

PROJECT MANUAL

HVAC PROJECT AT HUENEME HIGH SCHOOL

500 W. BARD RD., OXNARD, CA 93033

for

OXNARD UNION HIGH SCHOOL DISTRICT
309 South K Street (Building C)
Oxnard, California 93030

Flewelling & Moody
Project No. 2844.0100



FLEWELLING & MOODY

architects for education

**PROJECT DIRECTORY
HUENEME HIGH SCHOOL HVAC PROJECT
F&M 2844.0100
AUGUST 13, 2020**

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(DISTRICT OFFICE)**

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END OF DIRECTORY

PROJECT MANUAL

**HUENEME HIGH SCHOOL
NEW HVAC SYSTEM**

for

OXNARD UNION HIGH SCHOOL DISTRICT

Oxnard, California

IDENTIFICATION STAMP
DIV. OF THE STATE ARCHITECT

APP: 03-120328 INC:

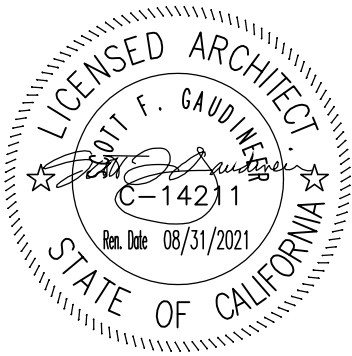
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Flewelling & Moody
Project No. 2844.100

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**SECTION 01 10 00
SUMMARY OF WORK**

PART 1 - GENERAL

1.01. SUMMARY

A. Section includes:

1. Project information.
2. Work covered by Contract Documents.
3. Access to site.
4. Coordination with occupants.
5. Work restrictions.
6. Specification and drawing conventions.

B. Related Section:

1. Division 01 50 00 Section "Temporary Facilities & Controls" for limitations and procedures governing temporary use of Owner's facilities.

1.02. PROJECT INFORMATION

C. Project Identification: Hueneme High School HVAC Project.

1. Project Location: 500 W. Bard Road, Oxnard, CA 93033.

D. Owner: Oxnard Union High School District

1. Owner's Representative: Poul Hanson.

E. Architect: Flewelling & Moody.

1.03. WORK COVERED BY CONTRACT DOCUMENTS

F. The Work of the Project is defined by the Contract Documents and consists of the following:

1. HVAC upgrades throughout campus.
2. Lighting upgrades at classroom buildings.
3. Window replacement at classroom buildings.

G. Type of Contract.

1. Project will be constructed under Design – Bid – Build.

1.04. ACCESS TO SITE

- H. General: Contractor shall have full use of Project site for construction operations during construction period. Contractor's use of Project site is limited only by Owner's right to perform work or to retain other contractors on portions of Project.
- I. Use of Site: Limit use of Project site to areas within the Contract limits indicated. Do not disturb portions of Project site beyond areas in which the Work is indicated.
 - 1. Limits: Limit site disturbance; 10 feet (3 m) beyond surface walkways, patios, surface parking, and utilities less than 12 inches (300 mm) in diameter; 15 feet (4.5 m) beyond primary roadway curbs and main utility branch trenches; and 25 feet (7.6 m) beyond constructed areas with permeable surfaces (such as pervious paving areas, storm water detention facilities, and playing fields) that require additional staging areas in order to limit compaction in the constructed area.
 - 2. Driveways, Walkways and Entrances: Keep driveways loading areas, and entrances serving premises clear and available to Owner, Owner's employees, 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 on-site.

1.05. COORDINATION WITH OCCUPANTS

- J. Partial Owner Occupancy: Owner will partially occupy the premises during entire construction period. Adjacent site is commercial and residential area. Cooperate with Owner during construction operations to minimize conflicts and facilitate Owner usage. Perform the Work so as not to interfere with Owner's operations. Maintain existing exits unless otherwise indicated.
 - 1. Maintain access to existing walkways, corridors, and other adjacent occupied or used facilities. Do not close or obstruct walkways, corridors, or other occupied or used facilities without written permission from Owner and authorities having jurisdiction.
 - 2. Provide not less than 72 hour notice to Owner of activities that will affect Owner's operations.
- K. Owner Limited Occupancy of Completed Areas of Construction: 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 such occupancy does not interfere with completion of the Work. Such placement of equipment and limited occupancy shall not constitute acceptance of the total Work.
 - 1. 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.
 - 2. Obtain a Certificate of Occupancy from authorities having jurisdiction before limited Owner occupancy.

3. Before limited Owner occupancy, mechanical and electrical systems shall be fully operational, and required tests and inspections shall be successfully completed. On occupancy, Owner will operate and maintain mechanical and electrical systems serving occupied portions of Work.
4. On occupancy, Owner will assume responsibility for maintenance and custodial service for occupied portions of Work.

1.06. WORK RESTRICTIONS

- L. Work Restrictions, General: Comply with restrictions on construction operations.
 1. Comply with limitations on use of public streets and other requirements of authorities having jurisdiction.
- M. On-Site Work Hours: Limit work in the existing building to normal business working hours as regulated by the City of Camarillo.
- N. Existing Utility Interruptions: Do not interrupt utilities serving facilities occupied by Owner or others unless permitted under the following conditions and then only after providing temporary utility services according to requirements indicated:
 1. Notify Owner not less than two days in advance of proposed utility interruptions.
 2. Obtain Owner's written permission before proceeding with utility interruptions.
- O. Noise, Vibration, and Odors: Coordinate operations that may result in high levels of noise and vibration, odors, or other disruption to Owner occupancy with Owner.
 1. Notify Owner not less than two days in advance of proposed disruptive operations.
 2. Obtain Owner's written permission before proceeding with disruptive operations.
- P. Nonsmoking Campus: Smoking is not permitted within the campus.
- Q. Controlled Substances: Use of tobacco products and other controlled substances on the Project site is not permitted.

1.07. SPECIFICATION AND DRAWING CONVENTIONS

- R. Specification Content: 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:
 1. 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.
 2. Specification requirements are to be performed by Contractor unless specifically stated otherwise.
- S. Division 01 General Requirements: Requirements of Sections in Division 01 apply to the Work of all Sections in the Specifications.

- T. Drawing Coordination: Requirements for materials and products identified on the Drawings are described in detail in the Specifications. One or more of the following are used on the Drawings to identify materials and products:
1. Terminology: Materials and products are identified by the typical generic terms used in the individual Specifications Sections.
 2. Abbreviations: Materials and products are identified by abbreviations published as part of the U.S. National CAD Standard and scheduled on Drawings.
 3. Keynoting: Materials and products are identified by reference keynotes referencing Specification Section numbers found in this Project Manual.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION

**SECTION 01 10 30
PROJECT PROCEDURES**

PART 1 – GENERAL

1.01 DESCRIPTION

- A. Work included: This section establishes special project procedures regarding
 - 1. Documents and bid procedures;
 - 2. Protection of existing facilities;
 - 3. Limits of work and storage areas;
 - 4. Construction controls;
 - 5. Coordination;

1.02 QUALITY ASSURANCE

- A. Perform all work in strict accordance with pertinent requirements of these Specifications and, in the event no such requirements are determined, in conformance with the Architect's written direction.

1.03 SUBMITTALS

- A. None required.

PART 2 – PRODUCTS

2.01 GENERAL

- A. It is the intent of these Specifications and other Contract Documents to provide a complete workable design in all parts; any equipment shown or specified shall be furnished and installed with all accessories, controls, power, and full connections as may be necessary to assure safe and proper installation and operation.

2.02 PRECEDENCE

- A. The Contract and each of the Contract Documents are complementary and they shall be interpreted so that what is called for in any one shall be as binding as if called for in all.
- B. If there is a conflict between these Technical Specifications and any remaining portion of the bid, the provisions requiring the most expensive or elaborate method of work, materials, or equipment shall control. Items in direct conflict, discovered during the bid, should be brought to the attention of the Architect, for clarification, by written Addenda. If clarification and/or Addenda is unable to be issued, the bidders shall bid the more expensive of the conflicting items/conditions; this provision shall govern the entire scope of this contract. Following Award of Bid, should the District elect to utilize the cheaper or less elaborate condition, a credit change Order shall be issued. Refer to related information in the General and Special Conditions. Contractor shall secure written permission from Architect before proceeding with work affected by omission or discrepancies in the Contract.

- C. Separate sections of this Specification are arranged only for convenience of Contractor, and nothing stated herein should be misconstrued as suggesting jurisdiction over items of work by any different building trades.
- D. When Agreement is signed, the Contractor will be given copies of the Architect's original plans and CAD disk to make one (1) set of reproducible sepia's and one (1) as-built CAD Disk, the cost to be funded by the Bidder's General Conditions. All drawing print sets required by the awarded firm, subcontractors and suppliers shall be included. This sepia and CAD disk set will also be used for the "as-built" drawings as referenced in Section 01720, Project Record Documents. A complete As-Built submission shall consist of the sepia's and the CAD disk.

PART 3 – EXECUTION

3.01 CARE OF PRESENT BUILDINGS AND GROUNDS

- A. Contractor shall be held responsible, so far as his operations are concerned, for the care and preservation of the adjacent premises, utilities, walks, streets and co-terminus property. Any parts of them injured, damaged, or disturbed because of his work shall be repaired, replaced, or cleaned, at Contractor's expense, to the satisfaction of District Representative. Prior to commencement of the Work, the Contractor or his designated representative shall jointly review the site as a part of the Pre-Construction Conference.
- B. Any such facilities as existing roads, curbing, utility poles, or underground utility lines damaged by Contractor in execution of this Contract shall be restored to former condition by Contractor at no change in the Contract price to satisfaction of District.
- C. Contractor shall take all precautions and care to preserve and protect all trees and shrubs in the right-of-ways and on the property. No tree or trees shall be cut or felled without specific permission in writing from the Architect. Trees cut without explicit instructions do so shall be replaced at the expense of the Contractor.
- D. No pruning of trees is to be done except by specified instructions of the District. Soil within the spread of the tree branches shall not be disturbed. Advance notice shall be given to the District if roots of a diameter greater than 1" must be cut.
- E. Contractor shall record and submit to District for verification any damage prior to commencement of work. Any damage not recorded and verified by District is the responsibility of the Contractor to correct.

3.02 LIMITS OF WORK AND STORAGE AREAS

- A. Submit for Construction Manager's approval a site utilization plan for construction. Plans shall indicate limits of work, storage areas, and truck routes.

3.03 CONSTRUCTION CONTROLS

- A. Dust palliation: In addition to cleanup provisions of the Specifications, Contractor shall take appropriate steps during and throughout term of the Project to prevent airborne dust due to work under this Contract. Water shall be applied to settle and prevent dust, particularly during excavation and moving of materials. No chemical palliatives shall be used without permission of the District.
- B. Noise control: Noise from job equipment shall be kept to a minimum by adequate mufflers and other means as approved by Architect or Construction manager.

- C. Interruptions of existing services shall be held to minimum and shall be made only at such times as the District directs. Approval of the District shall be requested at least 3 days in advance of desired interruption time. **Contractor shall be responsible for full Utility service to be maintained at all times to the adjacent buildings.**

3.04 SPECIAL COORDINATION REQUIREMENT

- A. It is possible that the District might have various projects under different contracts in progress simultaneously in areas adjacent to, or coincident with, areas involved in the Project.
- B. Contractor shall be responsible to coordinate the work with that of other contractors' work to allow access to sites and to avoid rework and damages to new work.
- C. Contractor shall submit a detailed critical-path schedule for District's approval before beginning work and shall make such changes in this schedule as required by District in order to assure smooth and proper execution of all works.

3.05 VERIFICATION OF EXISTING UTILITIES

- A. Prior to constructing any new underground utility the Contractor shall expose and verify all existing underground facilities that may conflict with the new utility, to ensure accuracy of the information shown on the Drawings.

3.06. HAZARDOUS MATERIALS

- A. Should asbestos, PCB or other hazardous materials be encountered in any area, immediately stop all work in that area and notify the District's representative; the District will remove all hazardous material, clean the area, and have it certified as safe by a Certified Industrial Hygienist before work under this contract may proceed in that area. A time extension will be granted for delay caused by this cleanup.
- B. Non-Specified asbestos removal from buildings shall be done under separate contract by the District.

3.07 ADDENDA AND CHANGE ORDER

- A. Changes in the Plans and Specifications shall be made by Addenda and Change Orders approved by the Division of the State Architect. Minor modifications, as determined by the District, may be made to the Plans and Specifications in writing accompanied with the Architect's signature without the processing of a formal Change Order.

3.08 ACCESS PANELS

- A. Access panels are referenced in separate sections for different trades (mechanical, plumbing, electrical). It shall be the responsibility of the individual trades to provide the access panels (sized accordingly) required for their installations. Coordinate exact location with Construction Manager prior to installation.

3.09 FIRESAFETY DURING DEMOLITION

- A. Demolition of buildings shall be in accordance with Section 8706 and, where applicable, Sections 8704 and 8705 of the California Fire Code, most recent addition.
- B. Suitable fire hose, shall be maintained at the demolition site. Such hose shall be connected to an approved source of water and shall not impede fire department use of hydrants.

- C. Demolition operations involving cutting and welding shall be in accordance with Section 4907, C.F.C.
- D. Combustible waste material, trash and rubbish shall not be burned at the demolition site, unless approved. Accumulations of such material shall be removed from the site as often as necessary to minimize the hazards therefrom.
- D. When required by the District, for building demolition which is hazardous in nature, qualified personnel shall be provided to serve as on-site fire watch. The sole duty of fire watch personnel shall be to watch for the occurrence of fire.

3.10 FIRE SAFETY DURING CONSTRUCTION

- A. Buildings under construction shall be in accordance with Section 8704 of the California Fire Code, most recent edition.
- B. Fire department access roads shall be established and maintained in accordance with Section 902, C.F.C.
- C. Water mains and hydrants shall be installed and operational in accordance with Section 903.
- D. During the construction of a building and until the permanent fire-extinguishing system has been installed and is in service, fire protection shall be provided in accordance with Section 8704, C.F.C.
- E. Fire extinguishers shall be provided for the buildings under construction. The number and type of extinguishers and the type of extinguisher shall be suitable for the type of fire associated with the hazards present.
- F. Combustible Debris. Combustible debris shall not be accumulated within buildings. Combustible debris, rubbish and waste material shall be removed from building as often as practical. Combustible debris, waste material and trash shall not be burned on the site unless approved.
- G. Internal-combustion-powered construction equipment shall be used in accordance with the following:
 - 1. Equipment shall be located so that exhausts do not discharge against combustible material.
 - 2. When possible, exhausts shall be piped to the outside of the building.
 - 3. Equipment shall not be refueled while in operation.
 - 4. Fuel for equipment shall be stored in an approved area outside of the building.
- H. Temporary heating devices shall be located away from combustible materials, and attended and maintained by competent personnel.
- I. Smoking shall be prohibited. A suitable number and type of NO SMOKING signs shall be posted.
- J. Cutting and welding operations shall be in accordance with Article 49, C.F.C.
- K. The use of torched or flame-producing devices for the sweating of pipe joints shall be in accordance with Section 1109.3.2, C.F.C.

- M. The storage, use and handling of flammable liquids shall be in accordance with Article 79. Ventilation shall be provided for operation utilizing the application of materials containing flammable solvents.
- N. Open-flame devices and other sources of ignition shall not be located in areas where flammable materials are being used.
- O. Asphalt and tar kettles shall be located and operated in accordance with Section 1105, C.F.C.
- P. Temporary electrical wiring shall be in accordance with Section 8503, C.F.C.
- Q. When required by the chief, access to buildings for the purpose of fire-fighting shall be provided. Construction material shall not block access to buildings, hydrants or fire appliances.
- R. Telephone facilities shall be provided at the construction site for the purpose of emergency notification of the fire department. The street address of the construction site shall be posted adjacent to the telephone together with the fire department telephone number.
- S. A fire-protection plan shall be established by the Shell, Electrical and HVAC Contractors for each school site

3.11 REQUESTS FOR INFORMATION AND OTHER OFFICIAL CONTRACT CORRESPONDENCE

- A. Requests for Information (and/or Clarification) (hereinafter referred to as "RFI's") submitted by the Contractor to the District shall contain the following:
 - 1. Sequential RFI number.
 - 2. Date.
 - 3. Project Title and Information.
 - 4. Statement whether sent via facsimile only and/or hard copy to follow. It is acceptable to send a facsimile copy only; it is acceptable for the District to send a facsimile response only.
 - 5. Addressed to the District.
 - 6. Plan Sheet Reference and/or Spec. Section Reference including additional detail as required, such as column grid reference, or Part/Paragraph section of the Specification.
 - 7. Bold Reference citing the "Description of the Scope in Question" such as: "Ceiling Height in Classroom B123, Duct Clearances".
 - 8. A complete, concise question regarding the issue. Note: If sketches, or other documentation, are attached, a reference shall be provided alluding to these attachments. If the RFI is originated from a subcontractor, this shall be noted.
 - 9. The date the answer is needed by so as not to impact schedule. Note: The Contractor shall allow a minimum of 5 working days for each RFI.
 - 10. If a "yes" answer, or some such similar answer, would impact the contract schedule, this shall be noted.

