-6161, LC&D SL-277-NC, or equal.
 2. Double Pole: Douglas WR-6172, LC&D SL-480-NC, or equal.

2.6 LOW VOLTAGE SWITCHES

- A. Low voltage switches shall be wired in compliance with manufactures requirements. Digital switches shall be part of the lighting control system network.

1. Provide stainless steel switch plates, unless noted otherwise in construction documents.
 2. Approved Products: LC&D Chelsea series, Douglas WSW-3500 series, or OWNER approved equal.
- B. Physical removal of any single switch shall have no effect on the communication between relay panels in the rest of the lighting control network. Lighting control systems requiring the continuous connection of all low voltage switches are not acceptable.
- C. Keyed switches shall be digital.
1. Approved products: Douglas WSK-35XX Series, LC&D KS Series, or equal.
 2. Provide stainless steel switch plates, unless noted otherwise in construction documents.
- D. Classrooms switches controlling luminaires in classrooms shall be digital and be wired to programmable inputs in the lighting control system network.
3. Each switch shall be programmed to control ON only, OFF only or ON and OFF, dimming, audio/visual and quiet time one, some, or all relays in the entire network.
 4. Whiteboard luminaires shall be controlled independently with On, Off, and dimming capabilities.
- E. High abuse areas (common areas, gymnasiums, etcetera) shall be controlled using a vandal resistant, touch sensitive high abuse switch and available with up to three buttons in a single gang. Multi gang versions shall also be available.
1. Touch pads shall be stainless steel and capable of handling both high abuse and power wash cleaning crews' activities.
 2. Switches shall be digital or analog as indicated on plans.
 3. High abuse switch touch buttons shall control a single relay or group(s) of relays of the lighting control system.
 4. Touch buttons shall be controllable via programmed commands to enable or disable, ON, OFF, Toggle or Maintain operation functions. Programming shall be done locally or remotely.
 5. Touch pad(s) shall be identified as to function by an engraved label.
- F. Switches must be capable of handling electrostatic discharges of at least 30,000 volts (1cm spark) without any interruption or failure in operation.

2.7 INTERIOR DAYLIGHT SENSORS

- A. Interior daylight sensors shall cause light fixtures to brighten or dim to maintain pre-determined and uniform light levels.
- B. The sensors shall permit any relay to switch at a unique light level and shall attempt to maintain a constant light level by switching individual relays ON or OFF as the ambient light level changes.

- C. Controllers offering single set point controls are not acceptable.
- D. Each interior daylight sensor shall continuously monitor the true light level and shall broadcast this level to lighting control network. Controllers requiring readings at the sensor head itself are not acceptable.
- E. Each interior daylight sensor shall be fully adjustable via the lighting control software. Controllers requiring adjustments at the sensor head are not acceptable.
- F. Provide daylight sensors in all rooms with windows, skylights, or daylight filtration. Refer to lighting plans to determine which switch legs are controlled by the daylight controller.
- G. Approved Products: LC&D iPC Series, Douglas WPS-3711, Douglas WPP-INT, or equal.

2.8 EXTERIOR LIGHT SENSORS

- A. One exterior light sensor shall permit different relays to switch at different light levels. Sensors offering less than 14 remotely settable trip points are not acceptable.
- B. Exterior light sensor shall continuously monitor light levels and shall broadcast this level over the lighting control network. Exterior light sensor shall be fully adjustable via the networked lighting control system.
- C. Sensors and controllers requiring adjustments at the sensor head are not acceptable.
- D. Sensors shall be UL or NRTL listed for exterior application.
- E. Approved products: Douglas WPS-3741B, LC&D PCO, or equal.

2.9 DIMMING CONTROLLER

- A. Remote relay panels shall be capable of outputting 0V – 10V dimming signal for each relay provided in the remote room controller. LED Dimming drivers shall be controlled by industry standard 0V-10V control input.
- B. LED Drivers using proprietary control protocols shall not be acceptable.
- C. To maximize daylight harvesting and minimize disruption to occupants, each dimming output shall provide adjustment for baseline, start point, mid-point, end point, trim fade up rate, fade down rate, time delay and enable/disable masking.
- D. Photocells settings must be remotely accessible.
- E. Systems that provide ON, OFF with Time Delay only and systems that do not provide remote accessibility are not acceptable.
- F. Mount photocells in locations indicated on plans and according to manufacturer's recommendations for daylight system type, open or closed loop. Trip points shall be able to be programmed and altered remotely via programming functions at the master Lighting Control Panel (LCP) and remote access to programming functions via computers or other intelligent communication devices.
- G. Photocells requiring manual trip point adjustment, or systems that provide local adjustment only are not acceptable.

- H. Photocells used for interior lighting control shall have multiple settings such as start-point, mid-point, off-point, fade-up rate, fade-down etc.
- I. Approved Products: Douglas WPS-3711, Douglas WPP-INT, LC&D iPC series, or equal.

2.10 OCCUPANCY SENSORS

A. Occupancy Sensors:

1. Ceiling-Mounted Dual Technology Sensors:

- a. Sensors shall be dual technology infrared-ultrasonic capable of detecting presence in floor area to be controlled, by detecting Doppler shifts in transmitted ultrasound and infrared technology.
 - 1. ADI-Voice technology may be used in addition to the required infrared-ultrasonic features.
- b. Detection shall be maintained when a person moves only within a maximum distance of 12 inches, in either a horizontal or vertical manner, at approximate speed of 12 inches per second. Lights shall not go off when a person is reading or writing while seated at a desk.
- c. Each sensor shall be furnished with a convenient shunt provision, which will enable a person to by-pass sensor in event of failure.
- d. Sensitivity shall not change more than ten percent in temperature range of 0 degrees F. to 120 degrees F., and in humidity range of ten percent to 80 percent. Sensitivity adjustment shall be provided for each technology.
- e. Time delay range shall be adjustable from 15 seconds to 15 minutes.
- f. Sensors power supply shall be provided by power pack, consisting of a transformer and contact closure relay in one package. Power output of transformer shall be capable of operating a minimum of two sensors.
- g. Approved products: Watt Stopper No. DT-200, similar as manufactured by Leviton, Sensor Switch, Unenco, DLC Diversa, or equal.

B. Dual Technology Passive Infrared Wall Switch Sensors with Daylight Controls:

- a. Sensors shall be capable of detecting presence in floor area to be controlled, by detecting changes in infrared-ultrasonic energy. Small movements shall be detected such as when a person is writing while seated at a desk.
- b. Passive infrared sensor shall utilize a dual-element sensor and a multi-element fresnel lens.
- c. Sensor shall be furnished with a daylight filter which ensures that sensor is insensitive to short-wavelength infrared waves, such as those emitted by the sun.

- d. Sensors shall be furnished with convenient bypass provisions, which enable lighting to be turned on in case of failure.
- e. Time delay range shall be adjustable from 15 seconds to 15 minutes.
- f. Sensitivity adjustment shall range from 0 (off) to ten (maximum).
- g. Adjustments and mounting hardware shall be concealed under a removable cover to prevent tampering with adjustments and hardware.
- h. Each sensor shall cover up to 800 square feet, with a field-of-view of 180 degrees.
- i. Sensor shall be a completely self-contained control system.
- j. Power shall be provided via an internal transformer.
- k. Switching mechanism shall be a latching dry contact relay.
- l. Sensor shall be capable of switching from 30 to 1000 Watts, LED, incandescent or fluorescent light sources.
- m. Sensor shall be furnished with a daylight feature, adjustable from ten to 400 foot-candles, that maintains lighting off when a desired foot-candle level is present.
- n. Sensors shall be dual voltage, 120 volt and 277 Volt.
- o. Approved products: Watt Stopper No. WI 200, I 300, similar as manufactured by Leviton Sensor Switch, Unenco, DLC Diversa, or equal.

2.11 LIGHT LEVEL CONTROLLERS (EXISTING FACILITIES)

- A. Controller shall be capable of detecting changes in lighting levels; it shall utilize an internal photoconductive cell to measure light levels through 50 percent diffused lens.
- B. Controller shall be capable of controlling any type of lighting. It shall be a self-contained 24 VDC device that controls lighting through use of power switch packs.
- C. Controller shall be capable of turning lighting on and off between ten and 200 foot-candles.
- D. Controller shall be furnished with an adjustable dead-band feature to prevent lighting from cycling when lighting goes on and off, and from minor changes due to cloud cover.
- E. Controller shall be furnished with an adjustable time delay range of five seconds to five minutes.
- F. Controller shall be furnished with an LED lamp indicating status of sensor. LED shall have different colors for on and off status.
- G. Adjustments and mounting hardware shall be concealed under a removable cover to prevent tampering with adjustments and hardware.

- H. Each controller shall be equipped with a by-pass mechanism, which will enable lighting to be turned on during failure conditions.
- I. Approved manufacturers: Watt Stopper No. LS-100 XA, or similar products by Leviton, Sensor Switch, Unenco or equal.

2.12 INTERFACE TO BUILDING MANAGEMENT SYSTEM

- A. When interface to the Building Management System is required, The lighting control system shall provide a BACnet/IP interface module that communicates with the BMS via a BACnet/IP network. (a collection of one or more IP sub networks (IP domains) that are assigned a single BACnet network number). Verify if interface to BMS is required.
- B. BACnet/IP interface module shall provide the capability for the BMS to:
 - 1. Communicate directly with each relay in the lighting control system network and each group used within the lighting control system.
 - 2. Monitor the status and status changes of each relay and each group.
- C. Install wiring and confirm operation of the lighting control BACnet/IP interface module per the lighting control manufacturer's instructions. Installing, wiring, and interfacing of BMS components to the lighting control system.

PART 3 – EXECUTION

3.1 GENERAL

- A. Lighting control system shall not be used for any other purpose other than its intended use and application.
- B. Provide required interconnections with other systems such as emergency power sources, fire alarm systems, and building management system as required or indicated on drawings.
- C. Installation shall meet or exceed standard practice of workmanship and quality.
- D. Drawings are diagrammatic in nature and indicate work to be provided, but do not provide means and methods, bends, transitions, or special fittings required to clear beams, girders or other work already in place. Investigate conditions where conduits are to be installed and furnished and install required fittings.

3.2 INSTALLATION AND SET-UP

- A. Verify that conduit for line voltage wires enters panel in line voltage areas and conduit for low-voltage control wires enters panel on low-voltage areas. Refer to manufacturer's drawings for location of line and low-voltage areas.
- B. Provide for digital type switches and make all connections according to lighting control manufactures requirements.
- C. Central Lighting Control Panels and Remote Room Controllers shall be connected via a data line (Douglas uses a non-polarized two No. 18 and LC&D uses Cat5 four twisted pair cable,

with RJ45 end connectors). Connect entire lighting control system per manufacturer's requirements. Do not exceed manufacturer's total data line length requirement.