11. If there is a potential cost/credit impact to the District's answer, this shall be noted. Failure to notify the Construction manager at the time of the RFI may waive the Contractor's rights to such future claim.
 12. The signature of the Contractor or Contractor's superintendent.
 13. An area with printed lines for the District's response.
 14. A space for the Project Manager's signature and date.
 15. The Contractor's field office facsimile number printed on the RFI.
- B. The Contractor shall not submit more than six (6) RFI's in any one day, or more than twenty-four (24) RFI's in any one working week. It shall be the Contractor's responsibility to study the plans and specifications, in conjunction with his subcontractors, far enough in advance to submit the RFI's so as to not have an adverse impact upon the project sequencing or schedule.
- C. The Construction Manager shall be responsible for the distribution of all RFI's, once they have been answered by the Architect, in an appropriate and final manner, to all applicable trade contractors. The Architect shall make initial distribution to the District, Inspector of Record, Construction Manager, as well as to her own consultants and engineers.
- D. The Construction Manager shall maintain an RFI log, and distribute the log, showing current status at each project meeting. The Construction Manager shall maintain a bound file of all the RFI's, with the District's response, including all applicable attachments, in the job trailer at all times during the project.
1. When applicable, all Contractors shall attach an RFI response to the Master Project Construction Set, at the appropriate location in the plans and/or specifications, if the answer affects, revises, or provides necessary clarification to the construction issue in question.
- E. Proposal Requests: When the Contractor has notified the Construction Manager that the response is generating either a potential cost or credit to the contract, the Construction Manager shall issue a proposal request to the Contractor, and copy all applicable parties.
1. When the costs and/or credits have been submitted properly for the work in question, and have been reviewed by the District and Construction Manager, and the cost(s) and/or credits have been agreed upon, the Construction Manager will then assign the item to the next change order in the billing cycle.
- F. Frivolous RFI's: The RFI format shall not be used for the following:
1. A method for getting the Construction Manager or Architect to perform the Contractor's duties of properly reviewing and coordinating the plans and specifications. The Contractor is asked to use discretion in submitting RFI's; simple questions can be solved by teleconference with the Construction Manager, or bringing up questions at the weekly meetings. The Construction Manager will work with the Contractor in defining what constitutes the difference.
 2. The method for getting the District to answer a subcontractor's question that normally is part of the trade bid Contractor's responsibility.
 3. A method for attempting to create additional cost to the contract where no additional cost is due.

4. A method for luring to District into providing an answer clearly different than the documents require.
 5. In the event that the Contractor is deemed to be abusing the RFI process, the Construction Manager reserves the right to “back-charge” the contract, per his standard hourly rates, as a credit in dollars to be applied to contract extra costs.
- G. Status of District's Responses to RFI's: The Architect's written response, when applicable, shall be incorporated into the contract as the most current ruling or interpretation of the plans and specifications.
- H. Bulletins: “Bulletins” issued by the Architect, whether or not generated by an RFI, shall become official contract correspondence and incorporated into the contract. If necessary, and subject to the agreement of all parties, Bulletin issues may lead into a Proposal Request and Change Order.

END OF SECTION

**SECTION 01 10 45
CUTTING AND PATCHING**

PART 1 – GENERAL

1.01 SUMMARY

- A. This Section establishes general requirements pertaining to cutting (including excavating), fitting, and patching of the Work required to:
 - 1. Make the several parts fit properly;
 - 2. Uncover work to provide for installing, inspecting, or both, of ill-timed work;
 - 3. Remove and replace work not conforming to requirements of the Contract Documents; and
 - 4. Remove and replace defective work.
- B. Related work:
 - 1. Documents affecting work of this Section include, but are not necessarily limited to, General Conditions, Supplementary Conditions, and Sections in Division 1 of these Specifications.
 - 2. In addition to other requirements specified, upon the District's request uncover work to provide for inspection by the District of covered work, and remove samples of installed materials for testing.
 - 3. Do not cut or alter work performed under separate contracts without the District's written permission.

1.02 SUBMITTALS

- A. Request for District's consent:
 - 1. Prior to cutting which affects structural safety, submit written request to the Project Architect for permission to proceed with cutting.
 - 2. Should conditions of the Work, or schedule, indicate a required change of materials or methods for cutting and patching, so notify the Project Architect and secure his written permission and the required Change Order prior to proceeding.
- B. Notices to the Architect:
 - 1. Prior to cutting and patching performed pursuant to the District's instructions, submit cost estimate to the Architect. Secure the Project Architect approval of cost estimates and type of reimbursement before proceeding with cutting and patching.
 - 2. Submit written notice to the Project Architect designating the time the Work will be uncovered, to provide for the District's observation.

1.03 QUALITY ASSURANCE

- A. Use adequate numbers of skilled workmen thoroughly trained and experienced in the necessary crafts and completely familiar with the specified requirements and methods needed for proper performance of the work of this Section.

PART 2 – PRODUCTS

2.01 MATERIALS

- A. For replacement of items removed, use materials complying with pertinent Sections of these Specifications.

2.02 PAYMENT FOR COSTS

- A. The Owner will reimburse the Contractor for cutting and patching performed pursuant to a written Change Order, after claim for such reimbursement is submitted by the Contractor. Perform other cutting and patching needed to comply with the Contract Documents at no additional cost to the Owner.

PART 3 – EXECUTION

3.01 SURFACE CONDITIONS

- A. Inspection:
 - 1. Inspect existing conditions, including elements subject to movement or damage during cutting, excavating, patching, and backfilling.
 - 2. After uncovering the work, inspect conditions affecting installation of new work.
- B. Discrepancies:
 - 1. If uncovered conditions are not as anticipated, immediately notify the Architect and secure needed directions.
 - 2. Do not proceed until unsatisfactory conditions are corrected.

3.02 PREPARATION PRIOR TO CUTTING

- A. Provide required protection including, but not necessarily limited to, shoring, bracing, and support to maintain structural integrity of the Work.

3.03 PERFORMANCE

- A. Perform required excavating and backfilling as required under pertinent other Sections of these Specifications and OSHA standards for such work.
 - 1. Perform cutting and demolition by methods which will prevent damage to other portions of the Work and provide proper surfaces to receive installation of repair and new work.
 - 2. Perform fitting and adjusting of products to provide finished installation complying with the specified tolerances and finishes.

3. Typically chip back existing adjoining plaster surfaces to expose the lath and building paper to permit proper lapping on new infill materials.

END OF SECTION

**SECTION 01 10 60
REGULATORY REQUIREMENTS**

PART 1 – GENERAL

1.01. SECTION INCLUDES:

- A. This Section sets forth certain codes and standards and relevant requirements applicable to the work required under this contract.

1.02. STATUTORY AND JURISDICTIONAL REGULATIONS

B. State of California Code of Regulation and Amendments:

1. Title 24 – Industrial Relations; Safety Orders.
2. Current Federal ADA Guidelines
3. 2019 Building Standards Administrative Code, Title 24 C.C.R.
4. 2019 California Building Code (CBC), Title 24 C.C.R.; (2018 International Building Code of the International Code Council, with California Amendments)
5. 2019 California Electrical Code (CEC), Title 24 C.C.R.; (2016 National Electrical Code of the National Fire Protection Association, NFPA with California Amendments)
6. 2019 California Mechanical Code (CMC), Title 24 C.C.R.; (2018 IAPMO Uniform Mechanical Code with California Amendments)
7. 2019 California Plumbing Code (CPC), Title 24 C.C.R.; (2015 Edition IAPMO Uniform Plumbing Code with California Amendments)
8. 2019 Energy Code (CEC), Title 24 C.C.R.
9. 2019 California Historical Building Code, Title 24, C.C.R
10. 2019 California Fire Code (CFC), Title 24, C.C.R. (2018 International Fire Code of the International Code Council with California Amendments)
11. 2019 California Existing Building Code, Title 24 C.C.R (2018 International Existing Building Code of the International Code Council with California Amendments)
12. 2019 California Green Building Standards Code (CalGreen) Title 24, C.C.R
13. 2019 California Referenced Standards Code, Title 24, C.C.R.
14. 2019 California Public Safety, State Fire Marshal Regulations, Title 19, C.C.R.

C. List of Applicable NFPA Standards:

1. NFPA 253 Critical Radiant Flux of Floor Covering Systems 2019 Edition

2. NFPA 2001 Clean Agent Fire extinguishing Systems 2015 Edition
Reference code section for NFPA Standards – CBC (SFM) 3504.1
3. NFPA 13 Automatic Sprinkler Systems 2016 Edition
4. NFPA 14 Standpipe Systems 2013 Edition
5. NFPA 17 Dry Chemical Extinguishing Systems 2013 Edition
6. NFPA 17A Wet Chemical Extinguishing Systems 2013 Edition
7. NFPA 20 Stationary Pumps 2013 Edition
8. NFPA 24 Private Fire Service Mains 2016 Edition
9. NFPA 72 National Fire Alarm Code (California Amended) 2016 Edition
(Note see UL Standard 1971 for “Visual Devices”)
10. NFPA 80 Fire Door & Windows 2016 Edition

D. Construction Safety

1. Statutory and jurisdictional requirements as applicable to temporary work, including California Construction Safety Orders.
2. Associated General Contractors of America, Inc., Manual of Accident Prevention.
3. OSHA, Occupational Safety and Health Agencies requirements.

1.03. GENERAL STANDARDS FOR WORK AND MATERIALS

- E. Work or materials specified by reference to a number, symbol or title of a specific standard - - such as ASTM, U.L., F.S., or other standards - - shall comply with requirements thereof, except as limited to type, class, grade or modifications shown or specified.
- F. Referenced standards shall have full force and effect as though printed herein and are not repeated for reasons that manufacturers and Contractors are assumed to be familiar with requirements governing or applicable to their work. Upon request, Architect will furnish information as to where copies may be obtained.
- G. Material or trade associations, societies, or other bodies regularly publishing standards most widely used under these documents are listed herein together with reference symbols.
- H. Individual standards are referred to under Technical Sections by said reference symbol followed by designation number.

- | | |
|-------|--|
| A.A. | The Aluminum Association |
| AASHO | American Association of the State Highway and Transportation Officials |
| ACI | American Concrete Institution |
| AGA | American Gas Association |
| AISC | American Institute for Steel Construction |
| ANSI | American National Standards Institute |

ASHRAE	American Society of Heating, Refrigeration and Air Conditioning Engineers
ASME	American Society of Mechanical Engineers
ASTM	American Society of Testing and Materials
AWS	American Welding Society
AWWA	American Water Works Association
CS	Commercial Standards, U.S. Department of commerce
FGMA	Flat Gas Marketing Society
FML	Factory Mutual Laboratories
F.S.	Federal Specifications
GA	Gypsum Association
IEEE	Institute of Electrical and Electronic Engineers
MFMA	Maple Flooring Manufacturer's Association
M.S.	Military Specifications U.S. GSA
NAAMM	National Association of Architectural Metal Manufacturers
NBS	National Bureau of Standards
NEMA	National Electrical Manufacturer's Association
NFPA	National Fire Protection Association
PCA	Portland Cement Association
PS	Product Standard, U.S. Department of Commerce
RIS	Redwood Inspection Service
SDI	Steel Door Inspections
SMANCA	Sheet Metal and Air Conditioning Contractor's National Association
TCA	Tile Council of America
UL	Underwriter's Laboratories, Inc.
WCLIB	West Coast Lumber Inspection Bureau
WIC	Wood Work Institute of California
WWPA	Western Wood Products Association

I. Book of Standards

1. State of California, Business and Transportation Agency, Department of Transportation.
 - a. CALIFORNIA STANDARD SPECIFICATIONS: Standard Specifications, January 1988, specific parts referred to by Section number.
 - b. CALIFORNIA TEST METHOD: Methods and Research Dept., Materials manual, 1988; specific tests referred to by California number.
2. APWA Standard Specifications: American Public Works Association, No. California Chapter, Standard Specifications for Public Works Construction, 2000 Edition; specific parts referred to by APWA Section number 3 U.L.; Underwriters' Laboratories Inc.; Buildings Materials List, 2001 or latest edition; and others regularly published; specific parts referred to by U.L. Classification Title and number.

1.04 FIRE RATED WORK OR MATERIAL

- A. Applicable to materials, construction or fabrication specified or required to have limited fire hazard characteristics.
- B. Materials or assemblies shall be tested and classified per applicable ASTM Test Methods; or comparable scientific testing establishing like valuations, under sponsorship of manufacturer and conducted by U.L. or other established testing agency regularly performing tests of a type required.

1. Testing standards, methods and procedures shall be subject to approval by California State Fire Marshall having jurisdiction.
 2. Flame spread of materials used, when installed under the conditions shown or specified, shall not exceed characteristic values specified.
 3. Compliance shall be substantiated by written certificate, labeling or both as specified.
- C. Wood: Refer to Division 6.
- D. Electrical: Refer to division 16.
- E. ASTM Tests not otherwise identified shall be listed under ASTM publication titled 2000 Annual Book of ASTM Standards, Section 00 under section of subject index, and under subject headings Fire Tests, and Flammability Tests.

1.05. MANUFACTURER'S STANDARDS

- A. Applicable to type of items and products.
- B. Instructions not otherwise shown or specified shall be those of producer, as applicable, covering:
1. Primary materials, auxiliary materials and accessories.
 2. Conditions of handling and for storage and protection.
 3. Preparation of backup surfaces.
 4. Installation, cleaning and maintenance procedures.
- C. Publications of procedures shall apply as particularly referred to, otherwise as regularly provided by producer, and shall include generalized installation publications or instructions.

END OF SECTION

**SECTION 01 31 00
PROJECT MANAGEMENT AND COORDINATION**

PART 1 - GENERAL

1.01. SUMMARY

- A. Section includes administrative provisions for coordinating construction operations on Project including, but not limited to, the following:
 - 1. Coordination drawings.
 - 2. Requests for Information (RFIs).
 - 3. Project meetings.

1.02. DEFINITIONS

- B. RFI: Request from Owner, Architect, or Contractor seeking information from each other during construction.

1.03. COORDINATION

- C. Coordination: Coordinate construction operations included in different Sections of the Specifications to ensure efficient and orderly installation of each part of the Work. Coordinate construction operations, included in different Sections that depend on each other for proper installation, connection, and operation.
 - 1. Schedule construction operations in sequence required obtaining 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.
- D. Prepare memoranda for distribution to each party involved, outlining special procedures required for coordination. Include such items as required notices, reports, and list of attendees at meetings.
 - 1. Prepare similar memoranda for Owner and separate contractors if coordination of their Work is required.
- E. Administrative Procedures: Coordinate scheduling and timing of required administrative procedures with other construction activities to avoid conflicts and to ensure orderly progress of the Work. Such administrative activities include, but are not limited to, the following:
 - 1. Preparation of Contractor's construction schedule.

2. Preparation of the schedule of values.
3. Installation and removal of temporary facilities and controls.
4. Delivery and processing of submittals.
5. Progress meetings.
6. Pre-installation conferences.
7. Project closeout activities.
8. Startup and adjustment of systems.
9. Project closeout activities.

1.04. COORDINATION DRAWINGS

F. Coordination Drawings, General: Prepare coordination drawings in accordance with requirements in individual Sections, where installation is not completely shown on Shop Drawings, where limited space availability necessitates coordination, or if coordination is required to facilitate integration of products and materials fabricated or installed by more than one entity.

1. Content: Project-specific information, drawn accurately to a scale large enough to indicate and resolve conflicts. Do not base coordination drawings on standard printed data. Include the following information, as applicable:
 - a. Indicate functional and spatial relationships of components of architectural, structural, civil, mechanical, and electrical systems.
 - b. 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.

G. Coordination Drawing Organization: Organize coordination drawings as follows:

1. Floor Plans and Reflected Ceiling Plans: Show architectural and structural elements, and mechanical, plumbing, fire protection, fire alarm, and electrical Work. Show locations of visible ceiling-mounted devices relative to acoustical ceiling grid.
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.
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. Review: Architect will review coordination drawings to confirm that the Work is being coordinated, but not for the details of the coordination, which are the Contractor's responsibility.

1.05. REQUESTS FOR INFORMATION (RFIs)

H. General: Immediately on discovery of the need for additional information or interpretation of the Contract Documents, Contractor shall prepare and submit an RFI in the form specified.

1. Architect will return RFIs submitted to Architect by other entities controlled by Contractor with no response.
2. Coordinate and submit RFIs in a prompt manner so as to avoid delays in Contractor's work or work of subcontractors.

I. Content of the RFI: Include a detailed, legible description of item needing information or interpretation and the following:

1. Project name.
2. Project number.
3. Date.
4. Name of Contractor.
5. Name of Architect.
6. RFI number, numbered sequentially.
7. RFI subject.
8. Specification Section number and title and related paragraphs, as appropriate.
9. Drawing number and detail references, as appropriate.
10. Field dimensions and conditions, as appropriate.
11. Contractor's suggested resolution. If Contractor's solution(s) impacts the Contract Time or the Contract Sum, Contractor shall state impact in the RFI.
12. Contractor's signature.
13. Attachments: Include sketches, descriptions, measurements, photos, Product Data, Shop Drawings, coordination drawings, and other information necessary to fully describe items needing interpretation.