- D. Panels shall be located so that they are readily accessible and not exposed to physical damage.
- E. Panel locations shall be furnished with enough working space around panels to comply with the California Electrical Code.
- F. Panels shall be securely fastened to the mounting surface by at least four points.
- G. Unused openings in the cabinet shall be effectively closed.
- H. Cabinets shall be grounded in accordance with Article 250 of the California Electrical Code, and manufacturer's recommendations.
- I. Lugs shall be suitable and listed for installation with the conductor being connected.
- J. Conductor lengths shall be maintained to a minimum within the wiring gutter space. Conductors shall be long enough to reach the terminal location in a manner that avoids strain on the connecting lugs.
- K. Maintain the required bending radius of conductors inside cabinets.
- L. Clean cabinets of foreign material such as cement, plaster and paint.
- M. Distribute and arrange conductors neatly in the wiring gutters.
- N. Follow the manufacturer's torque values to tighten lugs.
- O. Before energizing the panelboard, the following steps shall be taken:
 - 1. Retighten connections to the manufacturer's torque specifications. Verify that required connections have been furnished.
 - 2. Remove shipping blocks from component devices and the panel interior.
 - 3. Remove debris from panelboard interior.
- P. Follow manufacturers' instructions for installation.

3.3 OPERATING/SERVICE MANUALS

- A. Service and Operation Manuals:
 - 1. Submit operation and service manuals. Complete manuals shall be bound in flexible binders and data shall be typewritten or drafted.
 - 2. Record drawings: Provide (3) printed and one electronic copy on flash media of as built documents in latest version of ACAD of the entire system; including, floor plans with equipment, and devices layouts and wiring, interconnections with other systems, conduit and cable runs, programmed configurations, sequence of operations, system labeling codes, system passwords, and other pertinent information.
 - 3. Manuals shall include instructions necessary for proper operation and servicing of system and shall include complete wiring circuit diagrams of system, wiring

destination schedules for circuits and replacement part numbers. Manuals shall include as-built cable Project site plot plans and floor plans indicating cables, both underground and in each building with conduit, and as-built coding used on cables. Programming forms of systems shall be submitted with complete information.

3.4 PROTECTION

- A. Protect all work, equipment and components of the lighting control system until Substantial Completion.

3.5 TESTING

- A. Set-up, commissioning and testing of the lighting control system, and OWNER instruction shall include:
 1. Confirmation of system programming.
 2. Confirmation of operation of individual relays, switches, occupancy sensors and daylight sensors.
 3. Operation of system's features under normal and emergency operations.
 4. Before energizing check and demonstrate in the presence of the Project Inspector that cables and wire connections are free from short circuits, ground faults, and that there is continuity, and necessary insulation.
 5. Confirm system operations and functionality.
 6. Check system interface response to other systems such as fire alarm and emergency power system conditions.

3.6 SPARE PARTS

- A. Provide a minimum of five percent spare parts of each type of relay, sensors, switches, and peripheral devices.

3.7 CLEANUP

- A. Remove rubbish, debris, and waste materials and legally dispose of off the Project site.

END OF SECTION

SECTION 26 5010
SOLID STATE (LED) LIGHTING

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes: LED Luminaires, LED modules, drivers, wiring, and lighting controls.
- B. Related Requirements:
 - 1. Division 01 - General Requirements.
 - 2. Section 26 0500: Common Work Results for Electrical.
 - 3. Section 26 0513: Basic Electrical Materials and Methods.
 - 4. Section 26 0526: Grounding and Bonding.
 - 5. Section 26 0519: Low-Voltage Wires (<600 Volt AC).
 - 6. Section 26 0923: Lighting Controls Systems.
 - 7. Section 26 5200: - Emergency Power Systems.
 - 8. Section 32 1313 - Site Concrete Work.

1.2 REFERENCES

The latest version of the following industry standards applies:

- A. American National Standards Institute/American National Standard Lighting Group ANSI/ANSLG – C78.377-2008 Specifications for the Chromaticity of Solid-State Lighting Products.
- B. American National Standards Institute/American National Standard Lighting Group ANSI/ANSLG – C82.77-2002 Harmonics Emission Limits.
- C. Federal Communication Commission (FCC) 47 CFR Part 15 – Radio Frequency Devices.
- D. Illuminating Engineering Society of North America (IESNA) LM-79-, LM-80-15, and TM-21.
- E. National Electrical Manufacturers Association (NEMA) SSL-1-2010 Electronic Drivers for LED Devices, Arrays, or Systems.
- F. SSL-3-2010 Solid State Lighting High Power LED Binning for General Illumination.
- G. SSL-4-2012 Solid State Lighting Retrofit Lamps.
- H. National Fire Protection Association (NFPA) NEC-70-2011

- I. Underwriters Laboratories (UL) 8750-Light Emitting Diode (LED) Equipment for Use in Lighting Products.
- J. Underwriters Laboratories (UL) 1598C- Light Emitting Diode (LED) Retrofit Luminaire Conversion Kits.

1.3 SUBMITTALS

- A. List of Materials: Submit a complete list of proposed materials.
- B. Shop Drawings: Provide detailed and dimensioned Shop Drawings indicating kind, weight and thickness of materials, method of fitting and fastening parts together, location and number of sockets, size of lamps, and complete details of method of fitting suspension and fastening luminaires in place. Provide wiring diagrams for lighting control equipment. Drawings shall contain sufficient information to assemble and install equipment at the Project site without further instructions.
- C. Prior to start of construction; provide photometric calculations with graphic of lighting foot-candle levels at work plane, ceiling and walls. Calculations shall comply with IESNA recommendations.
- D. Installation Instructions: Submit manufacturer's written installation instructions for luminaires and accessories.

1.4 SUBSTITUTIONS

- A. Luminaires that deviate from these requirements shall not be accepted without written approval from OWNER'S Design Standards Section and Maintenance and Operations Technical Unit. When deviating or substituting luminaires, the following information shall be submitted:
 - 1. Substitution request form with clear indication of reasons and benefits to OWNER.
 - 2. Provide substantiating evidence of benefits and pros and cons on favor of the proposed material/equipment/components substitution.
 - 3. OWNER'S approval shall be obtained for any equipment or materials substitutions.
 - 4. Submit a completed OWNER's LED luminaires evaluation form with supporting documentation for any and all fixtures' performance claims. The form can be found at the following electronic address:
http://www.laschools.org/documents/file?file_id=310976408
- B. Submittals must comply with contract general provisions, and provide as a minimum necessary installation details, lighting Foot-Candle level calculations in compliance with owner's illumination requirements indicated in OWNER's School Design Guide Section 3.7.B.

1.5 QUALITY ASSURANCE

- A. Design of lighting luminaires, accessories, supports, and method of luminaire installation shall comply with requirements for earthquake-resistant construction of the State of California.

- B. Provide suspension points at no more than two feet from luminaire ends. Spacing between supports shall not exceed eight feet.
- C. Components and luminaires shall be listed and approved for the intended application by Underwriter's Laboratories (UL), or other Nationally Recognized Testing Laboratory (NRTL), and in compliance with applicable industry standards and codes, including those mentioned under article 1.02 – References.

1.6 COMMISSIONING

- A. A Commissioning Services Provider (CxSP) retained by the OWNER will lead and provide Commissioning (Cx) of lighting systems and lighting controls, including submittal review, installation, testing, documentation, and training.
- B. CONTRACTOR shall follow the commissioning responsibilities stated in Section 01 9113, General Commissioning Requirements.
- C. CONTRACTOR shall provide all tools and personnel, and perform start-up, prefunctional and functional performance testing in the presence of the OWNER's CxSP.

1.7 WARRANTY

- A. Provide the following warranties:
 - 1. One-year labor warranty.
 - 2. Material warranty:
 - a. LED modules: five years minimum.
 - b. Drivers: five years minimum.
 - c. Lighting Pole (Standards): five year minimum.
- B. Warranty period shall begin at substantial completion or at project acceptance for beneficial occupancy, whichever occurs first.
- C. CONTRACTOR shall warranty Luminaires, including drivers, LED modules and ancillary components via a single warranty source. Multiple warranty sources are not acceptable.

PART 2 - PRODUCTS

2.1 MATERIAL AND FABRICATION

- A. Luminaires of same type shall be of one manufacturer.
- B. Manufacturer and model number references are indicated as a standard of performance and quality; other manufacturers' models may be submitted for review, provided the product meets or exceeds the product's specified requirements and substantially complies with OWNER'S LED Luminaires Evaluation Requirements Form.

- C. Conductors that pass over edges or through metal opening(s) shall be secured from contacting the edges and be protected from cutting and abrasion. This requirement shall be met through one of the following:
1. Rolling the edge of the metal not less than 120 degrees.
 2. A bushing or grommet of a material other than rubber at least 1.2 mm (0.047”) thick.
 3. Glass sleeving at least 0.025 mm (0.010”) thick.
- D. Lighting luminaires shall meet the following requirements:
1. Industry standards as indicated under Article 1.02.
 2. Luminaire shall be from a manufacturer who has been in the business of manufacturing LED lighting luminaires for interior and exterior applications for a minimum of 5 years.
 3. Luminaires shall comply with the California Health and Safety Code requirements for products containing substances identified in the California Lighting Efficiency and Toxics Reduction Act or follow the European Restriction of Hazardous Substances (RoHS), whichever is more stringent.
 4. Luminaires shall be baked-on enamel or powder-coated, unless otherwise specified in this section.
 5. The luminaire(s) lens, including end caps shall be 0.187 nominal thickness.
 6. Drivers shall be easily accessible without the use of special tools.
 7. Wiring cavity shall be field accessible for service or repairs.
 8. Luminaires shall be capable of being operated by standard motion/ vacancy sensors, daylight sensors, and dimmers.
 9. Luminaires shall be provided with a manufacturer’s stencil or permanent legible sticker that states manufacturer business information and date of delivery.
 10. Temperature rating; -20 degrees Celsius minimum starting temperature. Luminaire accessories including LEDs and drivers shall be able to withstand temperatures in excess of 110 Fahrenheit degrees.
 11. Color Rendering Index (CRI):
 - 1) Interior Applications: +82 CRI.
 - 2) Exterior Applications: +70 CRI
 12. Power factor: Greater than 0.9 at 120V and 277V.
 13. Total Harmonic Distortion: Less than 20% at 120V and 277V.
 14. Color Correlated Temperature: 4000K minimum \pm 275K degrees.

15. LEDs and drivers' life expectancy: 50,000 minimum projected hours at 6,000 hours testing for both LEDs and drivers.
16. Luminaires in contact with insulation materials shall be IC rated.

2.2. DRIVERS and LED MODULES

A. Drivers:

1. Approved Drivers Manufacturers:
 - a. Osram – Optotronic.
 - b. Signify – Advance and Xitanium.
 - c. Universal Lighting Technologies – Everline.
 - d. General Electric – Lightech.
 - e. Thomas Research Products
 - f. Kenall – Low Profile LED Driver
 - g. EldoLED
 - h. Equal. Only if approved by OWNER's M&O Technical Services and Design Standards units through a deviation request.
2. Driver Type and Characteristics:
 - a. Comply with the state of California Health and Safety Code requirements for products containing substances identified in the California Lighting Efficiency and Toxics Reduction Act, or be RoHS compliant, whichever is more stringent.
 - b. Dimming for 0-10 volt DC control circuits. Drivers shall be specifically compatible with the lighting control system being provided.
 - c. Comply with applicable state, federal, and industry standards listed under References article.
 - d. Wattage as stated in Luminaire's LM-79 test report.
 - e. Driver performance requirements: Refer to Appendix A.

B. Light Emitting Diodes (LEDs):

1. Approved Manufacturers:
 - a. General Electric.
 - b. Signify.
 - c. NICHIA

- d. Samsung LED Co.
- e. CREE
- f. Equal. With OWNER's approval.