J. RFI Forms: AIA Document G716 or Software-generated form with substantially the same content as indicated above, acceptable to Architect.

- K. Architect's Action: Architect will review each RFI, determine action required, and respond. Allow seven working days for Architect's response for each RFI. RFIs received by Architect after 1:00 p.m. will be considered as received the following working day.
1. The following RFIs will be returned without action:
 - a. Requests for approval of submittals.
 - b. Requests for approval of substitutions.
 - c. Requests for coordination information already indicated in the Contract Documents.
 - d. Requests for adjustments in the Contract Time or the Contract Sum.
 - e. Requests for interpretation of Architect's actions on submittals.
 - f. Incomplete RFIs or inaccurately prepared RFIs.
 2. Architect's action may include a request for additional information, in which case Architect's time for response will date from time of receipt of additional information.
 3. Architect's action on RFIs that may result in a change to the Contract Time or the Contract Sum may be eligible for Contractor to submit Change Proposal according to Division 1 Section "Contract Modification Procedures."
 - a. If Contractor believes the RFI response warrants change in the Contract Time or the Contract Sum, notify Architect and Owner's Project Manager in writing within **10** days of receipt of the RFI response.
- L. On receipt of Architect's action, update the RFI log and immediately distribute the RFI response to affected parties. Review response and notify Architect and Owner's Project Manager within seven days if Contractor disagrees with response.
- M. RFI Log: Prepare, maintain, and submit a tabular log of RFIs organized by the RFI number. Submit log weekly.
1. Project name.
 2. Name and address of Contractor.
 3. Name and address of Architect.
 4. RFI number including RFIs that were dropped and not submitted.
 5. RFI description.
 6. Date the RFI was submitted.
 7. Date Architect's response was received.
 8. Identification of related Minor Change in the Work, Construction Change Directive, and Proposal Request, as appropriate.
 9. Identification of related Field Order, Work Change Directive, and Proposal Request, as appropriate.

1.06. PROJECT MEETINGS

- N. General: Architect will schedule and conduct meetings and conferences at Project site, unless otherwise indicated.
1. Attendees: Inform participants and others involved, and individuals whose presence is required, of date and time of each meeting. Notify Owner and Architect of scheduled meeting dates and times.
 2. Agenda: Prepare the meeting agenda. Distribute the agenda to all invited attendees.
 3. Minutes: 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.
- O. Preconstruction Conference: Architect will schedule and conduct a preconstruction conference before starting construction, at a time convenient to Owner and Architect, but no later than **15** days after execution of the Agreement.
1. Attendees: Authorized representatives of Owner, Architect, Contractor and its superintendent. Participants at the conference shall be familiar with Project and authorized to conclude matters relating to the Work.
 2. Agenda: Discuss items of significance that could affect progress, including the following:
 - a. Tentative construction schedule.
 - b. Phasing.
 - c. Critical work sequencing and long-lead items.
 - d. Designation of key personnel and their duties.
 - e. Procedures for processing field decisions and Change Orders.
 - f. Procedures for RFIs.
 - g. Procedures for testing and inspecting.
 - h. Procedures for processing Applications for Payment.
 - i. Distribution of the Contract Documents.
 - j. Submittal procedures.
 - k. Sustainable design requirements.
 - l. Preparation of record documents.
 - m. Use of the premises and existing building.
 - n. Work restrictions.
 - o. Working hours.

- p. Owner's occupancy requirements.
 - q. Responsibility for temporary facilities and controls.
 - r. Procedures for moisture and mold control.
 - s. Procedures for disruptions and shutdowns.
 - t. Construction waste management and recycling.
 - u. Parking availability.
 - v. Office, work, and storage areas.
 - w. Equipment deliveries and priorities.
 - x. First aid.
 - y. Security.
 - z. Progress cleaning.
3. Minutes: Entity responsible for conducting meeting will record and distribute meeting minutes.
- P. Preinstallation Conferences: Conduct a preinstallation conference at Project site before each construction activity that requires coordination with other construction.
- 1. 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 Owner's Project Manager, of scheduled meeting dates.
 - 2. Agenda: Review progress of other construction activities and preparations for the particular activity under consideration, including requirements for the following:
 - a. Contract Documents.
 - b. Options.
 - c. Related RFIs.
 - d. Related Change Orders.
 - e. Purchases.
 - f. Deliveries.
 - g. Submittals.
 - h. Review of mockups.
 - i. Possible conflicts.
 - j. Compatibility problems.
 - k. Time schedules.

- l. Weather limitations.
 - m. Manufacturer's written recommendations.
 - n. Warranty requirements.
 - o. Compatibility of materials.
 - p. Acceptability of substrates.
 - q. Temporary facilities and controls.
 - r. Space and access limitations.
 - s. Regulations of authorities having jurisdiction.
 - t. Testing and inspecting requirements.
 - u. Installation procedures.
 - v. Coordination with other work.
 - w. Required performance results.
 - x. Protection of adjacent work.
 - y. Protection of construction and personnel.
3. Record significant conference discussions, agreements, and disagreements, including required corrective measures and actions.
 4. Reporting: Distribute minutes of the meeting to each party present and to other parties requiring information.
 5. 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.

Q. Progress Meetings: Architect will conduct progress meetings at weekly intervals.

1. Attendees: Representative of Owner, Architect and Contractor. All participants at the meeting shall be familiar with Project and authorized to conclude matters relating to the Work.
2. Agenda: Review and correct or approve minutes of previous progress meeting. Review other items of significance that could affect progress. Include topics for discussion as appropriate to status of Project.
 - a. Contractor's Construction Schedule: Review progress since the last meeting. Determine whether each activity is on time, ahead of schedule, or behind schedule, in relation to Contractor's construction schedule. Determine how construction behind schedule will be expedited; secure commitments from parties involved to do so. Discuss whether schedule revisions are required to ensure that current and subsequent activities will be completed within the Contract Time.
 - 1) Review schedule for next period.

- b. Review present and future needs of each entity present, including the following:
 - 1) Interface requirements.
 - 2) Sequence of operations.
 - 3) Status of submittals.
 - 4) Deliveries.
 - 5) Off-site fabrication.
 - 6) Access.
 - 7) Site utilization.
 - 8) Temporary facilities and controls.
 - 9) Progress cleaning.
 - 10) Quality and work standards.
 - 11) Status of correction of deficient items.
 - 12) Field observations.
 - 13) Status of RFIs.
 - 14) Status of proposal requests.
 - 15) Pending changes.
 - 16) Status of Change Orders.
 - 17) Pending claims and disputes.
 - 18) Documentation of information for payment requests.
- 3. Minutes: 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.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION

**SECTION 01 32 16
CONSTRUCTION SCHEDULE**

PART 1 – GENERAL

1.01 DESCRIPTION

- A. Work included: Construction Schedule procedures, preparation, submittal, updates, and revisions.

1.02 QUALITY ASSURANCE

- A. Perform all work in strict accordance with pertinent requirements of these Specifications and in the event no such requirements are determined, in conformance with the Architect's written direction.

1.03 SUBMITTALS

- A. The construction of this project will be planned and recorded with a conventional Critical Path Method (CPM) schedule. The schedule shall be used for coordination, monitoring, and payment of all work under the contract including all activity of subcontractors, vendors, suppliers, and for all submittals.
- B. Contractor is responsible for preparing the schedule. All costs incurred by Contractor in preparing the schedule shall be borne by Contractor as a part of its responsibility under this contract.

1.04 PROCEDURES

- A. Baseline Construction Schedule
 1. Before proceeding with any work on site, Contractor shall prepare, submit, and receive District's approval of a Baseline Construction Schedule. This schedule shall provide a detailed breakdown of activities scheduled for the first 90 days of the project and shall include mobilization, submittals, procurement, and construction.
 2. No contact work may be pursued at the site without an approved Baseline Construction Schedule or an approved CPM schedule.
- B. Within forty five (45) calendar days after date of Notice to Proceed, Contractor shall submit, for review, a Detailed Project Schedule setting forth all requirements for complete execution of work.
- C. Preparation of Detailed Project Schedule
 1. The construction time, for the entire project or any milestone, shall not exceed the specified contract time. In the event that any milestone date or contract completion date is exceeded in the schedule, logic and/or time estimates will be revised.
 2. Following the District's review, if revisions to the proposed schedule are required, the Contractor shall do so promptly. The schedule must be finalized within 60 days of the Notice to Proceed. Failure to finalize the schedule by that date will result in withholding all contract payments until the schedule is finalized.

- D. Simultaneously with each submittal of Progress Payment Request, Contractor shall deliver to the District an updated Detailed Project Schedule reflecting work progress as of end of previous reporting period. Each such Schedule shall indicate actual progress to date in execution of work, together with a projected schedule for completion of work.
- E. All Schedule submittals are subject to review and acceptance by the District. The District shall withhold progress payments until Contractor submits a Detailed Project Schedule acceptable to the District.
- F. Concurrent with the District's acceptance of Contractor's submitted Detailed Project Schedule, shall be Contractor's signature of acceptance.

1.05 PREPARATION GUIDELINES

- A. Work of this Contract shall be scheduled and progress monitored using a bar chart, although any of the CPM network type scheduling systems, including precedence diagramming or arrow are acceptable. Scheduling system shall show the sequence and interdependence of all activities required for complete performance of all items of work under this contract, including all approvals, shop drawings and other submittals and approvals, and fabrication and delivery activities. Scheduling system shall indicate all inter-relationships between trades and suppliers.
- B. Level of detail indicated in schedule shall be equal to or greater than that provided by Table of Contents of Contract Technical Specifications, including any addenda. Duration and events indicated on schedule shall conform to phasing set forth in the Contract and shall show any area or building within a particular phase. Schedule shall indicate any and all Contract "milestone events" and other milestones agreed to by the District, but no other manually-imposed dates will be accepted unless approved.
- C. Detailed Project Schedule shall represent a practical plan to complete work within time requirements of the Contract.
 - 1. The Contractor may submit a Detailed Project Schedule depicting completion of the Work in a duration shorter than the Contract Time; provided that such Detailed Project Schedule shall not be a basis for adjustment to the Contract Price in the event that completion of the Work shall occur after the time depicted therein, nor shall such Detailed Project Schedule be the basis for any extension of the Contract Time.
 - 2. A schedule found unacceptable by the District shall be revised by Contractor and resubmitted.
- D. Detailed Project schedule shall clearly indicate sequence of construction activities, grouped by applicable phase and sorted by areas, buildings, or facilities within phase, and shall specifically indicate:
 - 1. Start and completion of all items of work, their major components, and interim milestone completion dates, as determined by Contractor and the District.
 - 2. Activities for procurement, delivery, installation of equipment, materials, and other supplies, including:
 - a. Time for submittals, re-submittals, and reviews. Include decision dates for selection of finishes, if applicable.
 - b. Time for fabrication, and delivery of, manufactured products for work.
 - c. Interdependence of procurement and construction activities.

- d. As applicable, dates for testing, balancing equipment, and final inspection.
- E. Schedule shall be in sufficient detail to assure adequate planning and execution of work.
- 1. Each activity shall range in duration no longer than two (2) weeks and shall be total of actual days required for completion, and shall include consideration of normal weather impact on completion of that activity.
 - 2. The activities are to be described so that the work is readily identifiable and the progress of each activity can be readily measured. For each activity, Contractor shall identify the trade or subcontractor performing the work, the duration of the activity in work days, the manpower involved by trade, the equipment involved, the location of the work, and a dollar value of the activity. The dollar value assigned to each activity is to be reasonable and based on the amount of labor, materials, and equipment involved. When added together, the dollar value of all activities are to equal the contract price.
 - 3. Schedule shall be suitable, in judgement of the Architect, to allow monitoring and evaluation of progress in performance of work; it shall be calendar time-scaled and, at a minimum, in a Bar Chart format.
 - 4. Activities shall include:
 - a. Description; what is to be accomplished and where.
 - b. Workday duration.
 - c. Scheduled activities shall indicate continuous flow, from left to right.
 - 5. Identify days per week and shifts per day worked; also, non-work days and holidays.
 - 6. For all schedules submitted, Contractor shall provide the following:
 - a. Computerized sorts by:
 - (1) Total Float
 - (2) Early Start
 - (3) Area Sort
 - (4) Trade responsibility
 - b. 60-day look ahead bar charts by early start.
 - c. A narrative explaining progress to date on the project, work required in the succeeding update period, a description of the critical path, and comments concerning potential problem areas.
 - d. Contractor will submit four copies of each of the above.
- F. Failure to include any element of work required for performance of this Contract shall not excuse Contractor from completing work required to comply with the Contract Documents, notwithstanding acceptance of Construction Schedule.
- G. Submittal of Construction Schedule shall be understood to be Contractor's confirmation that the schedule meets requirements of the Contract Documents, and that work will be executed in sequence indicated in schedule.

1.06 REVIEWS, UPDATES, AND REVISIONS

- A. The District will review and return Contractor's Detailed Project Schedule, with summary comments, within Seventeen (17) calendar days. If revisions are required, Contractor shall resubmit Schedule within fourteen (14) calendar days following receipt of the District's comments.
- B. After Contractor and the District agree to a final schedule, it will become the Project Construction Schedule and considered part of the Contract Documents. No changes to Schedule will be allowed unless mutually agreed upon with the District.
- C. Contractor shall analyze and update the Detailed Project Schedule:
 - 1. As part of monthly payment application, Contractor shall submit to and participate with the District in a schedule review to include:
 - a. Actual completion dates for work items completed during report period.
 - b. Actual start dates for work items started during report period.
 - c. Estimated remaining duration for work items in progress, which will not exceed original duration for activity.
 - d. Estimated start dates for work items scheduled to start during month following report period, if applicable.
 - e. Changes in duration of work items.
 - f. A summary bar chart schedule, organized first by work segment plan, and then by area (building number or other appropriate sub-division) shall show construction progress in each area. The previous schedule shall be included in this report to compute the current performance with the original planned sequence of work.
 - 2. In case of a change to Contractor's planned sequence of work, Contractor shall include a narrative report with updated progress schedule which shall include, but not be limited to, a description of problem areas, current and anticipated delaying factors, and any proposed revisions for a recover plan.
 - 3. All change orders affecting this schedule shall be clearly identified as a separate and new activity.
 - 4. Review of Detailed Project Schedule will not relieve Contractor of responsibility for accomplishing all work in accordance with the Contract Documents.
- D. Updates: The Contractor shall submit to the District, with each payment application, an up-to-date Detailed Project Schedule to include following:
 - 1. Work Item Report: Detailing work items and dependencies as indicated on Bar Chart.
 - 2. Separate listing of activities completed during reporting period.
 - 3. Separate listing of activities which are currently in progress, indicating their remaining duration and percentages completed.
 - 4. Separate listing of activities which are causing delay in work progress.

5. Narrative report to define problem areas, anticipated delays, and impact on Detailed Project Schedule. Report corrective action taken, or proposed, and its effect, including effect of changes on schedules of separate contractors.
 6. Resolution of conflict between actual work progress and schedule logic: when out-of-sequence activities develop in the Schedule because of actual construction progress, Contractor shall submit a revised schedule to conform to current job sequence and direction.
- E. If, according to current updated Detailed Project Schedule, the District determines Contractor is behind the Contract completion date or any interim milestone completion dates, considering all time extensions to which Contractor is entitled, Contractor shall submit a revised schedule, showing a workable plan and a narrative description to complete project on time in accordance with Article 1.06, Paragraph C-2.
1. The District shall withhold progress payments until a revised schedule, acceptable to the District, is submitted by Contractor.
- F. Scheduling of change or extra work orders is responsibility of Contractor.
1. Contractor shall revise Detailed Project Schedule to incorporate all activities involved in completing change orders or extra work orders and submit it to the District for review.
- G. If the District finds Contractor is entitled to extension of any completion date, under provisions of the Contract, the District's determination of total number of days extension will be based upon current analysis of Construction Schedule, and upon data relevant to extension.
- H. Contractor acknowledges and agrees that delays to non-critical activities will not be considered a basis for a time extension unless activities become critical. Non-critical activities are those activities which, when delayed, do not affect an interim or final Contract completion date.
- I. Any claim for extension of time shall be made in writing to the Architect not more than seven (7) days after commencement of delay, otherwise, it shall be deemed finally waived for all purposes. Contractor shall provide an estimate of probable effect of such delay on progress of work as part of claim.

1.07 CONTRACTOR'S RESPONSIBILITY

- A. Nothing in these requirements shall be deemed to be an assumption of Contractor's authority and responsibility to plan and schedule work as Contractor sees fit, subject to all other requirements of Contract Documents.
- B. Contractor shall provide at all times sufficient competent labor, materials, and equipment to properly carry on work and to insure completion of each part in accordance with Construction Schedule and within time agreed.
- C. Contractor shall be responsible for ensuring that all submittals to the District are accurate and consistent. Damages, including extra time and cost, caused by inaccuracies from Contractor will be compensated by Contractor.

1.08 SUSPENSION OF PAYMENTS

- A. Initial Submittal: The District has the right to withhold progress payments until Detailed Project Schedule is accepted by the District.

- B. Update Submittals: The District has the right to withhold progress payments if Contractor fails to update and submit Detailed Project Schedule and reports as required by the District.

1.09 RECORD COPY

- A. At completion of work items, submit Detailed Project Schedule reflecting "as-built" sequence.

1.10 FORM OF SUBMITTAL

- A. All Detailed Project Schedule submittals shall be transmitted with a Letter of Transmittal and shall include three (3) hard copies and one (1) electronic copy.

END OF SECTION

**SECTION 01 33 00
SUBMITTAL PROCEDURES**

PART 1 - GENERAL

1.01. SUMMARY

- A. Section includes requirements for the submittal schedule and administrative and procedural requirements for submitting Shop Drawings, Product Data, Samples, and other submittals.
- B. Related Sections:
 - 1. Division 1 Section "Operation and Maintenance Manuals" for submitting operation and maintenance manuals.
 - 2. Division 1 Section "General Commissioning Requirements" for submitting video recordings of demonstration of equipment and training of Owner's personnel.

1.02. DEFINITIONS

- C. Action Submittals: Written and graphic information and physical samples that require Architect's responsive action.
- D. Informational Submittals: Written and graphic information and physical samples that do not require Architect's responsive action. Submittals may be rejected for not complying with requirements.

1.03. ACTION SUBMITTALS

- E. Submittal Schedule: Submit a schedule of submittals, arranged in chronological order by dates required by construction schedule. Include time required for review, ordering, manufacturing, fabrication, and delivery when establishing dates. Include additional time required for making corrections or modifications to submittals noted by the Architect and additional time for handling and reviewing submittals required by those corrections.

1.04. SUBMITTAL ADMINISTRATIVE REQUIREMENTS

- F. All submittals to be provided by Contractor within 15 days of award of bid.
- G. Architect's Digital Data Files: Electronic copies of CAD Drawings of the Contract Drawings will **not** be provided by Architect for Contractor's use in preparing submittals.
- H. Coordination: Coordinate preparation and processing of submittals with performance of construction activities.
 - 1. Coordinate each submittal with fabrication, purchasing, testing, delivery, other submittals, and related activities that requires sequential activity.

2. Coordinate transmittal of different types of submittals for related parts of the Work so processing will not be delayed because of need to review submittals concurrently for coordination.
 - a. Architect reserves the right to withhold action on a submittal requiring coordination with other submittals until related submittals are received.

- I. Processing Time: Allow time for submittal review, including time for resubmittals, as follows. Time for review shall commence on Architect's receipt of submittal. No extension of the Contract Time will be authorized because of failure to transmit submittals enough in advance of the Work to permit processing, including resubmittals.
 1. Initial Review: Allow 18 days for initial review of each submittal. Allow additional time if coordination with subsequent submittals is required. Architect will advise Contractor when a submittal being processed must be delayed for coordination.
 2. Intermediate Review: If intermediate submittal is necessary, process it in same manner as initial submittal.
 3. Resubmittal Review: Allow 15 days for review of each resubmittal.
 4. DSA Deferred Approval: In addition to the review periods indicated above allow 90 days for DSA review and approval.

- J. Identification and Information: Place a permanent label or title block on each paper copy submittal item for identification.
 1. Indicate name of firm or entity that prepared each submittal on label or title block.
 2. Provide a space approximately 6 by 8 inches (150 by 200 mm) on label or beside title block to record Contractor's review and approval markings and action taken by Architect.
 3. Include the following information for processing and recording action taken:
 - a. Project name.
 - b. Date.
 - c. Name of Architect.
 - d. Name of Construction Manager.
 - e. Name of Contractor.
 - f. Name of subcontractor.
 - g. Name of supplier.
 - h. Name of manufacturer.
 - i. Submittal number or other unique identifier, including revision identifier.
 - 1) Submittal number shall use Specification Section number followed by a decimal point and then a sequential number (e.g., 06 10 00.01). Resubmittals shall include an alphabetic suffix after another decimal point (e.g., 06 10 00.01.A).
 - j. Number and title of appropriate Specification Section.
 - k. Drawing number and detail references, as appropriate Location(s) where product is to be installed, as appropriate.
 - l. Other necessary identification.

- K. Identification and Information: Identify and incorporate information in each electronic submittal file as follows:

1. Assemble complete submittal package into a single indexed file with links enabling navigation to each item.
 2. Name file with submittal number or other unique identifier, including revision identifier.
 - a. File name shall use project identifier and Specification Section number followed by a decimal point and then a sequential number (e.g., LNHS-06 10 00.01). Resubmittals shall include an alphabetic suffix after another decimal point (e.g., LNHS-06 10 00.01.A).
 3. Provide means for insertion to permanently record Contractor's review and approval markings and action taken by Architect.
 4. Include the following information on an inserted cover sheet:
 - 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. Name of subcontractor.
 - h. Name of supplier.
 - i. Name of manufacturer.
 - j. Number and title of appropriate Specification Section.
 - k. Drawing number and detail references, as appropriate.
 - l. Location(s) where product is to be installed, as appropriate.
 - m. Related physical samples submitted directly.
 - n. Other necessary identification.
- L. Options: Identify options requiring selection by the Architect.
- M. Deviations: Identify deviations from the Contract Documents on submittals.
- N. Additional Paper Copies: Unless additional copies are required for final submittal, and unless Architect observes noncompliance with provisions in the Contract Documents, initial submittal may serve as final submittal.
1. Submit one copy of submittal to concurrent reviewer in addition to specified number of copies to Architect.
- O. Transmittal: Assemble each submittal individually and appropriately for transmittal and handling. Transmit each submittal using a transmittal form. Architect will return submittals, without review, received from sources other than Contractor.
1. 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.
- P. Resubmittals: Make resubmittals in same form and number of copies as initial submittal.
1. Note date and content of previous submittal.

2. Note date and content of revision in label or title block and clearly indicate extent of revision.
 3. Resubmit submittals until they are marked with approval notation from Architect's action stamp.
- Q. Distribution: Furnish copies of final submittals to manufacturers, subcontractors, suppliers, fabricators, installers, and authorities having jurisdiction, and others as necessary for performance of construction activities. Show distribution on transmittal forms.
- R. Use for Construction: Use only final submittals that are marked with approval notation from Architect's action stamp.

PART 2 - PRODUCTS

2.01. SUBMITTAL PROCEDURES

A. General Submittal Procedure Requirements:

1. Action Submittals: Submit six paper copies of each submittal, unless otherwise indicated. Architect through owner's project manager will return at least two copies.
2. Informational Submittals: Submit four paper copies of each submittal, unless otherwise indicated. Architect and owner's project manager will not return copies.
3. Closeout Submittals and Maintenance Material Submittals: Comply with requirements specified in Division 1 Section "Closeout Procedures."
4. Certificates and Certifications Submittals: Provide a 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.
5. Test and Inspection Reports Submittals: Comply with requirements specified in Division 1 Section "Quality Requirements."

B. Product Data: Collect information into a single submittal for each element of construction and type of product or equipment.

1. If information must be specially prepared for submittal because standard published data are not suitable for use, submit as Shop Drawings, not as Product Data.
2. Mark each copy of each submittal to show which products and options are applicable.
3. Include the following information, as applicable:
 - a. Manufacturer's catalog cuts.

- b. Manufacturer's product specifications.
 - c. Standard color charts.
 - d. Statement of compliance with specified referenced standards.
 - e. Testing by recognized testing agency.
 - f. Application of testing agency labels and seals.
 - g. Notation of coordination requirements.
 - h. Availability and delivery time information.
4. For equipment, include the following in addition to the above, as applicable:
- a. Wiring diagrams showing factory-installed wiring.
 - b. Printed performance curves.
 - c. Operational range diagrams.
 - d. Clearances required to other construction, if not indicated on accompanying Shop Drawings.
5. Submit Product Data before or concurrent with Samples.
6. Submit Product Data in the following format:
- a. Six paper copies of Product Data, unless otherwise indicated. Architect, through owner's project manager, will return two copies.
- C. Shop Drawings: Prepare Project-specific information, drawn accurately to scale. Do not base Shop Drawings on reproductions of the Contract Documents or standard printed data.
1. Preparation: Fully illustrate requirements in the Contract Documents. Include the following information, as applicable:
- a. 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.
2. Sheet Size: Except for templates, patterns, and similar full-size drawings, submit Shop Drawings on sheets at least 8-1/2 by 11 inches (215 by 280 mm) but no larger than 30 by 42 inches (750 by 1067 mm)].
- D. Samples: Submit Samples for review of kind, color, pattern, and texture for a check of these characteristics with other elements and for a comparison of these characteristics between submittal and actual component as delivered and installed.
1. Transmit Samples that contain multiple, related components such as accessories together in one submittal package.
2. Identification: Attach label on unexposed side of Samples that includes the following:
- a. Generic description of Sample.
 - b. Product name and name of manufacturer.
 - c. Sample source.
 - d. Number and title of applicable Specification Section.

3. Disposition: Maintain sets of approved Samples at Project site, available for quality-control comparisons throughout the course of construction activity. Sample sets may be used to determine final acceptance of construction associated with each set.
 - a. Samples 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.
 - b. Samples not incorporated into the Work, or otherwise designated as Owner's property, are the property of Contractor.
 4. Samples for Initial Selection: Submit manufacturer's color charts consisting of units or sections of units showing the full range of colors, textures, and patterns available.
 - a. Number of Samples: Submit four full set(s) of available choices where color, pattern, texture, or similar characteristics are required to be selected from manufacturer's product line. Architect, through Owner's Project Manager, will return one submittal with options selected.
 5. Samples for Verification: Submit full-size units or Samples of size indicated, prepared from same material to be used for the Work, cured and finished in manner specified, and physically identical with material or product proposed for use, and that show full range of color and texture variations expected. Samples include, but are not limited to, the following: partial sections of manufactured or fabricated components; small cuts or containers of materials; complete units of repetitively used materials; swatches showing color, texture, and pattern; color range sets; and components used for independent testing and inspection.
 - a. Number of Samples: Submit four sets of Samples. Architect and Owner will retain two Sample sets; remainder will be returned.
 - 1) If variation in color, pattern, texture, or other characteristic is inherent in material or product represented by a Sample, submit at least three sets of paired units that show approximate limits of variations.
- E. Contractor's Construction Schedule: Comply with requirements specified in Division 1 Section "Project Record Documents."
 - F. Application for Payment: Comply with requirements specified in Division 1 Section "Payment Procedures."
 - G. Schedule of Values: Comply with requirements specified in Division 1 Section "Payment Procedures."
 - H. Coordination Drawings: Comply with requirements specified in Division 1 Section "Project Management and Coordination."
 - 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 American Welding Society (AWS) forms. Include names of firms and personnel certified.

- K. Installer Certificates: Submit written statements on manufacturer's letterhead certifying that Installer complies with requirements in the Contract Documents and, where required, is authorized by manufacturer for this specific Project.
- 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 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: Submit written evidence, from a model code organization acceptable to authorities having jurisdiction, that product complies with building code in effect for Project.
- R. Schedule of Tests and Inspections: Comply with requirements specified in Division 1 Section "Quality Controls."
- S. Preconstruction 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.
- T. 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.
- U. Field Test Reports: Submit 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.
- V. Maintenance Data: Comply with requirements specified in Division 1 Section "Operation and Maintenance Manuals."
- W. 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.

2.02. DELEGATED-DESIGN SERVICES

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

PART 3 - EXECUTION

3.01. 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. Project Closeout and Maintenance/Material Submittals: Refer to requirements in Division 1 Section "Project Closeout."
- C. 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.

3.02. ARCHITECT'S ACTION

- D. General: Architect will not review submittals that do not bear Contractor's approval stamp and will return them without action.
- E. Action Submittals: Architect will review each submittal, make marks to indicate corrections or modifications required, and return it. Architect will stamp each submittal with an action stamp and will mark stamp appropriately to indicate action.
- F. Informational Submittals: Architect will review each submittal and will not return it, or will return it if it does not comply with requirements. Architect will forward each submittal to appropriate party.
- G. Incomplete submittals are not acceptable, will be considered nonresponsive, and will be returned without review.
- H. Submittals not required by the Contract Documents may not be reviewed and may be discarded.

END OF SECTION

**SECTION 01 42 00
REFERENCES**

PART 1 - GENERAL

1.01. DEFINITIONS

- A. General: Basic Contract definitions are included in the Conditions of the Contract.
- B. "Approved": When used to convey Architect's action on Contractor's submittals, applications, and requests, "approved" is limited to Architect's duties and responsibilities as stated in the Conditions of the Contract.
- C. "Directed": A command or instruction by Architect. Other terms including "requested," "authorized," "selected," "required," and "permitted" have the same meaning as "directed."
- D. "Indicated": Requirements expressed by graphic representations or in written form on Drawings, in Specifications, and in other Contract Documents. Other terms including "shown," "noted," "scheduled," and "specified" have the same meaning as "indicated."
- E. "Regulations": Laws, ordinances, statutes, and lawful orders issued by authorities having jurisdiction, and rules, conventions, and agreements within the construction industry that control performance of the Work.
- F. "Furnish": Supply and deliver to Project site, ready for unloading, unpacking, assembly, installation, and similar operations.
- G. "Install": Operations at Project site including unloading, temporarily storing, unpacking, assembling, erecting, placing, anchoring, applying, working to dimension, finishing, curing, protecting, cleaning, and similar operations.
- H. "Provide": Furnish and install, complete and ready for the intended use.
- I. "Project Site": Space available for performing construction activities. The extent of Project site is shown on Drawings and may or may not be identical with the description of the land on which Project is to be built.

1.02. INDUSTRY STANDARDS

- J. Applicability of Standards: Unless the Contract Documents include more stringent requirements, applicable construction industry standards have the same force and effect as if bound or copied directly into the Contract Documents to the extent referenced. Such standards are made a part of the Contract Documents by reference.
- K. Publication Dates: Comply with standards in effect as of date of the Contract Documents unless otherwise indicated.
- L. Copies of Standards: Each entity engaged in construction on Project should be familiar with industry standards applicable to its construction activity. Copies of applicable standards are not bound with the Contract Documents.

1. Where copies of standards are needed to perform a required construction activity, obtain copies directly from publication source.

1.03. ABBREVIATIONS AND ACRONYMS

- M. Industry Organizations: Where abbreviations and acronyms are used in Specifications or other Contract Documents, they shall mean the recognized name of the entities indicated in Thomson Gale's "Encyclopedia of Associations" or in Columbia Books' "National Trade & Professional Associations of the U.S."
- N. Industry Organizations: Where abbreviations and acronyms are used in Specifications or other Contract Documents, they shall mean the recognized name of the entities in the following list.

AA	Aluminum Association, Inc. (The)
AAADM	American Association of Automatic Door Manufacturers
AABC	Associated Air Balance Council
AAMA	American Architectural Manufacturers Association
AASHTO	American Association of State Highway and Transportation Officials
AATCC	American Association of Textile Chemists and Colorists
ABAA	Air Barrier Association of America
ABMA	American Bearing Manufacturers Association
ACI	American Concrete Institute
ACPA	American Concrete Pipe Association
AEIC	Association of Edison Illuminating Companies, Inc. (The)
AF&PA	American Forest & Paper Association
AGA	American Gas Association
AGC	Associated General Contractors of America (The)
AHA	American Hardboard Association (Now part of CPA)
AHAM	Association of Home Appliance Manufacturers
AI	Asphalt Institute
AIA	American Institute of Architects (The)
AISC	American Institute of Steel Construction
AISI	American Iron and Steel Institute
AITC	American Institute of Timber Construction

ALCA	Associated Landscape Contractors of America (Now PLANET - Professional Landcare Network)
ALSC	American Lumber Standard Committee, Incorporated
AMCA	Air Movement and Control Association International, Inc.
ANSI	American National Standards Institute
AOSA	Association of Official Seed Analysts, Inc.
APA	Architectural Precast Association
APA	APA - The Engineered Wood Association
APA EWS	APA - The Engineered Wood Association; Engineered Wood Systems (See APA - The Engineered Wood Association)
API	American Petroleum Institute
ARI	Air-Conditioning & Refrigeration Institute
ARMA	Asphalt Roofing Manufacturers Association
ASCE	American Society of Civil Engineers
ASCE/SEI	American Society of Civil Engineers/Structural Engineering Institute (See ASCE)
ASHRAE	American Society of Heating, Refrigerating and Air-Conditioning Engineers
ASME	ASME International (American Society of Mechanical Engineers International)
ASSE	American Society of Sanitary Engineering
ASTM	ASTM International (American Society for Testing and Materials International)
AWCI	Association of the Wall and Ceiling Industry
AWCMA	American Window Covering Manufacturers Association (Now WCMA)
AWI	Architectural Woodwork Institute
AWPA	American Wood Protection Association (Formerly: American Wood Preservers' Association)
AWS	American Welding Society
AWWA	American Water Works Association
BHMA	Builders Hardware Manufacturers Association

BIA	Brick Industry Association (The)
BICSI	BICSI, Inc.
BIFMA	BIFMA International (Business and Institutional Furniture Manufacturer's Association International)
BISSC	Baking Industry Sanitation Standards Committee
BWF	Badminton World Federation (Formerly: IBF - International Badminton Federation)
CCC	Carpet Cushion Council
CDA	Copper Development Association
CEA	Canadian Electricity Association
CEA	Consumer Electronics Association
CFFA	Chemical Fabrics & Film Association, Inc.
CGA	Compressed Gas Association
CIMA	Cellulose Insulation Manufacturers Association
CISCA	Ceilings & Interior Systems Construction Association
CISPI	Cast Iron Soil Pipe Institute
CLFMI	Chain Link Fence Manufacturers Institute
CRRC	Cool Roof Rating Council
CPA	Composite Panel Association
CPPA	Corrugated Polyethylene Pipe Association
CRI	Carpet and Rug Institute (The)
CRSI	Concrete Reinforcing Steel Institute
CSA	Canadian Standards Association
CSA	CSA International (Formerly: IAS - International Approval Services)
CSI	Cast Stone Institute
CSI	Construction Specifications Institute (The)
CSSB	Cedar Shake & Shingle Bureau
CTI	Cooling Technology Institute (Formerly: Cooling Tower Institute)

DHI	Door and Hardware Institute
EIA	Electronic Industries Alliance
EIMA	EIFS Industry Members Association
EJCDC	Engineers Joint Contract Documents Committee
EJMA	Expansion Joint Manufacturers Association, Inc.
ESD	ESD Association (Electrostatic Discharge Association)
ETL SEMCO	Intertek ETL SEMCO (Formerly: ITS - Intertek Testing Service NA)
FIBA	Federation Internationale de Basketball (The International Basketball Federation)
FIVB	Federation Internationale de Volleyball (The International Volleyball Federation)
FM Approvals	FM Approvals LLC
FM Global	FM Global (Formerly: FMG - FM Global)
FMRC	Factory Mutual Research (Now FM Global)
FRSA	Florida Roofing, Sheet Metal & Air Conditioning Contractors Association, Inc.
FSA	Fluid Sealing Association
FSC	Forest Stewardship Council
GA	Gypsum Association
GANA	Glass Association of North America
GRI	(Part of GSI)
GS	Green Seal
GSI	Geosynthetic Institute
HI	Hydraulic Institute
HI	Hydronics Institute
HMMA	Hollow Metal Manufacturers Association (Part of NAAMM)
HPVA	Hardwood Plywood & Veneer Association
HPW	H. P. White Laboratory, Inc.