2. LEDs Characteristics:

- a. Color Correlated Temperature (CCT):
 - 1) Chromaticity target Duv and tolerance 0.001 plus/minus 0.006.
 - 2) Nominal CCT for 4000K, target CCT 3985K \pm 275K.
 - 3) CCT measurements in compliance with ANSI C78.377-2008.
- b. Lumen Maintenance: Greater than 90% at 50⁰ C degrees.
- c. LEDs must be from same manufacturer and batch.
- d. TM-21 and LM-80 reported hours of no less than 50,000 at minimum of 6000 hours testing.
- e. LM-79 reported CCT and CRI in compliance with articles 2.01.D.11 and 14.

2.3. LUMINAIRES

- A. Refer to appendix A for list of approved luminaires.
- B. Luminaires types and minimum requirements:

1. Ceiling Surface-Mounted with wraparound diffusers:

- a. Lens shall be extruded of clear acrylic plastic, 12 pattern prismatic with minimum 25 DR meeting the ASTM specifications for methacrylate molding compounds D-788-69A. The overall length of the lens, including end caps shall be 0.187 nominal thickness.
- b. Furnish luminaires with number of LED strips as indicated on drawings.
- c. Spring-loaded barrel latches shall consist of sliding steel pins or rods operating through spring-loaded steel cylinders tack-welded or pop-riveted to luminaire body. Pins shall be fabricated of solid steel with round cross-sectional areas of enough size to prevent bending when operating latches. Latches shall engage when pins are fitted into corresponding catches on diffusers. Latches shall disengage by applying finger pressure to a portion of the pin, turned up at 90 degrees, at operating end. Alternative latches mechanisms are discouraged.
- d. Luminaire channels shall be formed as single pieces of 20 gage metal without joints or splices and shall be assembled by means of spot-welding. Metal surfaces of luminaires shall be powder-coat painted after fabrication. Provide two 8-32 screw knockouts for alignment on each end plate.

- e. Approved luminaires: Hubbell-Columbia LAW4-40ML-EDU, LA Lighting WBE200-4K-4L-DRP-3-1DRDM-UNV-2/840, or OWNER approved equal.
- f. Retrofit kits shall comply with all requirements sets forth in parts 2.01 and 2.02
- g. Provide proof of even distribution on lighting with max/min foot-candle ratios of 2.5.
- h. Approved luminaires: LED Living technology G2CLA-30-6-D-40-1K-24, Orion MKLDRTLX42551com-40, Lithonia BLTR, or OWNER approved equal. Narrow, medium, rectangular and wide light distributions.
- a. Housing shall be marine-grade die-cast aluminum, coated with electrostatically deposited and thermally set powdered polyester paint. Luminaire shall be supplied with a mounting yoke, or slip fitter as required for the installation and as indicated on drawings.
- b. IP rating of IP66 for dust and water.
- c. High impact UV stabilized acrylic or tempered glass lens with thermal and physical shock.
- d. Visor option for lighting control.
- e. Photocells and motion control capabilities.
- f. Listed for wet locations and suitable for ground mounting.
- g. Luminaires shall be capable of being aimed in any direction from any mounting surface orientation. Door fastening devices shall be captive.
- h. Electrical components shall be removable and replaceable as single units without disturbing aiming.
- i. Finish color shall be as selected by Architect from manufacturer's standard colors.
- j. Approved products: Hubbell Spaulding ARF Series, RAB FXLED, Lithonia DSXF, or OWNER approved equal.

PART 3 - EXECUTION

3.1. INSTALLATION

- A. Install a lighting luminaire for each lighting outlet indicated and label with day of installation.
- B. Luminaire voltage shall be as indicated on Drawings.

- C. Install recessed and surface-mounted luminaires, with plaster frames compatible with ceiling and wall systems employed; secure luminaires mechanically to frames.
- D. Align rows of suspended and surface-mounted luminaires to form straight lines at uniform elevations.
- E. Recessed luminaires shall fit snugly against ceilings to prevent light leakage.
- F. Luminaire installations shall comply with CBC Seismic requirements
- G. Support suspended recessed luminaires in T-bar ceilings as follows: Luminaires shall be attached to ceiling grid to resist a horizontal force equal to weight of luminaires. For heavy-duty grid systems, luminaires weighing less than 56 pounds must also have two 12 gage slack safety wires from diagonal corners to the structure above; luminaires weighing more than 56 pounds shall be independently supported by not less than four taut 12 gage wires capable of supporting four times the load. For intermediate duty grid systems, luminaires shall be independently supported by not less than four taut 12 gage wires capable of supporting four times the load. Luminaire hanger wire ends shall be twisted three tight turns within a 1 ½ -inch distance. Provide positive point of attachment to T-bar ceiling with four, #8 wafer head tek screws (one at each corner), avoiding conflict with operation of the lens. Luminaire installation shall be coordinated with acoustical ceiling installation.
- H. Emergency light luminaires shall be labeled “Emergency Luminaire” with one inch high letters produced with a P-touch or similar labeling system.
- I. Continuous suspended luminaires:
 - 1. Luminaire suspension device shall allow vertical adjustment of luminaire without the use of tools. Cable shall be minimum seven strand twisted stainless steel capable of supporting minimum four times the luminaire weight. For continuous linear suspended luminaires longer than eight feet, provide not less than three suspension points.
 - 2. Top of luminaire shall be suspended as shown on the Drawings, typically 24 inches below the ceiling and a minimum of 18 inches from the ceiling.
 - 3. Luminaire shall utilize factory furnished or approved hardware and canopy for either hard or T-bar ceilings.
 - 4. White Board Lights shall be suspended 24 inches from the wall unless specifically shown otherwise.
- J. Surface mount luminaires shall be attached to structure. Toggle bolts are NOT permitted. Provide backing where required.
- K. Low level exit signs shall be installed with the bottom of the sign not less than six inches, or more than eight inches above the floor level and shall indicate the path of exit travel. For exit and exit-access doors, the sign shall be on the door or adjacent to the door with the closest edge of the sign within four inches of the door frame.

3.2. TESTING

- A. Check and adjust luminaires for required illumination.
- B. Replace defective LED strips and drivers.
- C. Test and adjust lighting control equipment for proper operation.

3.3. SPARE PARTS

- A. Furnish ten percent spare LED strips with a minimum of one spare strip of each type.
- B. Furnish ten percent spare motion detectors of each type with a minimum of one spare detector of each type.
- C. Furnish ten percent spare drivers of each type with a minimum one spare driver of each type.

3.4. HAZARDOUS WASTE DISPOSAL

- A. Hazardous waste disposals shall be handled and disposed of by an approved, licensed contractor.
- B. Products with PCBs are not acceptable. Hazardous waste shall be placed in appropriate containers provided by hazardous waste contractor labeled clearly with:
 - 1. Project Name
 - 2. Quantity of materials
 - 3. Date materials became waste
- C. Store, remove, transport and dispose of hazardous materials in accordance with state and federal regulations.
- D. Provide Owner with copy of manifest and certificate of destruction.

3.5. PROTECTION

- A. Protect the Work of this section until Substantial Completion.

3.6. CLEANUP

- A. Remove rubbish, debris, and waste materials from all areas of work each day.
- B. Clean luminaire surfaces of dirt, cement, plaster and debris. Furnish cleansers compatible with material surfaces being cleaned.

END OF SECTION

ATTACHMENT A

DRIVERS PERFORMANCE CHARACTERISTICS		
No.	Characteristic	Minimum Requirements
1	Input Voltage range	120V, 277V
2	Input Overvoltage	320 VAC for 48 hours, 350 VAC for 2 hours.
3	Frequency	50/60 Hz Nominal
4	Power factor	+0.95 Minimum
5	Inrush Current	Less than 30 amps @ 120V Less than 70A @ 277V
6	Input Current Range	54A @ 120V, 23A @ 277V
7	Output Current	1670 mA Maximum
8	Maximum Power	65 Watts
9	Total Harmonic Distortion	Less than 20%
10	Leakage Current	Less than 500 mA
11	Output Protection	Short and Open Circuit Protection
12	Maximum Case Temperature	90 ⁰ C
13	Minimum Starting Temperature	-20 ⁰ C
14	Storage Temperature	No less than 70 ⁰ C
15	Humidity	Rated for dry and damp locations
16	Cooling	Convection
17	Sound Rating	Class A
18	Life Expectancy	>50,000 hours at +50 ⁰ C
19	Dimming, Motion Sensors and Daylight Sensors Controllability	0-10V

SECTION 311000

SITE CLEARING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Removal of masonry, concrete, rubbish, debris and other materials.
2. Removal of concrete and bituminous surfaces.

B. Related Requirements:

1. Division 01 - General Requirements.
2. Section 31 2200 - Grading.
3. Section 31 2313 - Excavation and Fill.
4. Section 31 2316 - Excavation and Fill for Pavement.
5. Section 31 2319 - Excavation and Fill for Structures.
6. Section 31 2323 - Excavation and Fill for Utilities.
7. Section 31 2326 - Base Course.

1.2 SUBMITTALS

- ###### A. Shop Drawings: Submit site plan indicating extent of site clearing.

1.3 QUALITY ASSURANCE

- ###### A. Comply with Standard Specifications for Public Works Construction, current edition, as a minimum requirement.

PART 2 - PRODUCTS - NOT USED

PART 3 - EXECUTION

3.1 CONCRETE AND BITUMINOUS SURFACING REMOVAL

- ###### A. Break up and completely remove existing concrete surfacing, curbs, gutters, walks and bituminous surfacing to indicate limits. Cutting shall be performed to a neat and even line with proper tools or a concrete cutting saw. Minimum depth of cut shall be 1 1/2-inch, unless otherwise indicated. Remove concrete broken beyond the indicated limits to the nearest joint or score line and replace with new concrete to match existing.

3.4 CLEANUP

- A. Remove rubbish, debris and waste materials and legally dispose of off the Project site.

END OF SECTION 311000

SECTION 312200

GRADING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. General exterior grading, cutting and filling, including grading for building area, paving.

B. Related Requirements:

1. Division 01 - General Requirements.
2. Section 31 1000 - Site Clearing.
3. Section 31 2313 - Excavation and Fill.
4. Section 31 2316 - Excavation and Fill for Pavement.
5. Section 31 2319 - Excavation and Fill for Structures.
6. Section 31 2323 - Excavation and Fill for Utilities.
7. Section 31 2326 - Base Course.

1.2 PROJECT REQUIREMENTS

A. General:

1. Fees: Pay as required by authorities having jurisdiction over the area.
2. Bonds: Post as required by authorities having jurisdiction over the area.
3. Haul Routes and Restrictions: Comply with requirements of authorities having jurisdiction over the area.
4. Before grading, contact Underground Service Alert of Southern California (USASC) for information on public buried utilities and pipelines. Retain the services of an underground utility locator for on-site utilities.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Materials shall conform to requirements specified in this and related sections.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Protect and maintain installed stakes until their removal is required for the Work. Provide replacement grade or location stakes lost or disturbed.
- B. Install grade stakes and compare to indicated grades. If discrepancies are found between existing grades and grades indicated on Drawings, do not proceed until discrepancies are resolved.