IAS	International Approval Services (Now CSA International)
IBF	International Badminton Federation (Now BWF)
ICEA	Insulated Cable Engineers Association, Inc.
ICRI	International Concrete Repair Institute, Inc.
IEC	International Electrotechnical Commission
IEEE	Institute of Electrical and Electronics Engineers, Inc. (The)
IESNA	Illuminating Engineering Society of North America
IEST	Institute of Environmental Sciences and Technology
IGCC	Insulating Glass Certification Council
IGMA	Insulating Glass Manufacturers Alliance
ILI	Indiana Limestone Institute of America, Inc.
ISO	International Organization for Standardization Available from ANSI
ISSFA	International Solid Surface Fabricators Association
ITS	Intertek Testing Service NA (Now ETL SEMCO)
ITU	International Telecommunication Union
KCMA	Kitchen Cabinet Manufacturers Association
LMA	Laminating Materials Association (Now part of CPA)
LPI	Lightning Protection Institute
MBMA	Metal Building Manufacturers Association
MFMA	Maple Flooring Manufacturers Association, Inc.
MFMA	Metal Framing Manufacturers Association, Inc.
MH	Material Handling (Now MHIA)
MHIA	Material Handling Industry of America
MIA	Marble Institute of America
MPI	Master Painters Institute

MSS	Manufacturers Standardization Society of The Valve and Fittings Industry Inc.
NAAMM	National Association of Architectural Metal Manufacturers
NACE	NACE International (National Association of Corrosion Engineers International)
NADCA	National Air Duct Cleaners Association
NAGWS	National Association for Girls and Women in Sport
NAIMA	North American Insulation Manufacturers Association
NBGQA	National Building Granite Quarries Association, Inc.
NCAA	National Collegiate Athletic Association (The)
NCMA	National Concrete Masonry Association
NCPI	National Clay Pipe Institute
NCTA	National Cable & Telecommunications Association
NEBB	National Environmental Balancing Bureau
NECA	National Electrical Contractors Association
NeLMA	Northeastern Lumber Manufacturers' Association
NEMA	National Electrical Manufacturers Association
NETA	InterNational Electrical Testing Association
NFHS	National Federation of State High School Associations
NFPA	NFPA (National Fire Protection Association)
NFRC	National Fenestration Rating Council
NGA	National Glass Association
NHLA	National Hardwood Lumber Association
NLGA	National Lumber Grades Authority
NOFMA	NOFMA: The Wood Flooring Manufacturers Association (Formerly: National Oak Flooring Manufacturers Association)
NOMMA	National Ornamental & Miscellaneous Metals Association
NRCA	National Roofing Contractors Association
NRMCA	National Ready Mixed Concrete Association

NSF	NSF International (National Sanitation Foundation International)
NSSGA	National Stone, Sand & Gravel Association
NTMA	National Terrazzo & Mosaic Association, Inc. (The)
NTRMA	National Tile Roofing Manufacturers Association (Now TRI)
NWWDA	National Wood Window and Door Association (Now WDMA)
OPL	Omega Point Laboratories, Inc. (Now ITS)
PCI	Precast/Prestressed Concrete Institute
PDCA	Painting & Decorating Contractors of America
PDI	Plumbing & Drainage Institute
PGI	PVC Geomembrane Institute
PLANET	Professional Landcare Network (Formerly: ACLA - Associated Landscape Contractors of America)
PTI	Post-Tensioning Institute
RCSC	Research Council on Structural Connections
RFCI	Resilient Floor Covering Institute
RIS	Redwood Inspection Service
SAE	SAE International
SDI	Steel Deck Institute
SDI	Steel Door Institute
SEFA	Scientific Equipment and Furniture Association
SEI/ASCE	Structural Engineering Institute/American Society of Civil Engineers (See ASCE)
SGCC	Safety Glazing Certification Council
SIA	Security Industry Association
SIGMA	Sealed Insulating Glass Manufacturers Association (Now IGMA)
SJI	Steel Joist Institute
SMA	Screen Manufacturers Association

SMACNA	Sheet Metal and Air Conditioning Contractors' National Association
SMPTE	Society of Motion Picture and Television Engineers
SPFA	Spray Polyurethane Foam Alliance (Formerly: SPI/SPFD - The Society of the Plastics Industry, Inc.; Spray Polyurethane Foam Division)
SPIB	Southern Pine Inspection Bureau (The)
SPRI	Single Ply Roofing Industry
SSINA	Specialty Steel Industry of North America
SSPC	SSPC: The Society for Protective Coatings
STI	Steel Tank Institute
SWI	Steel Window Institute
SWRI	Sealant, Waterproofing, & Restoration Institute
TCA	Tile Council of America, Inc. (Now TCNA)
TCNA	Tile Council of North America, Inc.
TIA/EIA	Telecommunications Industry Association/Electronic Industries Alliance
TMS	The Masonry Society
TPI	Truss Plate Institute, Inc.
TPI	Turfgrass Producers International
TRI	Tile Roofing Institute
UL	Underwriters Laboratories Inc.
UNI	Uni-Bell PVC Pipe Association
USAV	USA Volleyball
USGBC	U.S. Green Building Council
USITT	United States Institute for Theatre Technology, Inc.
WASTEC	Waste Equipment Technology Association
WCLIB	West Coast Lumber Inspection Bureau
WCMA	Window Covering Manufacturers Association
WCSC	Window Covering Safety Council

(Formerly: WCMA - Window Covering Manufacturers Association)

WDMA	Window & Door Manufacturers Association (Formerly: NWWDA - National Wood Window and Door Association)
WI	Woodwork Institute (Formerly: WIC - Woodwork Institute of California)
WIC	Woodwork Institute of California (Now WI)
WMMPA	Wood Moulding & Millwork Producers Association
WSRCA	Western States Roofing Contractors Association
WWPA	Western Wood Products Association

O. Code Agencies: Where abbreviations and acronyms are used in Specifications or other Contract Documents, they shall mean the recognized name of the entities in the following list.

IAPMO	International Association of Plumbing and Mechanical Officials
ICC	International Code Council
ICC-ES	ICC Evaluation Service, Inc.
UBC	Uniform Building Code (See ICC)

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

CE	Army Corps of Engineers
CPSC	Consumer Product Safety Commission
DOC	Department of Commerce
DOD	Department of Defense
DOE	Department of Energy
EPA	Environmental Protection Agency
FAA	Federal Aviation Administration
FCC	Federal Communications Commission
FDA	Food and Drug Administration
GSA	General Services Administration
HUD	Department of Housing and Urban Development
LBL	Lawrence Berkeley National Laboratory

NCHRP	National Cooperative Highway Research Program (See TRB)
NIST	National Institute of Standards and Technology
OSHA	Occupational Safety & Health Administration
PBS	Public Buildings Service (See GSA)
PHS	Office of Public Health and Science
RUS	Rural Utilities Service (See USDA)
SD	State Department
TRB	Transportation Research Board
USDA	Department of Agriculture
USPS	Postal Service

Q. Standards and Regulations: Where abbreviations and acronyms are used in Specifications or other Contract Documents, they shall mean the recognized name of the standards and regulations in the following list. Names, telephone numbers, and Web sites are subject to change and are believed to be accurate and up-to-date as of the date of the Contract Documents.

ADAAG	Americans with Disabilities Act (ADA) Architectural Barriers Act (ABA) Accessibility Guidelines for Buildings and Facilities Available from U.S. Access Board
CFR	Code of Federal Regulations Available from Government Printing Office
DOD	Department of Defense Military Specifications and Standards Available from Department of Defense Single Stock Point
DSCC	Defense Supply Center Columbus (See FS)
FED-STD	Federal Standard (See FS)
FS	Federal Specification Available from Department of Defense Single Stock Point Available from Defense Standardization Program Available from General Services Administration Available from National Institute of Building Sciences

FTMS Federal Test Method Standard
(See FS)

MIL (See MILSPEC)

MIL-STD (See MILSPEC)

MILSPEC Military Specification and Standards
Available from Department of Defense Single Stock Point

UFAS Uniform Federal Accessibility Standards
Available from Access Board

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

CBHF State of California, Department of Consumer Affairs Bureau of Home Furnishings and Thermal Insulation

CCR California Code of Regulations

CPUC California Public Utilities Commission

TFS Texas Forest Service
Forest Resource Development

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION

**SECTION 01 43 00
QUALITY CONTROL**

PART 1 - GENERAL

1.01. 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. These services do not relieve Contractor of responsibility for compliance with the Contract Document requirements.
 - 1. Specified tests, inspections, and related actions do not limit Contractor's other quality-assurance and -control procedures that facilitate compliance with the Contract Document requirements.
 - 2. Requirements for Contractor to provide quality-assurance and -control services required by Architect, Owner, or authorities having jurisdiction are not limited by provisions of this Section.
- C. Related Sections:
 - 1. Divisions 2 through 33 Sections for specific test and inspection requirements.

1.02. DEFINITIONS

- D. 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.
- E. 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.
- F. Mockups: Full size physical assemblies that are constructed on-site. 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.
- G. Preconstruction 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.
- H. Product Testing: Tests and inspections that are performed by a testing agency qualified to conduct product testing and acceptable to authorities having jurisdiction, to establish product performance and compliance with specified requirements.

- I. Source Quality-Control Testing: Tests and inspections that are performed at the source, i.e., plant, mill, factory, or shop.
- J. Field Quality-Control Testing: Tests and inspections that are performed on-site for installation of the Work and for completed Work.
- K. Testing Agency: An entity engaged to perform specific tests, inspections, or both. Testing laboratory shall mean the same as testing agency.
- L. Installer/Applicator/Erector: Contractor or another entity engaged by Contractor as an employee, Subcontractor, or Sub-subcontractor, to perform a particular construction operation, including installation, erection, application, and similar operations.
 - 1. 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 or trades.
- M. Experienced: When used with an entity or individual, "experienced" means having successfully completed a minimum of **five** previous projects similar in nature, size, and extent to this Project; being familiar with special requirements indicated; and having complied with requirements of authorities having jurisdiction.

1.03. CONFLICTING REQUIREMENTS

- N. Referenced Standards: If compliance with two 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.
- O. 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.

1.04. INFORMATIONAL SUBMITTALS

- P. Contractor's Statement of Responsibility: When required by authorities having jurisdiction, submit copy of written statement of responsibility sent to authorities having jurisdiction before starting work on the following systems.
 - 1. Seismic-force resisting system, designated seismic system, or component listed in the designated seismic system quality assurance plan prepared by the Architect.
 - 2. Main wind-force resisting system or a wind-resisting component listed in the wind-force-resisting system quality assurance plan prepared by the Architect.
- Q. Testing Agency Qualifications: For testing agencies specified in "Quality Assurance" Article to demonstrate their capabilities and experience. Include proof of qualifications in the form of a recent report on the inspection of the testing agency by a recognized authority.

1.05. REPORTS AND DOCUMENTS

- R. Test and Inspection Reports: Prepare and submit certified written reports specified in other Sections. Include the following:
1. Date of issue.
 2. Project title and number.
 3. Name, address, and telephone number of testing agency.
 4. Dates and locations of samples and tests or inspections.
 5. Names of individuals making tests and inspections.
 6. Description of the Work and test and inspection method.
 7. Identification of product and Specification Section.
 8. Complete test or inspection data.
 9. Test and inspection results and an interpretation of test results.
 10. Record of temperature and weather conditions at time of sample taking and testing and inspecting.
 11. Comments or professional opinion on whether tested or inspected Work complies with the Contract Document requirements.
 12. Name and signature of laboratory inspector.
 13. Recommendations on retesting and re-inspecting.
- S. Manufacturer's Field Reports: Prepare written information documenting tests and inspections specified in other Sections. Include the following:
1. Name, address, and telephone number of representative making report.
 2. Statement on condition of substrates and their acceptability for installation of product.
 3. Summary of installation procedures being followed, whether they comply with requirements and, if not, what corrective action was taken.
 4. Results of operational and other tests and a statement of whether observed performance complies with requirements.
 5. Other required items indicated in individual Specification Sections.
- T. 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.

1.06. QUALITY ASSURANCE

- U. General: Qualifications paragraphs in this article establish the minimum qualification levels required; individual Specification Sections specify additional requirements.
- V. Manufacturer Qualifications: A firm experienced in manufacturing products or systems similar to those indicated for this Project and with a record of successful in-service performance, as well as sufficient production capacity to produce required units.
- W. Fabricator Qualifications: A firm experienced in producing products similar to those indicated for this Project and with a record of successful in-service performance, as well as sufficient production capacity to produce required units.
- X. 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.
- Y. Professional Engineer Qualifications: A professional engineer who is legally qualified to practice in jurisdiction where Project is located and who is experienced in providing engineering services of the kind indicated. Engineering services are defined as those performed for installations of the system, assembly, or products that are similar to those indicated for this Project in material, design, and extent.
- Z. Specialists: 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.
 - 1. Requirements of authorities having jurisdiction shall supersede requirements for specialists.
- AA. Testing Agency Qualifications: An independent agency with the experience and capability to conduct testing and inspecting indicated, as documented according to **ASTM E 329**; and with additional qualifications specified in individual Sections; and where required by authorities having jurisdiction, that is acceptable to authorities.
- BB. Manufacturer's Representative Qualifications: An authorized representative of manufacturer who is trained and approved by manufacturer to observe and inspect installation of manufacturer's products that are similar in material, design, and extent to those indicated for this Project.
- CC. Preconstruction Testing: Where testing agency is indicated to perform preconstruction testing for compliance with specified requirements for performance and test methods, comply with the following:
 - 1. Contractor responsibilities include the following:
 - a. Provide test specimens representative of proposed products and construction.
 - b. Submit specimens in a timely manner with sufficient time for testing and analyzing results to prevent delaying the Work.
 - c. When testing is complete, remove test specimens, assemblies, mockups; do not reuse products on Project.

2. Testing Agency Responsibilities: Submit a 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.

DD. Mockups: 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:

1. Build mockups in location and of size indicated or, if not indicated, as directed by Architect.
2. Notify Architect **seven** days in advance of dates and times when mockups will be constructed.
3. Demonstrate the proposed range of aesthetic effects and workmanship.
4. Obtain Architect's approval of mockups before starting work, fabrication, or construction.
 - a. Allow **seven** days for initial review and each re-review of each mockup.
5. Maintain mockups during construction in an undisturbed condition as a standard for judging the completed Work.
6. Demolish and remove mockups when directed, unless otherwise indicated.

1.07. QUALITY CONTROL

EE. Owner Responsibilities: Where quality-control services are indicated as Owner's responsibility, Owner will engage a qualified testing agency to perform these services.

1. 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.
2. 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.**

FF. Contractor Responsibilities: 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.