3.2 ROUGH AND FINE GRADING

- A. Rough grade area sufficiently high to require cutting by fine grading:
 - 1. Grade area for bituminous surfacing and other paving to the indicated grades, equal to the section of the indicated base and pavement.
 - 2. Slope banks to required finish grades as cut progresses or leave cuts full and finish grade by mechanical equipment to provide grades and soil densities indicated on the Drawings.
 - 3. Rough grade, fill and compact banks beyond indicated finish grades. Finish grade banks and slopes to indicated grades and specified soil densities.
 - 4. Grade Only Areas: In areas not indicated to receive pavement, rough grade to approximate finish grades and then scarify, moisten and roll to obtain required density and indicated finish grades.
 - 5. Tolerances: Finish grades shall be within a tolerance of 0.05 inch per foot above or below grades indicated. Provide an average grade as indicated.
- B. Base or Subgrade:
 - 1. After subgrade has been constructed to approximate required grades, scarify to a depth of at least 6 inches:
 - a. After scarifying, process loosened material to a finely divided condition and adjust moisture content to optimum condition by addition of water, addition and blending of dry suitable material, or by drying of existing material.
 - b. Subgrade material shall be compacted by tamping, sheepfoot rollers or pneumatic tire rollers. Required relative compaction shall be **90** percent minimum for the top 6 inches below subgrade.
 - c. Install base course in accordance with Section 31 2326 - Base Course.
 - 2. Tolerance of completed grades of base or subgrade shall not vary more than 0.03 inch per foot from grades indicated. Provide an average grade as indicated.

3.3 SHORING

- A. Provide shoring as necessary to properly and safely support earth sides of excavations, and existing curbs, sidewalks, gutter, drives and stairs, against movement and collapse.

- B. Design and Calculations: Provide in accordance with requirement of CalOHSA.
- C. Remove shoring upon completion of the Work of this section or when no longer needed unless required otherwise by authorities having jurisdiction.

3.4 EXCESS MATERIAL DISPOSAL

- A. Remove rubbish, debris, and waste materials and legally dispose of off the Project site.

3.5 PROTECTION

- A. Protect the Work of this section until Substantial Completion.

END OF SECTION 312200

SECTION 312313

EXCAVATION AND FILL

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Excavating, filling, backfilling, and compacting for Project site pavement, planting areas, buildings, and other structures.
2. Trenches for utility lines such as water, gas, irrigation, storm drain and sewer lines, concrete-encased conduits, manholes, vaults, valve boxes, catch basins, underground tanks, thrust blocks, yard boxes, pull boxes, and other utility appurtenances.

B. Related Requirements:

1. Division 01 - General Requirements.
2. Section 01 4524 - Environmental Import/Export Materials Testing.
3. Section 31 1000 - Site Clearing.
4. Section 31 2200 - Grading.
5. Section 31 2326 - Base Course.
6. Section 32 1313 - Site Concrete Work.
7. Section 33 4000 - Storm Drainage Utilities.

1.2 PROJECT REQUIREMENTS

A. Import and Export of Earth Materials:

1. Fees: Pay as required by authorities having jurisdiction over the area.
2. Bonds: Post as required by authorities having jurisdiction over the area.
3. Haul Routes and Restrictions: Comply with requirements of authorities having jurisdiction over the area.

1.3 SUBMITTALS

A. Shoring calculations as required in Article 3.03 of this Section.

1.4 QUALITY ASSURANCE

- A. Comply with the Standard Specifications for Public Works Construction, current edition, except as modified herein.
- B. Sampling, testing, and certification of imported and exported soils shall be performed in accordance with Section 01 4524, Environmental Import/Export Materials Testing.

1.5 TESTING

- A. DISTRICT will retain a Geotechnical Engineer as a DISTRICT Consultant who will provide observations, tests, inspections and approvals identified in the Contract Documents as being responsibility of DISTRICT.
- B. Imported Soils: The Geotechnical Engineer will obtain initial product Sample for testing in accordance Article 3.05 of this Section.

1.6 PROJECT CONDITIONS

- A. Information on Drawings or in soil investigation report does not constitute a guarantee of accuracy or uniformity of soil conditions over the Project site.

PART 2 - PRODUCTS

2.1 FILL AND BACKFILL MATERIALS

- A. Fill and backfill material shall be a granular material previously removed from excavation or imported fill material, free of clods and stones larger than 3 inches, (2½ inches for utility trenches) foreign materials, vegetable growths, sod, expansive soils, rubbish and debris. Material shall conform to these specified requirements and related sections.
- B. Fill material exhibiting a wide variation in consistency and moisture content shall be blended and aerated to stabilize and upgrade the material.
- C. Bedding material from trench bottom to one foot above the pipe:
 - 1. Sand, gravel, crushed aggregate or native free-draining granular material providing a sand equivalent of at least 30 or a coefficient of permeability greater than 1.4 inches per hour.
 - 2. Sand complying with the Specifications for cement concrete aggregates.
- D. Brick rubble and broken concrete originating from the Project site shall be legally disposed of off the Project site No such material shall be imported from outside the Project site.
- E. Permeable Backfill:
 - 1. Provide permeable backfill material behind retaining structures consisting of gravel, crushed gravel, crushed rock, natural sands, manufactured sand, or combinations of these materials conforming to the following gradations:

<u>Sieve Size:</u>	<u>Percentage Passing:</u>
¾ inch (19mm)	100
⅜ inch (10mm)	80 to 100
No. 100	0 to 8

No. 200 0 to 3

2. Those portions of fill material passing a No. 4 sieve shall provide a sand equivalent of at least 60.
 3. Provided backing for weep-holes shall consist of two cubic feet of aggregate in burlap sacks, securely tied. Aggregate shall conform to requirements for No. 3 concrete aggregate as specified in subsection 200-1.4 of the Standard Specifications for Public Works Construction.
 4. Permeable Backfill Alternate Materials: Instead of the materials specified for retaining structures backfill, a drainage matting system Miradrain by Mirafi, Inc., American Wick Drain, JDR Enterprises, or equal, may be provided if reviewed and approved by the ARCHITECT.
- F. Cement-sand slurry shall be provided with one sack of cement per cubic yard of the mixture.

2.2 BASE MATERIALS

- A. Concrete Slabs on Grade: Provide "Crushed Aggregate Base" as specified in Standard Specifications for Public Works Construction, Section 200 - Rock Materials, with 3/4 inch maximum size aggregates. Provide 3 inch thick base, unless noted otherwise.
- B. Bituminous Surfacing: Provide as indicated on Drawings and specified in Section 31 2326 Base Course.

PART 3 - EXECUTION

3.1 GENERAL

- A. Before initiating intrusive activities, contact Underground Service Alert of Southern California (USA or Dig Alert) to obtain a Dig Alert ticket for location information on buried public and USA member utilities and pipelines at least 48-hours prior to beginning work. A copy of the Dig Alert ticket shall be forwarded to the DISTRICT. For on-site utilities, retain a state-licensed third party underground utility locating service.
- B. Where the Work includes a building extension or addition on an occupied Project site, perform Work in such a manner, and at such times, as not to disrupt performance of existing utility services to existing Project site facilities. Where an interruption is necessary, obtain review from the OAR before proceeding.
- C. Remove concrete or bituminous pavement to straight lines by saw cutting.

3.2 PROTECTION

- A. Protect and guard excavations against danger to life, limb, and property as required by, but not limited to, OSHA regulations.
- B. Protect existing improvements including landscaping against damage. Repair or replace damaged items.
- C. Protect existing utility services and distribution systems from damage or displacement.

- D. Remove conduits or pipes not in service, exposed during Work, unless a minimum cover of two feet is provided. Remove concrete, clay or other non-metallic pipe over 8 inches in diameter, unless otherwise indicated.
- E. Shore, crib, or lag excavations and earthen banks as necessary to prevent cave in, erosion or gulying of sides.
- F. Provide excavations free from standing water by pumping, draining, or providing protection against water intrusion. If soil becomes soft, soggy, or saturated, excavate to firm undisturbed earth and fill as required. Slope adjacent grades away from excavations to minimize entry of water.

3.3 SHORING

- A. Provide shoring as necessary to properly and safely support earth sides of excavations, and existing curbs, sidewalks, gutter, drives and stairs, against movement and collapse.
- B. Design and Calculations: Provide in accordance with requirement of governing Cal-OSHA requirements.
- C. Remove shoring upon completion of the Work of this Section or when no longer needed unless required otherwise by authorities having jurisdiction.

3.4 EXCAVATION

- A. Unclassified Excavations: Comply with the Standard Specifications for Public Works Construction, Section 300: "Earthwork", except as modified herein.
- B. Form sides of footings, pads, grade beams, and slab foundations, unless otherwise indicated. Provide excavations of sufficient size to permit installation and removal of forms and other required Work.
- C. Machine-drill excavation for round footings to size and depth indicated. Provide a collar or casing, or other adequate protection, to exclude dirt and debris. Protect excavations with plank covers until concrete is placed.
- D. Provide excavation bottoms level and free from loose material. Excavate to indicated or required elevations of undisturbed earth.
- E. Barricade trenches, ditches, pits, sumps, and similar Work outside the barricaded working area with chain link fence as specified in Section 01 5000 - Construction Facilities and Temporary Controls, and in accord with Cal-OSHA standards and requirements.
- F. Trenches over five feet in depth shall comply with the Construction Safety Orders of the California Division of Industrial Safety.
- G. Where indicated or required to excavate in lawn areas, protect adjoining lawn areas outside of the Work area. Replace or install removed sod upon completion of backfill by installing sod level with adjacent lawns. If installation of removed sod fails, furnish sod and install to match existing lawns.
- H. For Structures:
 - 1. Calculate excavation quantities based on elevations or depths indicated on Drawings.

2. Provide 2,000 psi concrete for backfill of over-excavated areas to indicated or required elevations.
3. Special preparation of bottom of excavated planes areas: Excavate areas shown on Drawings as bottom of excavated planes (B.E.P.), by excavating and filling to indicated grades and elevations.

I. For Utilities:

1. Excavate trenches to required depth for utility lines, such as pipes, conduits, and tanks, with minimum allowance of 6 inches at the bottom and 6 inches at the sides for bedding or concrete encasement as indicated on Drawings. Grade bottom of trenches to a uniform smooth surface. Remove loose soil from the excavation before placing sand bedding or concrete encasement.
2. Do not install piping lengthwise under concrete walks without review by the ARCHITECT.
3. Do not excavate trenches parallel to footings closer than 18 inches from the face of the footing or below a plane having a downward slope of two horizontal to one vertical, from a line 9 inches above bottom of footings.
 - a. Unless otherwise indicated on Drawings, depth of excavations outside buildings shall provide for a minimum coverage above top of piping, tank or conduit measured from the lowest adjoining finished grade, as follows:

Steel Pipe	24 inches below finish grade
Copper Water Tube	18 inches below finish grade
Cast-Iron, Pressure Pipe	36 inches below finished grade
Plastic Pipe (other than waste)	30 inches below finished grade
Tanks or other structure	36 inches below finished grade
Soil, sewer and storm drain	minimum 18 inches below finished grade, and as required for proper pitch and traffic load. Install polypropylene sewer pipe with at least 24 inches of coverage.
Irrigation Pipe:	Non-pressure pipe - 12 inches, pressure pipe - 24 inches.
 - b. Trench width shall provide space for fitting and joining. Excavate for piping bells and fittings, bell and spigot pipe and other fittings.
4. Where portions of existing structures, walks, paving, or other improvements are removed or cut for piping or conduit installation, replace the material with equal quality, finished to match adjoining existing improvements. Repair pavement as specified in Section 32 0117 - Pavement Repair.
5. Provide a minimum clear dimension of 2 inches from sides of wall excavation to outer surfaces of buried pipes or conduits placed in the same trench or outside surfaces of containers and tanks.