1. Where services are indicated as Contractor's responsibility, engage a qualified testing agency to perform these quality-control services.
 - a. Contractor shall not employ same entity engaged by Owner, unless agreed to in writing by Owner.
2. Notify testing agencies at least **48** hours in advance of time when Work that requires testing or inspecting will be performed.
3. Where quality-control services are indicated as Contractor's responsibility, submit a certified written report, in duplicate, of each quality-control service.

4. Testing and inspecting requested by Contractor and not required by the Contract Documents are Contractor's responsibility.
 5. Submit additional copies of each written report directly to authorities having jurisdiction, when they so direct.
- GG. Manufacturer's Field Services: Where indicated, engage a manufacturer's representative to observe and inspect the Work. Manufacturer's representative's services include examination of substrates and conditions, verification of materials, inspection of completed portions of the Work, and submittal of written reports.
- HH. 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.
- II. Testing Agency Responsibilities: Cooperate with Architect and Contractor in performance of duties. Provide qualified personnel to perform required tests and inspections.
1. Notify Architect and Contractor promptly of irregularities or deficiencies observed in the Work during performance of its services.
 2. Determine the location from which test samples will be taken and in which in-situ tests are conducted.
 3. Conduct and interpret tests and inspections and state in each report whether tested and inspected work complies with or deviates from requirements.
 4. Submit a certified written report, in duplicate, of each test, inspection, and similar quality-control service through Contractor.
 5. Do not release, revoke, alter, or increase the Contract Document requirements or approve or accept any portion of the Work.
 6. Do not perform any duties of Contractor.
- JJ. Associated 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. Provide the following:
1. Access to the Work.
 2. Incidental labor and facilities necessary to facilitate tests and inspections.
 3. Adequate quantities of representative samples of materials that require testing and inspecting. Assist agency in obtaining samples.
 4. Facilities for storage and field curing of test samples.
 5. Delivery of samples to testing agencies.
 6. Preliminary design mix proposed for use for material mixes that require control by testing agency.
 7. Security and protection for samples and for testing and inspecting equipment at Project site.

KK. Coordination: Coordinate sequence of activities to accommodate required quality-assurance and -control services with a minimum of delay and to avoid necessity of removing and replacing construction to accommodate testing and inspecting.

1. Schedule times for tests, inspections, obtaining samples, and similar activities.

1.08. SPECIAL TESTS AND INSPECTIONS

LL. Special Tests and Inspections: **Owner will engage** a qualified **testing agency** and/or **special inspector** to conduct special tests and inspections required by authorities having jurisdiction as the responsibility of Owner, **as indicated in Statement of Special Inspections attached to this Section**, and as follows:

MM. Special Tests and Inspections: Conducted by a qualified **testing agency** or **special inspector** as required by authorities having jurisdiction, as indicated in individual Specification Sections, and as follows:

1. Verifying that manufacturer maintains detailed fabrication and quality-control procedures and reviewing the completeness and adequacy of those procedures to perform the Work.
2. Notifying Architect and Contractor promptly of irregularities and deficiencies observed in the Work during performance of its services.
3. 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.
4. Submitting a final report of special tests and inspections at Substantial Completion, which includes a list of unresolved deficiencies.
5. Interpreting tests and inspections and stating in each report whether tested and inspected work complies with or deviates from the Contract Documents.
6. Retesting and re-inspecting corrected work.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION

3.01. REPAIR AND PROTECTION

A. General: On completion of testing, inspecting, sample taking, and similar services, repair damaged construction and restore substrates and finishes.

1. Provide materials and comply with installation requirements specified in other Specification Sections or matching existing substrates and finishes. Restore patched areas and extend restoration into adjoining areas with durable seams that are as invisible as possible. Comply with the Contract Document requirements for cutting and patching in Division 1 Section "Execution Requirements."

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

**SECTION 01 45 29
TESTING AND INSPECTION**

PART 1 - GENERAL

1.01 SUMMARY

- A. Section Includes: Cooperate with the Owner's selected testing agency, the Project Inspector, and others responsible for testing and inspecting the Work, and assist the Owner by coordinating such testing and inspecting services as specified in this Section and/or elsewhere in the Contract Documents including the attached Division of State Architect Structural Tests and Inspections sheet (enclosed).
- B. Related Work Specified Elsewhere:
 - 1. Requirements for testing may be required in other Sections of these Specifications.
 - 2. Where no testing requirements are specified or required by reference standards or authorities having jurisdiction, the Owner may require such testing to be performed under current pertinent standards for testing. Payment for such testing will be made as described herein.
- C. Work Not Included:
 - 1. The Owner will select a pre-qualified independent testing laboratory and Inspector as approved by the Division of the State Architect, Office of Regulation Services.
 - 2. The Owner will pay for initial services of the testing laboratory as further described hereinafter.

1.02 QUALITY ASSURANCE

- A. The Owner will select an independent testing laboratory to conduct the tests. Selection of the material required to be tested shall be by the laboratory or the Owner's representative and not by the Contractor.
- B. Qualifications of Testing Laboratory: The testing laboratory shall be qualified to the Owner's acceptance in accordance with ASTM E 329. The testing laboratory shall be qualified by the Division of State Architect in accordance with Interpretation of Regulation No. 1R1-1.
- C. Codes and Standards: Testing, when required, will be in accordance with pertinent codes and regulations and with selected standards of the American Society for Testing and Materials and other organizations or agencies which publish recognized codes, standards, or tests. Refer to Article 3.04 – Required Testing of this Section.
- D. The project specifications shall be in accordance with the provisions of the Standard Specifications for Public Works Construction (SSPWC) 2012 Edition.

1.03 TEST REPORT DISTRIBUTION

- A. Promptly process and distribute required copies of test reports and related instructions to ensure necessary retesting and/or replacement of materials with the least possible delay in progress of the Work.

- B. One copy of test reports shall be forwarded to the Division of the State Architect by the testing agency. Such reports shall include tests made, regardless of whether such tests indicate that the material is satisfactory or unsatisfactory. Samples taken but not tested shall also be reported. Records of special sampling operations as required shall also be reported. The reports shall show that the material or materials were sampled and tested in accordance with the requirements of Title 24 and with the approved specifications. Test reports shall show the specified design strength. They shall also state definitely whether or not the material or materials tested comply with requirements.
- C. Each testing agency shall submit to the Division of the State Architect a verified report in duplicate covering tests which are required to be made by that agency during the progress of the project. Such report shall be furnished each time that work on the project is suspended, including tests up to that time, and at the completion of the project.

1.04 PAYMENT FOR TESTING SERVICES

- A. Initial Services: The Owner will pay for initial testing and inspection except as specifically modified herein-after or as specified otherwise in technical sections. Provided the results of inspection indicating compliance with the Contract Documents.
- B. Retesting: When initial tests or inspection indicate noncompliance with the Contract Documents, subsequent retesting or re-inspection occasioned by the noncompliance shall be performed by the same testing laboratory or Inspector and the costs thereof will be deducted by the Owner from the Contract Sum. Retesting and re-inspection will continue until test or inspection results indicate compliance.
- C. Code Compliance Testing: Inspections and tests required by codes or ordinances, or by authorities having jurisdiction and made by a legally constituted authority, shall be the responsibility of and shall be paid for by the Owner, but back charged to the Contractor in case of retesting due to noncompliance.
- D. Specified Inspections and Tests: Tests and inspections specified in the Specifications, directly or by reference, shall be coordinated by the Contractor at his expense and paid for by the Owner. Corrections of noncompliance and test failures shall be paid for by the Owner, but shall be back charged to the Contractor. Re-inspection and retesting shall be in accordance with paragraph 1.04-B.
- E. Contractor's Convenience Testing: Inspecting or testing performed exclusively for the Contractor's convenience shall be the sole responsibility of and at the expense of the Contractor.

1.05 INSPECTION BY THE OWNER

- A. The Owner and his representatives will have access, for the purpose of inspection, to parts of the work and to the shops wherein the work is in preparation, and the Contractor shall maintain proper facilities and provide safe access for such inspection.
- B. The Owner shall have the right to reject materials and workmanship which are defective, and to require their correction. Rejected workmanship shall be satisfactorily corrected and rejected materials shall be removed from the premises without charge to the Owner. If the Contractor does not correct such rejected within a reasonable time, fixed by written notice, the Owner may correct rejected work and charge the expense to the Contractor.
- C. Should it be considered necessary or advisable by the Owner at any time before final acceptance of the entire work to make an examination of work already completed by removing or tearing out the same, the Contractor shall on request promptly furnish necessary facilities, labor and materials. If such work is found to be defective in respect due to fault of the Contractor or his subcontractor, he shall defray expenses of such examinations and of satisfactory reconstruction. If, however, such work is found to meet

the requirements of the contract, the additional cost of labor and material necessarily involved in the examination and replacement will be allowed the Contractor.

1.06 PROJECT INSPECTOR

A. An Inspector employed by the Owner in accordance with the requirements of State of California Building Code, Title 24, Part 1, and qualified in accordance with Division of State Architect will be assigned to the work. His duties are specifically defined in Title 24, Part 1, Section 4-342, reprinted herein:

1. Duties of the Project Inspector.

(A) General: The Project Inspector shall act under the direction of the A/E/Engineer.

(B) Duties: The general duties of the Project Inspector in fulfilling his or her responsibilities are as follows:

(1) Inspection: He or she must have actual personal knowledge, obtained by his personal inspection of the work of construction in stages of its progress, that the requirements of the approved plans and specifications are being completely executed. Inspection means complete inspection of every part of the work. Work, such as concrete work or brick work which can be inspected only as it is placed, shall require the constant presence of the Project Inspector. Other types of work which can be completely inspected after the work is installed may be carried on while the Inspector is not present. In any case, the Project Inspector must personally inspect every part of the work. In no case shall the Project Inspector have or assume duties which will prevent him or her from providing inspection.

The Project Inspector may obtain personal knowledge of the work of construction, either on-site or off-site, performed under the inspection of a Special Inspector or Assistant Inspector from the reporting of others on testing or inspection of materials and workmanship for compliance with the plans, specifications and applicable standards. The exercise of reasonable diligence to obtain the facts shall be required.

(2) Relations with A/E/Engineer: The Project Inspector shall work under the general direction of the A/E/Engineer. Inconsistencies or seeming errors in the A/E/Engineer for his interpretation and instructions. In no case, however, shall the instruction of the A/E/Engineer be construed to cause work to be done which is not in conformity with the approved plans, specifications, and change orders.

(3) Job File: The Project Inspector shall keep a file of approved plans and specifications (including approved addenda or change orders) on the job, and shall immediately return unapproved documents to the A/E for proper action. The Project Inspector, as a condition of his employment, shall have and maintain on the job, codes and documents referred to in the plans and specifications.

(4) Project Inspector's Semi-Monthly Reports: The Project Inspector shall keep the A/E/Engineer thoroughly informed as to the progress of the work by making semi-monthly reports in writing as required in Section 37.

- (5) Not Used.
- (6) Construction Procedure Records: The Project Inspector shall keep a record of certain phases of construction procedure. All such records of construction procedure shall be kept on the job until the completion of the work. These records shall be made a part of the permanent school records.
- (7) Deviations: The Project Inspector shall notify the Contractor, in writing, of deviations from the approved plans and specifications which are not immediately corrected by the Contractor when brought to his or her attention. Copies of such notice shall be forwarded immediately to the A/E/Engineer. Failure on the part of the Project Inspector to notify the Contractor of deviations from the approved plans and specifications shall in no way relieve the Contractor of responsibility to complete the work covered by his or her contract in accordance with the approved plans and specifications and laws and regulations.
- (8) Verified Reports: The Project and Special Inspectors shall each make and submit to the Division of the State Architect verified reports. The Project Inspector shall prepare and deliver to the Division of the State Architect detailed statements of fact regarding materials, operations, etc., when requested. Violations: Failure, refusal, or neglect on the part of the Inspector to notify the Contractor of work which does not comply with the requirements of the approved plans and specifications, or failure, refusal, or neglect to report immediately, in writing, such violation to the A/E/Engineer, to the School Board, and to the Division of the State Architect shall constitute a violation of the act and shall be cause for the Division of the State Architect to take action.

Note: Authority cited: Section 39152 and 81142, Education Code. Reference: Sections 39151, 39153, 81141 and 81143, Education Code."

- B. The work of construction in stages of progress shall be subject to the personal continuous observation of the Project Inspector as continuous observation is defined by Title 24. He shall have free access to all parts of the work at any time. The Contractor shall furnish the Project Inspector reasonable facilities for obtaining such information as may be necessary to keep him fully informed respecting the progress and manner of the work and the character of the materials. Inspection of the work shall not relieve the Contractor from obligation to fulfill this Contract.

1.07 OWNER'S OTHER PERSONNEL

- A. From time to time, other personnel in the employ of the Owner may inspect the Work when the Work is in progress but shall have no authority to direct the Contractor or request changes in the Work except as may be provided elsewhere in the Contract Documents.

1.08 REPRESENTATIVE OF THE DIVISION OF THE STATE ARCHITECT

- A. Architect shall have access to the site in accordance with Title 24, Part 1, 4-333.
- B. Field Engineers and Inspectors from D.S.A. Structural Safety Section, Fire & Life Safety Review and Access Compliance shall have access to the site in accordance with Title 24, Part 1, 4-334.

PART 2 - PRODUCTS

(NOT USED)

PART 3 - EXECUTION

3.01 COOPERATION WITH TESTING LABORATORY AND INSPECTORS

- A. Inspectors and representatives of the testing laboratory shall have access to the work. Provide facilities for such access in order that the testing, inspection, and the obtaining of samples may be done properly.
- B. Contractor shall deliver material specimens to the Owner's testing lab, which must by terms of the Contract be tested prior to inclusion in the Project, at least 45 days prior to scheduled delivery to the job site.
- C. Material shipped by the Contractor from the source of supply prior to having satisfactorily passed such testing and inspection or prior to the receipt of notice from said representative that such testing and inspection will not be required shall not be incorporated in the job.

3.02 TAKING SPECIMENS

- A. Field specimens and samples for testing, unless otherwise provided in these Contract Documents, shall be selected and taken by the Testing Laboratory or Project Inspector and not the Contractor. Sampling equipment and personnel will be provided by the testing laboratory. Deliveries of specimens and samples to the testing laboratory will be performed by the testing laboratory. Soil samples for approval of import fill shall be picked-up by the Testing Laboratory.

3.03 SCHEDULES FOR TESTING

- A. Establishing Schedule:
 - 1. By advance discussion with the testing laboratory selected by the Owner, determine the time required for the laboratory to perform its tests and to issue each of its findings.
 - 2. Provide required time within the construction schedule.
- B. Revising Schedule: When changes of construction schedule are necessary during construction, coordinate such changes of schedule with the testing laboratory as required.
- C. Adherence to Schedule: When the testing laboratory is ready to test according to the determined schedules, but is prevented from testing or taking specimens due to incompleteness of the work, extra charges for testing attributable to the delay may be back-charged to the Contractor and will be deducted by the Owner from the Contract Sum.

3.04 REQUIRED TESTING

Tests and inspections for the following items, where applicable, will be required in accordance with referenced Sections/Chapters of California Building Code, 2016 Edition, Title 24, Part 2 and DSA approved form 103 T&I:

END OF SECTION

**SECTION 01 50 00
TEMPORARY FACILITIES AND CONTROLS**

PART 1 - GENERAL

1.01. SUMMARY

- A. Section includes requirements for temporary utilities, support facilities, and security and protection facilities.
- B. Related Section:
 - 1. Division 1 Section "Summary" for limitations on work restrictions and utility interruptions.

1.02. USE CHARGES

- C. General: Installation and 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 Project, testing agencies, and authorities having jurisdiction.
- D. Water and Sewer Service from Existing System: Water from Owner's existing water system is available for use without metering and without payment of use charges. Provide connections and extensions of services as required for construction operations.
- E. Electric Power Service from Existing System: Electric power from Owner's existing system is available for use without metering and without payment of use charges. Provide connections and extensions of services as required for construction operations.

1.03. INFORMATIONAL SUBMITTALS

- F. Site Plan: Show temporary facilities, utility hookups, staging areas, and parking areas for construction personnel.
- G. Erosion- and Sedimentation-Control Plan: Show compliance with requirements of EPA Construction General Permit or authorities having jurisdiction, whichever is more stringent.

1.04. QUALITY ASSURANCE

- H. Electric Service: Comply with NECA, NEMA, and UL standards and regulations for temporary electric service. Install service to comply with NFPA 70.
- I. Tests and Inspections: Arrange for authorities having jurisdiction to test and inspect each temporary utility before use. Obtain required certifications and permits.
- J. Accessible Temporary Egress: Comply with applicable provisions in the U.S. Architectural & Transportation Barriers Compliance Board's ADA-ABA Accessibility Guidelines and ICC/ANSI A117.1.

1.05. PROJECT CONDITIONS

- K. 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.

PART 2 - PRODUCTS

2.01. MATERIALS

- A. Chain-Link Fencing: Minimum 2-inch (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, with 1-5/8-inch- (42-mm-) OD top rails.
- B. Portable Chain-Link Fencing: Minimum 2-inch (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, with 1-5/8-inch- (42-mm-) OD top and bottom rails. Provide galvanized steel bases for supporting posts.