3.05 IMPORT/EXPORT OF MATERIALS

- A. Unclassified Fill and Compaction: Comply with the Standard Specifications for Public Works Construction, Section 300 - Earthwork, except as modified herein. Install and compact fill in layers not to exceed 6 inches in thickness.
- B. Provide fill materials as specified in Part 2- Products. If excavated materials from the Project site are not of required quality or sufficient quantity, import additional materials as necessary.
- C. In addition to the requirements of this Section, import and/or exported materials shall comply with the requirements of Section 01 4524, Environmental Import/Export Materials Testing.
- D. Imported fill materials shall be sampled by the Geotechnical Engineer, for compliance with the requirements of Part 2 of this Section.
- E. The Geotechnical Engineer, will submit the samples to an independent DSA approved testing laboratory for testing.
- F. Initial sampling and testing shall be performed before importing material to the Project site. Identify the location of the source site in addition to the address, name of the person and entity responsible for the source site. The Geotechnical Engineer, will obtain both the initial and additional samples from the identified site and submit samples for required testing.
- G. The Geotechnical Engineer will perform additional sampling during import operations. If the total quantity of import is determined to be greater than 1000 cubic yards of material, one sample shall be obtained and submitted for testing for each 250 cubic yards of imported material. If the total quantity of import is determined to be less than 1000 yards, one sample shall be obtained and submitted for testing for each 100 cubic yards of imported material.
- H. The independent approved testing laboratory will perform the required tests and report results of tests noting if the tested material passed or failed such tests and will furnish copies to the Project Inspector, ARCHITECT, OAR, DSA, CONTRACTOR, and others as required. Report shall state tests were conducted under the responsible charge of a licensed State of California professional engineer and the material was tested in accordance with applicable provisions of the Contract Documents, California Building Code, and the DSA. Upon completion of the Work of this Section, the independent testing laboratory and Geotechnical Engineer will submit a verified report to the DSA as required by the CBC.
- I. Bills of lading or equivalent documentation will be submitted to the Project Inspector on a daily basis.
- J. Upon completion of import operations, provide the OAR a certification statement attesting that imported material has been obtained from the identified source site.

3.6 INSTALLATION OF MATERIALS

- A. Pavement: Fill or backfill materials shall be installed in horizontal layers of 6 inches, unless otherwise required. Each layer shall be evenly placed and moistened or aerated as necessary. Unless otherwise reviewed by the Geotechnical Engineer, each layer of fill material shall cover the length and width of the area to be filled before the next layer of material is installed. Top surface of each layer shall be installed to an approximate level with a crown or crossfall of at least 1 in 50, but not more than 1 in

20. Provide adequate drainage at all times during installation of the Work of this Section.

B. Structures:

1. After concrete has been placed, forms removed, and concrete Work inspected, backfill excavations with earth to indicated or required grades. Backfill simultaneously on each side of walls or grade beams. Remove rubbish, debris and other waste materials from excavations before placing backfill.
2. Before placing backfill, adequately cure concrete and provide bracing, if required to stabilize structure. Protect waterproofing or damp-proofing against damage during backfilling operations, with required protection board. Remove bracing as backfill operation progresses.
3. Do not furnish or install expansive soils for retaining wall backfill.
4. Rigidly control the amount of water to be installed to provide optimum moisture content for type of fill material furnished. Do not over-saturate or compact by flooding or jetting.
5. Install wall backfill before installing railings and fences on walls.
6. Install weep hole drainage at the backside of walls so the backing completely covers the weep holes, is horizontally centered and extends at least 12 inches above the bottom of the weep opening. Provide an 8-inch square section of 1/4 inch galvanized or aluminum screen, with a minimum wire diameter of 0.03 inch, and install at the backside of each weep hole before installing the backfill material.
7. Where a reviewed drainage matting system is provided instead of permeable backfill for retaining structures, install in accordance with the manufacturer recommendations.

C. Utilities:

1. Do not install backfill until the Work of this Section has been inspected and tested. Do not furnish or install materials excavated from the Project site containing materials not permitted for backfill.
2. Backfill electrical or other excavated utility trenches located outside of barricaded installation areas within 24 hours after inspection by the IOR.
3. Install backfill in layers not exceeding 4 inches in thickness, except cement-sand slurry.
4. If materials excavated from the Project site are not permitted for trench backfill in paved areas, backfill trenches with a cement-sand slurry mix. Install backfill to an elevation of the existing undisturbed grades plus one inch.

3.7 COMPACTING

- A. Each layer of fill material shall be compacted by tamping, sheepsfoot rollers, or pneumatic-tired rollers to provide specified relative compaction. At inaccessible locations, provide specified compaction by manually held, operated and directed compaction equipment.

- B. Install and compact sand bedding to provide a uniform bearing under the full length of piping and conduits.
- C. Unless otherwise indicated, compact each layer of fill material to a relative compaction of at least ninety percent.
- D. When fill materials, or a combination of fill materials, are encountered or provided which develop densely packed surfaces as a result of installation or compacting operations, scarify each layer of compacted fill before installing the next succeeding layer.

3.8 INSPECTION AND TESTING

- A. The Geotechnical Engineer will inspect and test excavations, sample material quality for testing as set required in Part 2, and observe installation and compaction of fill materials.
- B. The Geotechnical Engineer will sample imported fill materials from their designated source and submit samples to the independent approved testing laboratory before delivery to the Project site.
- C. Installation of backfill shall be observed by the Geotechnical Engineer.
- D. The Geotechnical Engineer will inspect and test excavation Work before the installation of fill and other materials.
- E. Compaction: Test compaction in accordance with ASTM D1557, Method C.
- F. The Project Inspector will inspect foundation excavations when completed and ready for forms, after forms are in place, and before first placement of concrete.

3.09 PROTECTION

- A. Protect the Work of this Section until Substantial Completion.

3.10 CLEANING

- A. Remove rubbish, debris, and waste materials and legally dispose of off the Project site.

END OF SECTION 312313

SECTION 312316

EXCAVATION AND FILL FOR PAVING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Excavating, backfill, and compacting for paved areas.
2. Installation of fill materials.

B. Related Requirements:

1. Division 01 - General Requirements.
2. Section 01 4524 - Environmental Import/Export Materials Testing.
3. Section 31 1000 - Site Clearing.
4. Section 31 2200 - Grading.
5. Section 31 2323 - Excavation and Fill for Utilities.
6. Section 32 2326 - Base Course.
7. Section 32 1313 - Site Concrete Work.

1.2 PROJECT REQUIREMENTS

A. Import and Export of Earth Materials:

1. Fees: Pay as required by authorities having jurisdiction over the area.
2. Bonds: Post as required by authorities having jurisdiction over the area.
3. Haul Routes and Restrictions: Comply with requirements of authorities having jurisdiction over the area.

1.3 QUALITY ASSURANCE

- A. Comply with Standard Specifications for Public Works Construction, current edition, except as modified herein.
- B. Sampling, testing, and certification of imported and/or exported soils shall be performed in accordance with Section 01 4524 - Environmental Import/Export Materials Testing.

1.4 TESTING

- A. DISTRICT will retain a Geotechnical Engineer as a DISTRICT Consultant who will provide observations, tests, inspections and approvals identified in the Contract Documents as being responsibility of the DISTRICT.
- B. Imported Soils: The Geotechnical Engineer will obtain initial product Sample for testing in accordance Article 3.05 of this Section.

1.5 PROJECT CONDITIONS

- A. Information on Drawings or in soils report does not constitute a guarantee of accuracy or uniformity of soil conditions over the Project site.

PART 2 - PRODUCTS

2.1 BASE MATERIALS

- A. Concrete Slabs On Grade: Provide “Crushed Aggregate Base “as specified in the Standard Specifications for Public Works Construction, Section 200: “Rock Materials,” with ¾ inch maximum size aggregates. Provide 3-inch thick base, unless noted otherwise.
- B. Bituminous Surfacing: As indicated on Drawings and specified in Section 31 2326 - Base Course.

2.2 FILL AND BACKFILL MATERIALS

- A. Fill and backfill materials shall be previously excavated materials or imported fill material, free of clods and stones larger than 3-inch, foreign materials, vegetable growths, sod, expansive soils, rubbish and debris. Material shall conform to these specified requirements and related sections.
- B. Fill material exhibiting a wide variation in consistency and moisture content shall be blended or aerated to stabilize and upgrade the material.
- C. Imported Fill Material:
 - 1. Provide suitable materials obtained from Project site excavations for earthwork and fill materials. If excavated materials are not of suitable quality or sufficient quantity, import additional materials as necessary.
 - 2. Imported fill shall be a granular material with sufficient binder to form a firm and stable unyielding subgrade and shall not have more than 60 percent of fines passing 200 mesh sieve. Material shall have a coefficient of expansion of not more than 2 percent from air dry to optimum moisture content and not more than 6 percent from air dry to saturation. Imported material shall be clean and free of rubbish, debris, and toxic or hazardous contaminants. Adobe or clay soils are not permitted.
- D. Brick rubble and broken concrete originating from the Project site shall be legally disposed of off the Project site. No such materials shall be imported from outside the Project site.
- E. Permeable Backfill:

1. Provide permeable backfill material behind retaining structures consisting of gravel, crushed gravel, crushed rock, natural sands, manufactured sand, or combinations of these materials conforming to the following gradations:

Sieve Size:	Percentage Passing:
3/4 inch (19mm)	100
3/8 inch (10mm)	80 to 100
No. 100	0 to 8
No. 200	0 to 3

2. Those portions of fill material passing a No. 4 sieve shall provide a sand equivalent of at least 60.
3. Provided backing for weep holes shall consist of two cubic feet of aggregate in burlap sacks, securely tied. Aggregate shall conform to requirements for No. 3 concrete aggregate as specified in subsection 200-1.4 of the Standard Specifications for Public Works Construction.
4. Permeable Backfill Alternate Materials: Instead of the materials specified for retaining structures backfill, a drainage matting system, Miradrain by Mirafi, Inc., or equal, may be provided if reviewed and approved by the ARCHITECT.

PART 3 - EXECUTION

3.1 GENERAL

- A. Before initiating intrusive activities, contact Underground Service Alert of Southern California (USA or Dig Alert) to obtain a Dig Alert ticket for location information on buried public and USA member utilities and pipelines at least 48-hours prior to beginning work. A copy of the Dig Alert ticket shall be forwarded to the DISTRICT. For on-site utilities, retain a state-licensed third party underground utility locating service.
- B. Clear the Project site as indicated in Section 31 1000 - Site Clearing.

3.2 PROTECTION

- A. Protect and guard excavations against danger to life, limb, and property as required by, but not limited to, Cal-OSHA regulations.
- B. Protect adjacent existing improvements including landscaping against damage.

3.3 EXISTING UTILITY LINES

- A. Protect existing utility lines from damage or displacement.
- B. Remove conduits or pipes not in service, exposed during Work, unless a minimum cover of 2 feet is provided. Remove concrete, clay or other non-metallic pipe over 8 inches in diameter, unless otherwise indicated.

3.4 EXCAVATION

- A. Unclassified Excavations: Comply with the Standard Specifications for Public Works Construction, Section 300: "Earthwork," except as modified herein.

3.5 FILL

- A. Unclassified Fill and Compaction: Comply with the Standard Specifications for Public Works Construction, Section 300: "Earthwork," except as modified herein.
- B. Provide fill materials as specified in Part 2 - Products. If excavated materials from the Project site are not of required quality or sufficient quantity, import additional materials as necessary.
- C. In addition to the requirements of this Section, import and/or exported materials shall comply with the requirements of Section 01 4524 - Environmental Import/Export Materials Testing.
- D. Imported fill materials will be sampled by the Geotechnical Engineer for compliance with the requirements of Part 2 of this Section.
- E. The Geotechnical Engineer will submit samples to a DSA approved independent approved testing laboratory for testing.
- F. Initial sampling will be performed by the Geotechnical Engineer before importing material to the Project site. Identify the location of the source site in addition to the address, name of the person and/or entity responsible for the source site. The Geotechnical Engineer will obtain both the initial and additional samples from the identified site and will submit samples to the approved independent testing laboratory for testing.
- G. The Geotechnical Engineer will perform additional sampling during import operations. If the total quantity of import is determined to be greater than 1,000 cubic yards of material, one sample shall be obtained and submitted for testing for each 250 cubic yards of imported material. If the total quantity of import is determined to be less than 1,000 yards, one sample shall be obtained and submitted for testing for each 100 cubic yards of imported material.
- H. The independent approved testing laboratory will perform the required tests and report results of tests noting if the tested material passed or failed such tests and will furnish copies to the Project Inspector, ARCHITECT, OAR, DSA, CONTRACTOR, and others as required. Report shall state tests were conducted under the responsible charge of a licensed State of California professional engineer and the material was tested in accordance with applicable provisions of the Contract Documents, CBC, and the DSA. Upon completion of the Work of this Section, the independent testing laboratory and Geotechnical Engineer shall submit a verified report to the DSA as required by CBC.
- I. Bills of lading or equivalent documentation will be submitted to the Project Inspector on a daily basis.
- J. Upon completion of import operations, provide the OAR a certification statement attesting that imported material has been obtained from the identified source site.

3.6 INSTALLATION OF MATERIALS

- A. Fill or backfill materials shall be installed in horizontal layers of 6 inches, unless otherwise required. Each layer shall be evenly placed and moistened or aerated as necessary. Unless otherwise reviewed by the Geotechnical Engineer, each layer of fill material shall cover the length and width of the area to be filled before the next layer of material is installed. Top surface of each layer shall be installed to an approximate level with a crown or crossfall of at least 1 in 50, but no more than 1 in 20. Provide adequate drainage at all times during construction of the Work of this Section.

3.7 COMPACTING

- A. Each layer of fill material shall be compacted by tamping, sheepsfoot rollers, or pneumatic-tired rollers to provide specified relative compaction. At inaccessible locations, provide specified compaction by manually held, operated and directed compaction equipment.
- B. Unless otherwise indicated, compact each layer of earth fill to a relative compaction of at least 90 percent.
- C. When fill materials, or a combination of fill materials, are encountered or provided which develop densely packed surfaces as a result of installation or compacting operations, scarify each compacted layer before installing the next succeeding layer.

3.8 INSPECTION AND TESTING

- A. The Geotechnical Engineer will inspect and test excavations, sample material quality as required in Part 2, and observe installation and compaction of fill materials.
- B. The Geotechnical Engineer will sample imported fill materials from their designated source before delivery to the Project site.
- C. Installation of backfill will be observed by the Geotechnical Engineer.
- D. The Geotechnical Engineer will inspect and test excavation Work before the installation of fill and/or other materials.
- E. Compaction: Test compaction in accordance with ASTM D1557, Method C.

3.9 PROTECTION

- A. Protect the Work of this Section until Substantial Completion.

3.10 CLEANING

- A. Remove rubbish, debris, and waste materials and legally dispose of off the Project site.

END OF SECTION 312316

SECTION 312319

EXCAVATION AND FILL FOR STRUCTURES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Excavating, backfilling, and compacting for buildings and structures.
2. Fill materials.

B. Related Requirements:

1. Division 01 - General Requirements.
2. Section 01 4524 - Environmental Import/Export Materials Testing.
3. Section 31 1000 - Site Clearing.
4. Section 31 2200 - Grading.
5. Section 31 2616 - Excavation and Fill for Paving.
6. Section 31 2323 - Excavation and Fill for Utilities.

1.2 PROJECT REQUIREMENTS

A. Import and Export of Earth Materials:

1. Fees: Pay as required by authorities having jurisdiction over the area.
2. Bonds: Post as required by authorities having jurisdiction over the area.
3. Haul Routes and Restrictions: Comply with requirements of authorities having jurisdiction over the area.

1.3 SUBMITTALS

- A. Imported Soils: A Geotechnical Engineer, retained by the District as a District Consultant, will obtain initial product Sample for testing in accordance with the terms of Article 3.05 of this Section.
- B. Shoring calculations as required in Article 3.03 of this Section.

1.4 QUALITY ASSURANCE

- A. Comply with the following as a minimum requirement: Standard Specifications for Public Works Construction, current edition, except as modified herein.

- B. Sampling, testing, and certification of imported and/or exported soils shall be performed in accordance with Section 01 4524 - Environmental Import/Export Materials Testing.

1.5 TESTING

- A. DISTRICT will retain a Geotechnical Engineer as a DISTRICT Consultant who will provide observations, tests, inspections and approvals identified in the Contract Documents as being responsibility of DISTRICT.
- B. Imported Soils: The Geotechnical Engineer will obtain initial product Sample for testing in accordance Article 3.05 of this Section.

1.6 PROJECT CONDITIONS

- A. Information on Drawings or in soils report does not constitute a guarantee of accuracy or uniformity of soil conditions over the Project site.

PART 2 - PRODUCTS

2.1 FILL AND BACKFILL MATERIALS

- A. Fill and backfill materials shall be a granular material previously removed from excavation, or imported fill material, free of large clods and stones larger than 3 inches, foreign materials, vegetable growths, sod, expansive soils, rubbish and debris. Material shall conform to these specified requirements and related sections.
- B. Fill material exhibiting a wide variation in consistency and or moisture content shall be blended and/or aerated to stabilize and upgrade the material.
- C. Imported Fill Material:
 - 1. Provide suitable materials obtained from Project site excavations for earthwork and fill materials. If excavated materials are not of suitable quality or sufficient quantity, import additional materials as necessary.
 - 2. Imported fill shall be a granular material with sufficient binder to form a firm and stable unyielding subgrade and shall not have more than 60 percent of fines passing 200 mesh sieve. Material shall have a coefficient of expansion of not more than two percent from air dry to optimum moisture content and not more than six percent from air dry to saturation. Imported material shall be clean and free of rubbish, debris and toxic or hazardous contaminants. Adobe or clay soils are not permitted.
- D. Brick rubble and broken concrete originating from the Project site shall be legally disposed of off the Project site No such materials shall be imported from outside the Project site.
- E. Permeable Backfill:
 - 1. Provide permeable backfill material behind retaining structures consisting of gravel, crushed gravel, crushed rock, natural sands, manufactured sand, or combinations of these materials conforming to the following gradations:

<u>Sieve Size</u>	<u>Percentage Passing</u>
3/4 inch	100
3/8 inch	80 to 100
No. 100	0 to 8
No. 200	0 to 3

2. Those portions of fill material passing a No. 4 sieve shall provide a sand equivalent of at least 60.
3. Provided backing for weep-holes shall consist of two cubic feet of aggregate in burlap sacks, securely tied. Aggregate shall conform to requirements for No. 3 concrete aggregate as specified in subsection 200-1.4 of the Standard Specifications for Public Works Construction.
4. Permeable Backfill Alternate Materials: Instead of the materials specified for retaining structures backfill, a drainage matting system, Miradrain by Mirafi, Inc., or equal, may be provided if reviewed and approved by the ARCHITECT.

PART 3 - EXECUTION

3.1 GENERAL

- A. Before initiating intrusive activities, contact Underground Service Alert of Southern California (USA or Dig Alert) to obtain a Dig Alert ticket for location information on buried public and USA member utilities and pipelines at least 48-hours prior to beginning work. A copy of the Dig Alert ticket shall be forwarded to the DISTRICT. For on-site utilities, retain a state-licensed third party underground utility locating service.
- B. Clear the Project site as indicated in Section 31 1000 - Site Clearing.

3.2 PROTECTION

- A. Protect and guard excavations against danger to life, limb, and property as required by, but not limited to, Cal-OSHA regulations.
- B. Protect adjacent existing improvements including landscaping against damage.
- C. Shore, crib, or lag excavations and earthen banks as necessary to prevent caving-in, erosion or gullyng of sides.
- D. Divert or de-water excavations until concrete is placed, forms are removed, and backfilling is complete.

3.3 SHORING

- A. Provide shoring as necessary to properly and safely support earth sides of excavations, curbs, sidewalks, gutter, drives and stairs, against movement and collapse.
- B. Design and Calculations: Provide in accordance with requirement of Cal-OHSA. Remove shoring upon completion of Work, or when no longer needed.

3.4 EXCAVATION

- A. Form sides of footings, pads, grade beams, and slab foundations, unless otherwise indicated. Provide excavations of sufficient size to permit installation and removal of forms and other Work as required.
- B. Machine-drill excavation for round footings to size and depth indicated. Provide a collar or casing, or other adequate protection, to exclude dirt and debris. Protect excavations with plank covers until concrete is placed.
- C. Provide excavation bottoms level and free from loose material. Excavate to indicated or required elevations of undisturbed earth.
- D. Provide excavations free from standing water by pumping, draining, or providing protection against water intrusion. If soil becomes soft, soggy, or saturated, excavate to firm undisturbed soil and fill as required. Slope adjacent grades away from excavations to minimize entry of water.
- E. Calculate excavation quantities based on elevations or depths indicated on Drawings.
- F. Provide 2,000 psi concrete for backfill of over-excavated areas to indicated or required elevations.
- G. Special preparation of bottom of excavated planes areas: Excavate areas designated on Drawings as bottom of excavated planes (B.E.P.), by excavating and filling to indicated grades and elevations.

3.5 IMPORT/EXPORT OF MATERIALS

- A. Provide fill materials as specified in Part 2- Products. If excavated materials from the Project site are not of required quality or sufficient quantity, import additional materials as necessary.
- B. In addition to the requirements of this Section, import and/or exported materials shall comply with the requirements of Section 01 4524 - Environmental Import/Export Materials Testing.
- C. Imported fill materials will be sampled by the Geotechnical Engineer for compliance with the requirements of Part 2 of this Section.
- D. The geotechnical engineer will submit all samples to a DSA approved independent testing laboratory for testing.
- E. Initial sampling will be performed by the Geotechnical Engineer before importing material to the Project site. Identify the location of the source site in addition to the address, name of the person and/or entity responsible for the source site. The Geotechnical Engineer will obtain both the initial sample and additional samples from the identified site and will submit samples to the approved independent testing laboratory for testing.
- F. The Geotechnical Engineer will perform additional sampling during import operations. If the total quantity of import is determined to be greater than 1,000 cubic yards of material, one sample shall be obtained and submitted for testing for each 250 cubic yards of imported material. If the total quantity of import is determined to be less than 1,000 yards, one sample shall be obtained and submitted for testing for each 100 cubic yards of imported material.