2.02. TEMPORARY FACILITIES

- C. Field Offices, General: Required.
- D. Common-Use Field Office: Required.
- E. Inspector Office: Contractor to provide 20'-0" X 8'-0" prefabricated or mobile unit with serviceable finishes, temperature controls, power, data, phone service and foundations adequate for normal loading. Office to be used exclusively by Inspector of Record during construction. Access to trailer shall be through gate in temporary fencing.

2.03. EQUIPMENT

- F. Fire Extinguishers: Portable, UL rated; with class and extinguishing agent as required by locations and classes of fire exposures.

PART 3 - EXECUTION

3.01. INSTALLATION, GENERAL

- A. Locate facilities where they will serve Project adequately and result in minimum interference with performance of the Work. Relocate and modify facilities as required by progress of the Work.
 - 1. Locate facilities to limit site disturbance as specified in Division 1 Section "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.

3.02. TEMPORARY UTILITY INSTALLATION

- C. General: Install temporary service or connect to existing service.
 - 1. Arrange with utility company, Owner, and existing users for time when service can be interrupted, if necessary, to make connections for temporary services.
- D. Water Service: Install water service and distribution piping in sizes and pressures adequate for construction.
- E. Water Service: Connect to Owner's existing water service facilities. Clean and maintain water service facilities in a condition acceptable to Owner. At Substantial Completion, restore these facilities to condition existing before initial use.
- F. Sanitary Facilities: 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. Contractor not to use adjacent school toilet facilities.
- G. Heating and/or 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.
- H. Ventilation and Humidity Control: Provide temporary ventilation required by construction activities for curing or drying of completed installations or for protecting installed construction from adverse effects of high humidity. Select equipment that will not have a harmful effect on completed installations or elements being installed. Coordinate ventilation requirements to produce ambient condition required and minimize energy consumption.
- I. Electric Power Service: Connect to Owner's existing electric power service. Maintain equipment in a condition acceptable to Owner.
- J. Electric Power Service: Provide electric power service and distribution system of sufficient size, capacity, and power characteristics required for construction operations.
 - 1. Install electric power service overhead or underground, unless otherwise indicated.
 - 2. Connect temporary service to Owner's existing power source, as directed by Owner.
- K. Lighting: Provide temporary lighting with local switching that provides adequate illumination for construction operations, observations, inspections, and traffic conditions.
 - 1. Install and operate temporary lighting that fulfills security and protection requirements without operating entire system.
- L. Telephone Service: Provide temporary telephone service in common-use facilities for use by all construction personnel. Install one telephone line(s) for each field office.
 - 1. Provide additional telephone lines for the following:

- a. Provide a dedicated telephone line for each facsimile machine in each field office.
2. At each telephone, post a list of important telephone numbers.
 - a. Police and fire departments.
 - b. Ambulance service.
 - c. Contractor's home office.
 - d. Architect's office.
 - e. Engineers' offices.
 - f. Owner's office.
 - g. Principal subcontractors' field and home offices.
3. Provide superintendent with cellular telephone or portable two-way radio for use when away from field office.

3.03. SUPPORT FACILITIES INSTALLATION

M. General: Comply with the following:

1. 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 E 136. Comply with NFPA 241.
2. 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.

N. Temporary Use of Permanent Roads and Paved Areas: 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.

1. Coordinate elevations of temporary roads and paved areas with permanent roads and paved areas.
2. Prepare subgrade and install subbase and base for temporary roads and paved areas according to Division 2 Section "Earthwork."
3. Recondition base after temporary use, including removing contaminated material, regrading, proof rolling, compacting, and testing.
4. Delay installation of final course of permanent hot-mix asphalt pavement until immediately before Substantial Completion. Repair hot-mix asphalt base-course pavement before installation of final course according to Division 2 Section "Asphalt Paving."

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

1. Protect existing site improvements to remain including curbs, pavement, and utilities.
 2. Maintain access for fire-fighting equipment and access to fire hydrants.
- P. Parking: Street parking is available as posted.
- Q. Dewatering Facilities and Drains: Comply with requirements of authorities having jurisdiction. Maintain Project site, excavations, and construction free of water.
1. Dispose of rainwater in a lawful manner that will not result in flooding Project or adjoining properties nor endanger permanent Work or temporary facilities.
 2. Remove snow and ice as required to minimize accumulations.
- R. Project Signs: Provide Project signs as indicated. Unauthorized signs are not permitted.
1. Identification Signs: Provide Project identification signs as indicated on Drawings.
 2. Temporary Signs: Provide other signs as indicated and as required to inform public and individuals seeking entrance to Project.
 - a. Provide temporary, directional signs for construction personnel and visitors.
 3. Maintain and touchup signs so they are legible at all times.
- S. Waste Disposal Facilities: Comply with requirements specified in Division 1 Section "Construction Waste Management."
- T. 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 Division 1 Section "Execution Requirements" for progress cleaning requirements.
- U. Lifts and Hoists: Provide facilities necessary for hoisting materials and personnel.
1. Truck cranes and similar devices used for hoisting materials are considered "tools and equipment" and not temporary facilities.
- V. Temporary Elevator Use: Use of elevators is not permitted.
- W. Temporary Stairs: Until permanent stairs are available, provide temporary stairs where ladders are not adequate.
- X. Existing Stair Usage: Use of Owner's existing stairs will be permitted, provided stairs are cleaned and maintained in a condition acceptable to Owner. At Substantial Completion, restore stairs to condition existing before initial use.
1. Provide protective coverings, barriers, devices, signs, or other procedures to protect stairs and to maintain means of egress. If stairs become damaged, restore damaged areas so no evidence remains of correction work.
- Y. 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.

3.04. SECURITY AND PROTECTION FACILITIES INSTALLATION

- Z. Environmental Protection: 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.
- AA. Temporary Erosion and Sedimentation Control: Comply with requirements of the latest SWRCB Construction General Permit or authorities having jurisdiction, whichever is more stringent and requirements specified in Division 2 Section "Site Clearing."
- BB. Temporary Erosion and Sedimentation Control: 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 the latest SWRCB Construction General Permit or authorities having jurisdiction, whichever is more stringent.
- CC. Stormwater Control: 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.
- DD. Tree and Plant Protection: Comply with requirements specified in Division 2 Section "Tree Protection and Trimming."
- EE. Tree and Plant Protection: 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.
- FF. Pest Control: Engage pest-control service to recommend practices to minimize attraction and harboring of rodents, roaches, and other pests and to perform extermination and control procedures at regular intervals so Project will be free of pests and their residues at Substantial Completion. Obtain extended warranty for Owner. Perform control operations lawfully, using environmentally safe materials.
- GG. Site Enclosure Fence: Before construction operations begin, furnish and install site enclosure fence in a manner that will prevent people and animals from easily entering site except by entrance gates.
 - 1. Extent of Fence: As required to enclose entire Project site or portion determined sufficient to accommodate construction operations.
 - 2. Maintain security by limiting number of keys and restricting distribution to authorized personnel.
- HH. Security Enclosure and Lockup: 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.
- II. Barricades, Warning Signs, and Lights: Comply with requirements of authorities having jurisdiction for erecting structurally adequate barricades, including warning signs and lighting.
- JJ. Temporary Egress: Maintain temporary egress from existing occupied facilities as indicated and as required by authorities having jurisdiction.
- KK. Temporary Enclosures: 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.

1. Where heating or cooling is needed and permanent enclosure is not complete, insulate temporary enclosures.

LL. Temporary Fire Protection: Install and maintain temporary fire-protection facilities of types needed to protect against reasonably predictable and controllable fire losses. Comply with NFPA 241.

1. Prohibit smoking in construction areas.
2. Supervise welding operations, combustion-type temporary heating units, and similar sources of fire ignition according to requirements of authorities having jurisdiction.
3. Develop and supervise an overall fire-prevention and -protection program for personnel at Project site. Review needs with local fire department and establish procedures to be followed. Instruct personnel in methods and procedures. Post warnings and information.
4. 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.

3.05. MOISTURE AND MOLD CONTROL

MM. Contractor's Moisture Protection Plan: Avoid trapping water in finished work. Document visible signs of mold that may appear during construction.

NN. Exposed Construction Phase: Before installation of weather barriers, when materials are subject to wetting and exposure and to airborne mold spores, protect materials from water damage and keep porous and organic materials from coming into prolonged contact with concrete.

OO. Partially Enclosed Construction Phase: After installation of weather barriers but before full enclosure and conditioning of building, when installed materials are still subject to infiltration of moisture and ambient mold spores, protect as follows:

1. Do not load or install drywall or other porous materials or components, or items with high organic content, into partially enclosed building.
2. Keep interior spaces reasonably clean and protected from water damage.
3. Discard or replace water-damaged and wet material.
4. Discard, replace or clean stored or installed material that begins to grow mold.
5. Perform work in a sequence that allows any wet materials adequate time to dry before enclosing the material in drywall or other interior finishes.

PP. Controlled Construction Phase of Construction: After completing and sealing of the building enclosure but prior to the full operation of permanent HVAC systems, maintain as follows:

1. Control moisture and humidity inside building by maintaining effective dry-in conditions.
2. Remove materials that can not be completely restored to their manufactured moisture level within **48** hours.

3.06. OPERATION, TERMINATION, AND REMOVAL

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

END OF SECTION

**SECTION 01 58 13
TEMPORARY PROJECT SIGNAGE**

PART 1 – GENERAL

1.01 PROJECT IDENTIFICATION

- A. Provide One 32 square foot Project Identification signs of wood frame and exterior grade plywood construction, painted, with exhibit lettering by professional sign painter, to District's design and colors as indicated on Drawings.
1. Confer with District for confirmation of names prior to lettering signs.
 2. Ground Clearance: Two feet.
 3. Materials: ½" MDO panel or exterior grade plywood panel with vertical structural members of 4x8 #2 creosote treated Douglas fir installed to depth of 4 feet below grade.
 - a. Stringers: 2x2 stingers of dense #1 Douglas fir, located behind top, bottom, and center of sign panel.
 4. Paint: Sign panel and structural members shall be painted on all sides and edges with two coats of exterior type alkyd paint over suitable primer and professionally lettered or silk screened.
 5. Typefaces: Optima.
 6. Seal: Obtain from District. Coordinate with Project Manager.
- B. Erect one sign at each street front site at locations established by District. Position parallel with street and locate in areas which will not interfere with construction activities.
- Signs: Remain on site until the buildings permanent exterior signing is installed, or as otherwise directed by the District.
- No other signs shall be permitted.
- C. Signs shall include the following:
1. Name of the School
 2. Title of Project.
 3. Rendering of the Project
 4. Seal of the District.
 5. Logo/Name of the Architect
 6. Logo/Name of the Contractor
- D. The project sign must be erected within 35 calendar days after Notice of award of this contract.

END OF SECTION

**SECTION 01 60 20
STORAGE AND PROTECTION**

PART 1 – GENERAL

1.01 SUMMARY

- A. Protect products scheduled for use in the Work by means including, but not necessarily limited to, those described in this Section.
- B. Related work:
 - 1. Documents affecting work of this Section include, but are not necessarily limited to the General Conditions and Supplementary Conditions.
 - 2. Additional procedures also may be prescribed in other Sections of these Specifications.

1.02 QUALITY ASSURANCE

- A. Include within the Contractor's quality assurance program such procedures as are required to assure full protection of work and materials.

1.03 MANUFACTURERS' RECOMMENDATIONS

- A. Except as otherwise approved by the District, determine and comply with manufacturers' recommendations on product handling, storage, and protection.

1.04 PACKAGING

- A. Deliver products to the job site in their manufacturer's original container, with labels intact and legible.
 - 1. Maintain packaged materials with seals unbroken and labels intact until time of use.
 - 2. Promptly remove damaged material and unsuitable items from the job site, and promptly replace with material meeting the specified requirements, at no additional cost to the Owner.
- B. The District may reject as non-complying such material and products that do not bear identification satisfactory to the District as to manufacturer, grade, quality, and other pertinent information.

1.05 PROTECTION

- A. Protect finished surfaces, including jambs and soffits of openings used as passageways, through which equipment and materials are handled.
- B. Provide protection for finished surfaces in traffic areas prior to allowing equipment or materials to be moved over such surfaces.

- C. Maintain finished surfaces clean, unmarred, and suitably protected until accepted by the Owner.

1.06 REPAIRS AND REPLACEMENTS

- A. In event of damage, promptly make replacements and repairs to the approval of the Architect and at no additional cost to the Owner.
- B. Additional time required to secure replacements and to make repairs will not be considered by the District to justify an extension in the Contract Time of Completion.

END OF SECTION

**SECTION 01 77 00
CLOSEOUT PROCEDURES**

PART 1 – GENERAL

1.01 SECTION INCLUDES:

- A. Closeout Procedures
- B. Final Cleaning.
- C. Pest Control.
- D. Adjusting.
- E. Demonstration and Instructions.
- F. Project Record Documents.
- G. Operation and Maintenance Data.
- H. Warranties.
- I. Spare Parts and Maintenance Materials.

1.02 CLOSEOUT PROCEDURES

- A. Submit written certification that Contract Documents have been reviewed, Work has been inspected, and that Work is complete in accordance with Contract Documents and ready for Architect's review.
- B. Prepare and submit to Architect a list of items to be completed or corrected, the value of the items on the list, and reasons why the Work is not complete.
- C. Submit written request to Architect for review of Work.
- D. Submit warranties, bonds, service agreements, certifications, record documents, maintenance manuals, receipt of spare parts and similar closeout documents.
- E. Make final changeover of permanent locks and deliver keys to Owner.
- F. Terminate and remove temporary facilities from Project site.
- G. Advise Owner of change over in heat and other utilities.
- H. Provide submittals to Architect that are required by governing or other authorities.
- I. Submit final Application for Payment identifying total adjusted Contract Sum, previous payments, and sum remaining due.
- J. Submit affidavit of payment of debts and claims, AIA Document G706.
- K. Submit affidavit of release of liens, AIA Document G706A.
- L. Submit consent of contractors surety to final payment, AIA Document G707.

M. Owner will occupy all portions of the building as specified in Section 01110.

1.03 FINAL CLEANING

- A. Execute final cleaning prior to final review by Architect.
- B. Employ experienced professional cleaners for final cleaning.
- C. Clean interior and exterior glass and surfaces exposed to view; remove temporary labels, stains and foreign substances, polish transparent and glossy surfaces.
- D. Vacuum carpeted and soft surfaces. Shampoo if visible stains exist.
- E. Clean equipment and plumbing fixtures to a sanitary condition.
- F. Clean exposed surfaces of grilles, registers and diffusers.
- G. Replace filters of operating mechanical equipment.
- H. Clean debris from roofs, gutters, downspouts, and drainage systems.
- I. Clean site; sweep paved areas, rake clean landscaped surfaces.
- J. Remove waste and surplus materials, rubbish, and construction facilities from the site.
- K. Clean light fixtures and replace burned out lamps and bulbs.
- L. Relamp all lamps and bulbs in lighting fixtures.
- M. Replace defective and noisy ballasts and starters in fluorescent fixtures.
- N. Leave project clean and ready for occupancy by Owner.

1.04 PEST CONTROL

- A. Engage an experienced, licensed exterminator to make final inspection and rid Project of rodents, insects, and other pests. Submit final report to Architect.

1.05 ADJUSTING

- A. Adjust operating Products and equipment to ensure smooth and unhindered operation.

1.06 DEMONSTRATION AND INSTRUCTIONS

- A. Demonstrate operation and maintenance of products, systems, and equipment to Owner's personnel two weeks prior to date of final review.
- B. For each demonstration submit list of participants in attendance.
- C. Provide two copies of video tape of each demonstration and instructions session.
- D. For equipment or systems requiring seasonal operation, perform demonstration for other season within six months.

- E. Utilize operation and maintenance manuals as basis for instruction. Review contents of manual with Owner's personnel in detail to explain all aspects of operation and maintenance.
- F. Demonstrate start-up, operation, control, adjustment, trouble-shooting, servicing, maintenance, and shutdown of each item of equipment at agreed-upon times, at equipment location.
- G. Prepare and insert additional data in operations and maintenance manuals when need for additional data becomes apparent during instruction.

1.07 PROJECT RECORD DOCUMENTS

- A. Maintain on site, one set of the following record documents; record actual revisions to the Work in contrasting color.
 - 1. Contract Drawings.
 - 2. Specifications.
 - 3. Addenda.
 - 4. Change Orders and other Modifications to the Contract.
 - 5. Reviewed shop drawings, product data, and samples.
- B. Store Record Documents separate from documents used for construction.
- C. Record information concurrent with construction progress.
- D. Specifications: Legibly mark and record at each Product Section in contrasting color ink, description of actual Products installed, including the following:
 - 1. Manufacturer's name and product model and number.
 - 2. Supplier and installers name and contact information.
 - 3. Changes made by Addenda and Modifications.
- E. Contract Drawings and Shop Drawings: Legibly mark each item in contrasting color ink to record actual construction including:
 - 1. Measured horizontal and vertical locations of underground utilities and appurtenances, referenced to permanent surface improvements.
 - 2. Measured locations of internal utilities and appurtenances concealed in construction, referenced to visible and accessible features of the Work.
 - 3. Field changes of dimension and detail.
 - 4. Details not on original Contract Drawings.
 - 5. Revisions to electrical circuitry and locations of electrical devices and equipment.
 - 6. Note change orders, alternate numbers, and similar information, where applicable.