- G. The independent approved testing laboratory will perform the required tests and report results of tests noting if the tested material passed or failed such tests and will furnish copies to the Project Inspector, ARCHITECT, OAR, DSA, CONTRACTOR, and others as required. Report shall state tests were conducted under the responsible charge of a licensed State of California professional engineer and the material was tested in accordance with applicable provisions of the Contract Documents, CBC and the DSA. Upon completion of the Work of this Section, the independent testing laboratory and Geotechnical Engineer will submit a verified report to the DSA as required by CBC.
- H. Bills of lading or equivalent documentation will be submitted to the Project Inspector on a daily basis.
- I. Upon completion of import operations, provide the OAR a certification statement attesting that all imported material has been obtained from the identified source site.

3.6 BACKFILLING

- A. After concrete has been placed, forms removed and concrete Work inspected, backfill excavations to indicated or required grades. Backfill simultaneously on each side of walls or grade beams. Remove rubbish, debris, and other waste materials from excavations before placing backfill.
- B. Before installing backfill, adequately cure concrete and provide bracing to stabilize structures. Protect waterproofing or dampproofing against damage during backfilling operations with required protection board. Remove bracing as backfill operation progresses.
- C. Do not furnish or install expansive soils for below grade building walls.
- D. Install each layer of material in a not to exceed thickness of 6 inches, unless otherwise required.
- E. Rigidly control the amount of water to be installed to provide optimum moisture content for type of fill material furnished. Do not over-saturate or compact by flooding or jetting.
- F. Install wall backfill before installing railings and fences on walls.
- G. Impervious backfill materials shall be installed in layers along with and by the same methods specified for structure backfill. Impervious backfill materials shall be at the approximate grade and elevation and where exposed to erosion, shall be covered with at least a 12-inch layer of fill material as reviewed by the Geotechnical Engineer.
- H. Install weep hole drainage at the backside of walls so the backing completely covers the weep holes, is horizontally centered and extends at least 12 inches above the bottom of the weep opening. Provide an 8-inch square section of 1/4 inch galvanized or aluminum screen, with a minimum wire diameter of 0.03 inch, and install at the backside of each weep hole before installing the backfill material.
- I. Where a reviewed drainage matting system is provided instead of permeable backfill for retaining structures, install in accordance with the manufacturer recommendations.

3.7 COMPACTING

- A. Compact each layer of fill material by tamping, sheepsfoot rollers or pneumatic-tired rollers, to such extent as to provide specified relative compaction. At inaccessible locations, compact to specified requirements with hand-held, operated and directed compaction equipment.
- A. Unless otherwise indicated, compact each layer of fill material to a relative compaction of at least 90 percent.
- B. Do not compact by flooding or jetting.
- C. When fill materials, or a combination of fill materials, are encountered or provided which develop densely packed surfaces as a result of installation or compacting operations, scarify each layer of compacted fill before installing the next succeeding layer.

3.8 INSPECTION AND TESTING

- A. The Geotechnical Engineer will inspect and test excavations, sample material quality as required in Part 2, and observe installation and compaction of fill materials.
- B. The Geotechnical Engineer will sample imported fill materials from their designated source before delivery to the Project site.
- C. Installation of backfill shall be observed by the Geotechnical Engineer.
- D. The Geotechnical Engineer will inspect and test excavation Work before the installation of fill and/or other materials.
- E. Compaction: Test compaction in accordance with ASTM D1557, Method C.
- F. The Project Inspector will inspect foundation excavations when completed and ready for forms, after forms are in place and before first placement of concrete.

3.9 PROTECTION

- A. Protect the Work of this Section until Substantial Completion.

3.10 CLEANUP

- A. Remove rubbish, debris, and waste materials and legally dispose of off the Project site.

END OF SECTION 312319

SECTION 312323

EXCAVATION AND FILL FOR UTILITIES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Excavating, backfilling, and compacting utility trenches such as water, gas, irrigation, storm drain, sewer lines, concrete-encased conduits, and manholes, vaults, valve boxes, catch basins, underground tanks, thrust blocks, yard boxes, pull boxes and other utility appurtenances.

B. Related Requirements:

1. Division 01 - General Requirements.
2. Section 01 4524 - Environmental Import/Export Materials Testing.
3. Section 31 1000 - Site Clearing.
4. Section 31 2200 - Grading.
5. Section 31 2316 - Excavation and Fill for Paving.
6. Section 31 2319 - Excavation and Fill for Structures.
7. Section 32 0117 - Pavement Repair.
8. Section 32 1313 - Site Concrete Work.
13. Section 33 4000 - Storm Drainage Utilities.

1.2 PROJECT REQUIREMENTS

A. Import and Export of Earth Materials:

1. Fees: Pay as required by authorities having jurisdiction over the area.
2. Bonds: Post as required by authorities having jurisdiction over the area.
3. Haul Routes and Restrictions: Comply with requirements of authorities having jurisdiction over the area.

1.3 QUALITY ASSURANCE

- ###### A. Comply with the following as a minimum requirement: Standard Specifications for Public Works construction, current edition except as modified herein.

- B. Sampling, testing, and certification of imported and/or exported soils shall be performed in accordance with Section 01 4524 - Environmental Import/Export Materials Testing.

1.4 TESTING

- A. DISTRICT will retain a Geotechnical Engineer as a DISTRICT Consultant who will provide observations, tests, inspections and approvals identified in the Contract Documents as being responsibility of DISTRICT.
- B. Imported Soils: The Geotechnical Engineer will obtain initial product Sample for testing in accordance Article 3.02 of this Section.

1.5 PROJECT CONDITIONS

- A. Information on Drawings or in soils report does not constitute a guarantee of accuracy or uniformity of soil conditions over the Project site.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Bedding material from trench bottom to one foot above the pipe:
 - 1. Sand, gravel, crushed aggregate or native free-draining granular material providing a sand equivalent of at least 30 or a coefficient of permeability greater than 1.4 inches per hour.
 - 2. Sand complying with the Specifications for cement concrete aggregates.
- B. Backfill Materials:
 - 1. Excavated trench material to be installed for backfilling shall be clean, free of large clods, and stones larger than 2 ½-inch in any dimension.
 - 2. Cement-sand slurry shall be provided with one sack of cement per cubic yard of the mixture.
 - 3. Imported Fill Material: Imported fill material shall be a granular material with sufficient binder to form a firm and stable unyielding subgrade and shall not have more than 60 percent of fines passing a 200 mesh sieve. Material shall provide a coefficient of expansion of not more than two percent from air dry to optimum moisture content and not more than six percent from air dry to saturation. Imported materials shall be clean and free of rubbish, debris, and toxic or hazardous contaminants. Adobe or clay soils are not permitted.

PART 3 - EXECUTION

3.1 GENERAL

- A. Before initiating intrusive activities, contact Underground Service Alert of Southern California (USA or Dig Alert) to obtain a Dig Alert ticket for location information on buried public and USA member utilities and pipelines at least 48-hours prior to beginning work. A copy of the Dig Alert ticket shall be forwarded to the DISTRICT. For on-site utilities, retain a state-licensed third party underground utility locating service.
- B. Barricade trenches, ditches, pits, sumps, and similar Work outside the barricaded working area with chain link fence as specified in Section 01 5000, Construction Facilities and Temporary Controls, and in accordance with Cal-OSHA standards and requirements.
- C. Saw-cut concrete or bituminous paving for trench installation.
- D. Trenches over 5 feet in depth shall conform to the Cal-OSHA.
- E. Where indicated and required to excavate in lawn areas, protect adjoining lawn areas outside of the Work area. Replace or install removed sod upon completion of backfill by installing sod level with adjacent lawns. If installation of removed sod fails, furnish sod and install to match existing lawns.
- F. Backfill over excavations to the required elevations with earth, gravel, sand, or concrete and compact as required. Provide excavations free from standing water by pumping, draining, or providing protection against water intrusion. Slope adjacent grades away from excavations to minimize entry of water.
- G. Do not install piping lengthwise under concrete walks without review by the ARCHITECT.
- H. Do not excavate trenches parallel to footings closer than 18 inches from the face of the footing or below a plane having a downward slope of two horizontal to one vertical, from a line 9 inches above bottom of footings.
 - 1. Unless otherwise indicated on Drawings, depth of excavations outside the buildings shall allow for a minimum coverage above top of pipe, tank, or conduit measured from the lowest adjoining finished grade, as follows:

Steel Pipe	24 inches below finished grade
Copper Water Tube	18 inches below finished grade
Cast-Iron Pressure Pipe	36 inches below finished grade
Plastic Pipe (other than waste)	30 inches below finished grade
Tanks or other structures	36 inches below finished grade
Soil, Sewer & Storm Drain	minimum 18 inches below finished grade, and as required for proper pitch and traffic load. (Install polypropylene sewer pipe with at least 24 inches coverage)
Irrigation Pipe:	nonpressure pipe 12 inches, pressure pipe 24 inches
 - 2. Trench width shall provide ample space for fitting and joining. Excavate for piping bells and fittings, bell and spigot pipe and other fittings.
- I. Unless indicated otherwise, excavate trenches to the required depths for utilities, such as pipes, conduit and tanks, with minimum allowances of 6 inches at the

bottom and 6 inches at the sides for bedding of unprotected piping or as required for concrete encasement of conduits as indicated on Drawings. Grade bottom of trenches to a uniform smooth surface. Remove loose soil from the excavation before installing sand bedding or concrete encasement.

- J. Provide excavations free from standing water by pumping, draining, or providing protection against water intrusion. If soil becomes soft, soggy, or saturated, excavate to firm undisturbed soil and fill as required. Slope adjacent grades away from excavations to minimize entry of water.
- K. Provide a minimum clear dimension of 2 inches from sides of wall excavation to outer surfaces of buried pipes or conduits installed in the same trench or outside surfaces of containers and tanks.
- L. Do not install backfill until required inspections and testing is completed.
- M. Backfill electrical or other excavated utility trenches located outside of barricaded installation areas within 24 hours after inspection by the Project Inspector.
- N. Install backfill materials in layers not exceeding 4 inches in thickness and compact to 90 percent of the maximum density.
- O. If materials excavated from the Project site are not permitted for trench backfill in paved areas, backfill trenches with a cement-sand slurry mix. Install backfill to an elevation of the existing undisturbed grade plus one inch.
- P. Install and compact sand bedding to provide a uniform full length bearing under piping and conduits.
- Q. Where portions of existing structures, walks, paving, or other improvements are removed or cut for piping or conduit installation, replace the material with equal quality, finished to match adjoining existing improvements. Repair pavement as specified in Section 32 0117, Pavement Repair.

3.2 IMPORT/EXPORT OF MATERIALS

- A. Provide fill materials as specified in Part 2, Products. If excavated materials from the Project site are not of required quality or sufficient quantity, import additional materials as necessary.
- B. In addition to the requirements of this Section, import and exported materials shall comply with the requirements of Section 01 4524, Environmental Import/Export Material Testing.
- C. Imported fill materials will be sampled by the Geotechnical Engineer for compliance with the requirements of Part 2 of this Section.
- D. The Geotechnical Engineer will perform the tests by utilizing an independent approved testing laboratory.
- E. Initial sampling will be performed by the Geotechnical Engineer before importing material to the Project site. Identify the location of the source site in addition to the address, name of the person and/or entity responsible for the source site. The Geotechnical Engineer will obtain both the initial sample and additional samples

from the identified site and shall submit all samples to the approved independent testing laboratory.

- F. The Geotechnical Engineer will perform additional sampling during import operations. If the total quantity of import is determined to be greater than 1,000 cubic yards of material, one sample shall be obtained and submitted for testing for each 250 cubic yards of imported material. If the total quantity of import is determined to be less than 1,000 yards, one sample shall be obtained and submitted for testing for each 100 cubic yards of imported material.
- G. The independent approved testing laboratory will perform the required tests and report results of all tests noting if the tested material passed or failed such tests and will furnish copies to the Project Inspector, ARCHITECT, OAR, DSA, CONTRACTOR, and others as required. Report shall state tests were conducted under the responsible charge of a licensed State of California professional engineer and the material was tested in accordance with applicable provisions of the Contract Documents, CBC and the DSA. Upon completion of the Work of this Section, the independent testing laboratory and Geotechnical Engineer will submit a verified report to the DSA as required by CBC.
- H. Bills of lading or equivalent documentation will be submitted to the Project Inspector on a daily basis.
- I. Upon completion of import operations, provide the OAR a certification statement attesting that imported material has been obtained from the identified source site.

3.3 INSPECTION AND TESTING

- A. The Geotechnical Engineer will inspect and test excavations, sample material quality as required in Part 2, observe installation and compaction of fill materials.
- B. Compaction test shall be performed in accordance with ASTM D1557, method "C."

3.4 PROTECTION

- A. Protect the Work of this Section until Substantial Completion.

3.5 CLEANUP

- A. Remove rubbish, debris, and waste materials and legally dispose of off the Project site.

END OF SECTION 312323

SECTION 312326

BASE COURSE

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Installation of base material.

B. Related Requirements:

1. Division 01 - General Requirements.
2. Section 01 4524 – Environmental Import / Export Material Testing.
3. Section 31 1000 - Site Clearing.
4. Section 31 2200 - Grading.
5. Section 31 2313 - Excavation and Fill.
6. Section 31 2316 - Excavation and Fill for Paving.
7. Section 32 1313 - Site Concrete Work.

1.2 SUBMITTALS

- A. Crushed aggregate base (CAB) shall consist of native rock without naturally occurring asbestos or recycled materials. The CONTRACTOR shall submit written documentation, which identifies the source, volume, and proposed transport date of the material for review and approval by DISTRICT'S Office of Environmental Health and Safety (OEHS) prior to importing the material. A statement on company letterhead from the CAB source, stamped by either a California Professional Geologist or Engineer, which states that the subject materials are native rock, do not contain any recycled materials and that the source quarry does not mine ultramafic materials, a source of natural occurring asbestos shall be included in the submittal to OEHS. The CONTRACTOR may request variance from analytical testing required by Section 01 4524 for CAB. To be considered for a variance, the CONTRACTOR shall submit a documentation package for OEHS approval, which includes all of the aforementioned information at least 48 hours in advance of planned import.

1. Frequently used suppliers for CNUSD projects include:

- a. Hansen Aggregates.
- b. Vulcan Materials, Reliance Company.
- c. Vulcan Materials Durbin.

- C. Product Data: Submit material source, technical information and test data for base materials. Gradation and quality certifications shall be dated within 30 days of the submittal.
- D. Sample: Submit sample of proposed base course material.

1.3 QUALITY ASSURANCE

- A. Comply with the following as a minimum requirement: Standard Specifications for Public Works Construction, current edition.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Crushed Aggregate Base (CAB) materials shall conform to the requirements of the Standard Specifications for Public Works Construction: Section 200 - Rock Materials.
- B. Crushed Miscellaneous Base (CMB) or materials generated on site shall not be used as a base course material.

2.2 MATERIAL APPROVAL

- A. Base material shall be inspected by the Project Inspector for gradation and material content prior to installation. The DISTRICT may choose to have additional tests performed by a geotechnical engineer, retained by the DISTRICT, before installation.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install base course material in layers not exceeding 4 inches in thickness, unless required otherwise. Grade and compact to indicated levels or grades, cut and fill, water and roll until the surface is hard and true to line, grade and required section. Provide a relative compaction of at least 95 percent, unless otherwise required.
- B. Grade base course to elevations indicated on Drawings, ready to receive surfacing, in accordance with Section 31 2200 - Grading.

3.2 PROTECTION

- A. Protect the Work of this section until Substantial Completion.

3.3 CLEANUP

- A. Remove rubbish, debris, and waste materials and legally dispose of off the Project site.

END OF SECTION 312326

SECTION 321313
SITE CONCRETE WORK

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Portland cement concrete pavement, cement walks, curbs, ramps, pipe bedding and encasements, transition structures.

B. Related Requirements:

1. Division 01 - General Requirements.
2. Section 31 2200 - Grading.
3. Section 31 2313 - Excavation and Fill.
4. Section 31 2316 - Excavation and Fill for Pavement.
5. Section 31 2326 - Base Course.
6. Section 33 4000 - Storm Drainage Utilities.

1.2 SUBMITTALS

A. Shop Drawings: Submit plans, elevations and details of concrete site Work.

B. Product Data: Submit mix designs and manufacturer's technical data for materials and products. Submit 3-inch by 3-inch concrete Sample of each specified color.

C. Material Sample: Submit one concrete bumper to the Project Inspector for destructive testing.

1.3 QUALITY ASSURANCE

A. Comply with Standard Specifications For Public Works Construction.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Concrete, Mortar and Related Materials: Comply with applicable provisions of Standard Specifications for Public Works Construction, Section 201 - Concrete, Mortar and Related Materials:

1. Concrete: 28-day compressive strength 2,500 psi, unless specified otherwise.
2. Reinforcing Mesh: ASTM A185, 4 by 4/W1.4 by W1.4 welded wire mesh.

3. Expansion Joint Filler: Preformed expansion joint filler, bituminous type, complying with ASTM D994.
- B. Form Materials:
1. Side forms: Douglas fir, Construction Grade or Better or metal forms.
 2. Stakes: Douglas fir, Construction Grade or Better or metal stakes.

PART 3 - EXECUTION

3.1 CONSTRUCTION OF FORMS FOR CAST-IN-PLACE STRUCTURES

- A. Concrete Pavement: Install Portland cement concrete pavement in compliance with the Standard Specifications for Public Works Construction, Section 302- Roadway Surfacing.
- B. Miscellaneous Exposed Concrete: Install concrete curbs, walks, gutters, cross gutters, access ramps, driveways, catch basins, yard boxes, vaults and similar structures, in compliance with the Standard Specifications for Public Works Construction, Section 303 - Concrete and Masonry Construction.
- C. Exposed Concrete Bases: Install bases, such as for post, flagpole, light standards and similar bases, in compliance with the Standard Specifications for Public Works Construction, Section 303 - Concrete and Masonry Construction.
- D. Post, flagpole, light standard footings below grade, underground conduit bedding, encasements, thrust blocks and similar structures may be placed directly in excavations conforming to the required sizes.
- E. Reinforcement installation and concrete placement, surface finishes, curing and removal of forms shall be performed in compliance with applicable provisions of Standard Specifications for Public Works Construction, Section 303 - Concrete and Masonry Construction. Provide heavy broom finish at slopes exceeding six percent and medium broom finish at slopes up to six percent.

3.2 INSTALLATION OF PARKING BUMPERS

- A. Install bumpers as indicated on the Drawings. On bituminous paving, install anchors through pavement and into the ground a minimum of 12 inches. On concrete pavement, install bumpers in a continuous bed of adhesive.

3.3 CLEAN UP

- A. Remove rubbish, debris, and waste materials and legally dispose of off the Project site.

3.4 PROTECTION

- A. Protect the Work of this section until Substantial Completion.

END OF SECTION 321313

SECTION 334000

STORM DRAINAGE UTILITIES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Drainage pipes.

B. Related Requirements:

1. Division 01 - General Requirements.
2. Section 31 2313 - Excavation and Fill.
3. Section 31 2323 - Excavation and Fill for Utilities.
4. Section 32 1313 - Site Concrete Work.

1.2 SUBMITTALS

- ###### A. Shop Drawings: Submit site plan denoting locations of lines, valves, and appurtenances.

- ###### B. Product Data: Manufacturer's catalog data for all required materials. Include technical data for accessories, information concerning gaskets, joints and couplings.

- ###### C. Certificates: Certificates attesting that tests set forth in referenced publication have been performed and the results required by design have been met.

1.3 QUALITY ASSURANCE

- ###### A. Comply with the following as a minimum requirement: Standard Specifications for Public Works Construction, current edition.

PART 2 – PRODUCTS

2.1 MATERIALS

- ###### A. Storm Drain Pipe:

1. Cast Iron Pipe (CIP): Provide in conformance with Section 207 - Pipe and Section 208 - Pipe Joint Types and Materials of the Standard Specifications for Public Works Construction.
 2. Ductile Iron Pipe (DIP): Provide in conformance with Section 207 - Pipe and Section 208 - Pipe Joint Types and Materials of the Standard Specifications for Public Works Construction.
 3. Annular High Density Polyethylene (HDPEP): Provide in conformance with Section 207 - Pipe and Section 208 - Pipe Joint Types and Materials of the Standard Specifications for Public Works Construction.
- B. Concrete, Mortar and Related Materials: Conform to Section 32 1313 - Site Concrete Work.
- C. Bedding Material for Pipe: Conform to the requirements of Section 31 2313 - Excavation and Fill or Section 31 2323 - Excavation and Fill for Utilities, as required.

PART 3 – EXECUTION

3.1 EXCAVATION, BACKFILLING AND COMPACTING

- A. Conform to the requirements of Section 31 2313 - Excavation and Fill or Section 31 2323 - Excavation and Fill for Utilities, as required.

3.2 INSTALLATION OF PIPE

- A. Conform to Section 306 - Underground Conduit Construction of the Standard Specifications for Public Works Construction.
- B. Non-ferrous drainpipe installed with less than 12 inches of cover to finish grade shall be provided with a 4 inch thick concrete pipe encasement.

3.3 DRAINAGE APPURTENANCES

- A. Catch basins, junction chambers, manholes, box culverts, outlet chambers and other drainage structures: Construct as indicated on Drawings and as specified in Section 32 1313 - Site Concrete Work.

3.4 ABANDONED DRAINAGE LINES AND STRUCTURES

- A. Cap or plug existing drain lines that are cut and abandoned and remove existing drainage structures that are abandoned.

3.5 CLEANUP

- A. Remove rubbish, debris, and waste materials and legally dispose of off the Project site.
- B. Maintain Post Construction BMP after installation and keep a maintenance log to be turned over to OAR at Substantial Completion.

1.8 PROTECTION

- A. Protect the Work of this section until Substantial Completion.

END OF SECTION 334000