7. Identify each record drawing with the written designation of "RECORD DRAWING" located in prominent location.
- F. Record Digital Data Files: Immediately before inspection for Substantial Completion, review marked-up record prints with Architect. When authorized, prepare a full set of corrected digital data files of the Contract Drawings, as follows:
1. Format: Same digital data software program, version, and operating system as the original Contract Drawings.
 2. Format: Annotated PDF electronic file with comment function enabled.
 3. Incorporate changes and additional information previously marked on record prints. Delete, redraw, and add details and notations where applicable.
 4. Refer instances of uncertainty to Architect for resolution.
 5. Architect will furnish Contractor one set of digital data files of the Contract Drawings for use in recording information.
 - (a) Refer to Section 01 33 00 "Submittal Procedures" for requirements related to use of Architect's digital data files.
 - (b) Architect will provide data file layer information, record markups in separate layers.
- G. Final Property Survey: Under the provisions of Section 01 78 00.
- H. Record Construction Schedule: Under the provisions of Section 01 32 17.
- I. Submit documents to Architect at time of Substantial Completion.

1.08 OPERATION AND MAINTENANCE DATA

- A. Summary:
1. Organize operation and maintenance data with directory.
 2. Provide operation and maintenance manuals for products, systems, subsystems, and equipment.
 3. Refer to Divisions 2 thru 16 for specific operation and maintenance manual requirements for the Work in those Divisions.
- B. Submit two sets prior to final review, bound in 8-1/2 inch x 11 inch, three ring D size binders with durable vinyl covers.
- C. Prepare binder covers with printed title "OPERATION AND MAINTENANCE INSTRUCTIONS", title of project, and subject matter of binder when multiple binders are required.
- D. Internally subdivide the binder contents with permanent page dividers, logically organized as described below; with laminated plastic tabs.
- E. Part 1: Directory, listing names, addresses, and telephone numbers of Architect, Engineers, Contractor, subcontractors, and major equipment suppliers and manufacturers.

- F. Part 2: Operation and maintenance instructions, arranged by specification section. For each category, identify names, addresses, and telephone numbers of Subcontractors and suppliers. Identify the following:
 - 1. Performance and design criteria.
 - 2. List of equipment.
 - 3. Parts list for each component.
 - 4. Start-up procedures.
 - 5. Shutdown instructions.
 - 6. Normal operating instructions.
 - 7. Wiring diagrams.
 - 8. Control diagrams.
 - 9. Maintenance instructions for equipment and systems.
 - 10. Maintenance instructions for finishes, including recommended cleaning methods and materials.

- G. Part 3: Project documents and certificates, including the following:
 - 1. Shop drawings and product data.
 - 2. Air and water balance reports.
 - 3. Certificates.
 - 4. Warranties.

1.09 WARRANTIES

- A. Commencement of warranties shall be date of Substantial Completion.
- B. For items of Work delayed beyond date of Substantial Completion, provide updated submittal within ten days after acceptance, listing date of acceptance as start of warranty period.
- C. Provide duplicate notarized copies in operation and maintenance manuals.
- D. Execute and assemble documents from subcontractors, suppliers, and manufacturers.
- E. Provide Table of Contents and assemble in binder with durable plastic cover.
- F. Submit prior to final Application for Payment.
- G. Manufacturer's disclaimers and limitations on product warranties do not relieve Contractor of warranty on the work that incorporates the products.

- H. Manufacturer's disclaimer and limitations on product warranties do not relieve suppliers, manufacturer's, and subcontractors required to countersign special warranties with Contractor.
- I. When correcting failed or damaged warranted construction, remove and replace construction that has been damaged as a result of such failure or must be removed and replaced to provide access for correction of warranted construction.
- J. When work covered by warranty has failed and has been corrected, reinstate warranty by written endorsement. Reinstated warranty shall be equal to original warranty with equitable adjustment for depreciation.
- K. Upon determination that Work covered by warranty has failed, replace or repair Work to an acceptable condition complying with requirements of the Contract Documents.

1.10 SPARE PARTS AND MAINTENANCE MATERIALS

- A. Provide products, spare parts, maintenance and extra materials in quantities specified in individual specification Sections.
- B. Deliver to Project site and place in location as directed.
- C. Obtain signed receipt for delivery of materials and submit prior to request for final review by Architect.

END OF SECTION

**SECTION 01 77 01
PROJECT CLOSEOUT**

PART 1 – GENERAL

1.01 REFERENCE

- A. Requirements in Addenda, Alternates, Conditions, and Division 1 collectively apply to this work.

1.02 GENERAL

- A. As a prerequisite for final payment, Contractor to complete the work of this Section.
- B. Comply with requirements stated in "Conditions Of The Contract" and in "Specifications" for administrative procedures in closing out the Work.
- C. Related Work Specified Elsewhere:
 - 1. Guarantee Form: See General Conditions.
 - 2. Close-out Submittals: See Respective Spec. Sections.

1.03 PREFINAL INSPECTION; SUBSTANTIAL COMPLETION

- A. Pre-final Inspection:
 - 1. Upon "substantial completion" of the Work, Contractor shall notify Architect and request a "pre-final inspection" of the Work.
 - 2. If Architect concurs that "substantial completion" has been reached, he will review the Work and list items to be completed or corrected. List will be amended as required to include items subsequently observed.
- B. Substantial Completion Defined: "Substantial Completion" of the Work is the status, as approved by the Architect, when construction is sufficiently complete, in accordance with the Contract Documents, so District can occupy or utilize the Work for the use for which it is intended, without incomplete work scope items either interior or exterior.

1.04 FINAL INSPECTION

- A. Reference: See General and Supplementary Conditions, titled "Final Adjustment And Completion".
- B. Final Inspection: When Contractor has complied with above Article, Architect will review the Work and list any items to be completed or corrected.
- C. Contractor shall correct and/or complete the Work.

1.05 GUARANTEES

- A. General: Contractor shall guarantee in writing to District that:
 - 1. "Contractor will repair or replace any and all work, together with any other work which may be displaced, damaged or marred in so doing, that may prove defective in workmanship and/or materials, or fail to conform to contract provisions and

requirements within the period cited below, such period to begin on date of acceptance of work by District, without any expense whatsoever to District, ordinary wear and tear, and unusual abuse or neglect excepted."

2. Format: Contractor shall submit guarantees typed in the format indicated in "Guarantee Form", See General Conditions Exhibit K.
3. Number of Copies: Submit in duplicate to Architect.
4. Required Guarantees:
5. General: Submit all guarantees listed herein or required by various Spec. Sections; more stringent shall apply. Guarantee periods begin at the date of acceptance written on the "Notice Of Completion" as accepted by the School District Board of Education.
6. General Guarantee:
 - a. By General Contractor; For The Entire Work: 1 Year

1.06 WARRANTIES

- A. General: Submit all warranties required by various Spec. Sections.

1.07 CERTIFICATES

- A. General: Submit all certificates and Verified Reports required by various Spec. Sections or listed herein, notarized as required.

1.08 OPERATION & MAINTENANCE DATA

- A. General: Submit all manuals required by various General Conditions, Spec. Sections or listed herein; two copies each.

1.09 PROJECT RECORD DOCUMENTS

- A. See Section 01 77 20.
- B. Additional Information Required: In addition to the requirements in Section 01720, provide the following:
 1. By measured dimensions (vertical and horizontal) from permanent improvements or buildings, locate the following new underground utilities, piping systems, and their appurtenances; and existing systems when known, uncovered, in work areas, adjacent to work areas, or modified as part of the work of this Project:
 - a. Site drainage systems piping and cleanouts.
 - b. Landscape sprinkler systems: Complete system, except non-pressure branch lines from automatic control valves to heads.
 - c. All fire protection systems.

- d. All plumbing systems.
 - e. All electrical systems.
 - f. All pool systems.
2. For gravity flow lines such as sewers and storm drains, locate all cleanouts, and indicate invert elevations at building lines, changes in direction, intersections, and property lines.
 3. Electrical Underground: In addition to locations, state number and sizes of conduits and wires, and provide invert elevations.
 4. Work Concealed Within Building Construction: Indicate by dimension the locations of Plumbing Systems, HVAC Systems, and Fire Protection Systems.
 5. Show any work performed that deviates from original Contract Documents.
 6. Show all work authorized by Change Order(s) and number of that Change Order.

END OF SECTION

**SECTION 01 77 20
PROJECT RECORD DOCUMENTS**

PART 1 – GENERAL

1.01 SUMMARY

- A. Throughout progress of the Work of this Contract, maintain an accurate record of all changes in the Contract Documents, as described in 3.1 below.
- B. Contractor shall periodically transfer the recorded changes to a set of “as-built” documents, as described in Article 3.02 below, and submit such “as-builts” to Architect for Architect’s use as required.
- C. The Project Manager shall verify that as-builts are current, on a monthly basis, prior to the processing of pay requests. Pay Requests WILL NOT be processed unless the As-Builts have been verified.
- D. Related work described elsewhere: Section 01 33 00 “Submittal Procedures”.

1.02 QUALITY ASSURANCE

- A. General: Delegate the responsibility for maintenance of Record Documents to one person on the Contractor’s staff as approved in advance by the Architect.
- B. Accuracy of records: Thoroughly coordinate all changes within the Record Documents, making adequate and proper entries on each page of a clean set of Specifications and each sheet of Drawings and other Documents where such entry is required to properly show the change. Accuracy of records shall be such that future search for items shown in the Contract Document may reasonably rely on information obtained from the approved Record Documents.
- C. Timing of entries: make all entries within 24 hours after receipt of information.

1.03 SUBMITTALS

- A. General: The Architect’s approval of the current status of Record Documents will be a prerequisite to the Architect’s approval of requests for progress payment and request for final payment under the Contract.
- B. Progress submittals: Prior to submitting each request for progress payment, secure the Architect’s approval of the Record Documents as currently maintained.
- C. Final submittals: Prior to submitting request for final payment, submit the Final Record Documents to the Architect and secure his approval.

1.04 PRODUCT HANDLING

- A. Use all means necessary to maintain the job set of Record Documents completely protected from deterioration and from loss and damage until completion of the work and transfer of the recorded data to the Final Record Documents. In the event of loss of recorded data, use all means necessary to secure the data to the Architect’s approval; such means shall include, if necessary in the opinion of the Architect, removal and replacement of concealing materials and, in such case, all replacements shall be to the standards originally specified in the record Documents.

PART 2 – PRODUCTS

2.01 RECORD DOCUMENTS

- A. Promptly following award of Contract, mark one set of documents (bluelines) as “RECORD DOCUMENTS-JOB SET”. All Addenda, issued during the Bid, shall be “cut and pasted” onto the appropriate sheets or pages of the Plans and Specifications.
 - 1. In addition to the requirements set forth, directing the Contractor to transfer all the information above to a reproducible set of prints and CAD disk, the Contractor shall provide the actual JOB SET (“marked-up prints”) referenced above to the District at the completion of construction, which will remain the District’s property.

PART 3 – EXECUTION

3.01 MAINTENANCE OF JOB SET

- A. Preservation:
 - 1. Considering the Contract completion time, the probable number of occasions upon which the job set must be taken out for new entries and for examination, and the conditions under which these activities will be performed devise a suitable method for protecting the “RECORD DOCUMENTS-JOB SET” to the approval of the Architect.
 - 2. Do not use the Job Set for any purpose except entry of new data and for review by the Architect, until start of transfer of data to Final Record Documents.
 - 3. Maintain the Job Set at the site of work where designated by the Architect.
- B. Making entries on drawings: Using an erasable colored pencil (not ink or indelible pencil) clearly describe the change by note and by graphic line, as required. Date all entries. Call attention to the entry by a “cloud” around the area or areas affected. In the event of overlapping changes, different colors may be used for each of the changes.
- C. Making entries on other documents:
 - 1. Where changes are caused by directives issued by the Architect, clearly indicate the change by note in ink, colored pencil, or rubber stamp.
 - 2. Where changes are caused by Contractor-originated proposals approved by the Architect, including inadvertent errors by the Contractor that have been accepted by the Architect, clearly indicate the change by note in erasable colored pencil.
 - 3. Make entries in the pertinent documents as approved by the Architect.
- D. Conversion of schematic layouts:
 - 1. In most cases on the Drawings, arrangement of conduits and circuits, piping, ducts, and other similar items is shown schematically and is not intended to portray precise physical layout. Final physical arrangement is as determined by the Contractor subject to the Architect’s approval. However, design of future modifications of the facility may require accurate information as to the final physical arrangement of items that are shown only schematically on the Drawings.
 - 2. Show on the job set of Record Drawings, by dimension accurate to within 1”, the centerline of each run of items such as are described in Paragraph 3.1 D.1 above. Clearly identify the item by accurate note such as “CAST-IRON DRAIN,” “GALV.

WATER” etc. Show by symbol or note the vertical location of the item (“under slab,” “in ceiling plenum” “exposed,” etc.). Make all identification sufficiently descriptive that it may be related reliably to the Specifications.

3. The Architect may waive the requirements for conversion of schematic data where, in the Architect’s judgment, such conversion serves no beneficial purpose. However, do not rely upon waivers being issued except as specifically issued in writing by the Architect.
 4. Timing of entries: Be alert to changes in the work from how it is shown in the Contract Documents. Promptly, and in no case later than 24 hours after the change has occurred and been made known to the Contractor, make the entry or entries required.
- E. Accuracy of entries: Use all means necessary, including the proper tools for measurement, to determine actual locations of the installed items.

3.02 FINAL RECORD DOCUMENTS

- A. General: The purpose of the Final Record Documents is to provide factual information regarding all aspects of the work, both concealed and visible, to enable future modification of design to proceed without lengthy and expensive site measurement, investigation, and examination.
- B. Approval of recorded data prior to transfer: Using the CAD disk and sepia vellums described in Section 01030, and prior to start of transfer of recorded data thereto, secure a review by the Architect and Project Manager of all recorded data. Make all required revisions.
- C. Transfer of data to drawings: Carefully transfer all change data shown on the job set of Record Drawings to the CAD disk and corresponding sepias, coordinating the changes as required, and clearly indicating at each affected detail and other drawing the full description of all changes made during construction and the actual location of items described in Paragraph 3.1 E. above. Call attention to each entry by drawing a “cloud” around the area or areas affected. Make all change entries on the sepias neatly, consistently, and in ink or crisp black pencil.
- D. Transfer of data to other Documents: If the documents other than Drawings have been kept clean successfully during progress of the work, and if entries have been sufficiently orderly thereon to the approval of the Architect, the job set of those Documents (other than Drawings) will be accepted by the Architect as Final Record Documents for those documents. If any such document is not so approved by the Architect, secure a new copy of that document from the Architect at the Architect’s usual charge for reproduction; carefully transfer the change data to the new copy and to the approval of the Architect.
- E. Review and approval: Submit the completed total set of Record Documents to the Architect as described in Paragraphs 1.3 C. and 2.1 A , above. Participate in review meeting or meetings as required by the Architect, make all required changes in the Record Documents, sign and date Record Documents, and promptly deliver the Final Record Documents to the Architect.

3.03 CHANGES SUBSEQUENT TO ACCEPTANCE

- A. The Contractor shall have no responsibility for recording changes in the work subsequent to acceptance of the work by the District, except for changes resulting from replacements, repairs, and alterations made by the Contractor as part of his guarantee.

END OF SECTION

**SECTION 01 77 40
WARRANTIES**

PART 1 – GENERAL

1.01 SUBMITTAL REQUIREMENTS

- A. Assemble Warranties and Service and Maintenance Contracts, executed by each of the respective Manufacturers, Suppliers, and Subcontractors.
- B. Number of original signed copies required: Four (4) each.
- C. Table of Contents: Neatly typed in orderly sequence.
- D. Provide complete information for each one of the following items:
 - 1. Product or Work Item.
 - 2. Firm with name of principal, address, and telephone number.
 - 3. Beginning date of Warranty or Service and Maintenance Contract.
 - 4. Duration of Warranty or Service and Maintenance Contract.
 - 5. Provide the following information for the District's Personnel:
 - a. Procedures in case of failure of malfunction.
 - b. Instances which affect Warranty.
 - 6. Contractor, name of responsible principal, address, and telephone number.

1.02 SUBMITTAL FORM

- A. The list identifies the submittal form requirements for WARRANTIES:
 - 1. Punch sheets for standard 3-ring binder.
 - 2. Size: 8-1/2 x 11 inches.
 - 3. Fold larger sheets to fit into binder.
 - 4. Cover: Identify each packet with typed or printed title "WARRANTIES". List:
 - a. Title of Project.
 - b. Name of Contractor.

END OF SECTION

**SECTION 01 78 23
OPERATION AND MAINTENANCE MANUALS**

PART 1 – GENERAL

1.01 SUMMARY

- A. Section Includes:
 - 1. Compilation of product data and related information appropriate for the District's maintenance and operation of products and equipment furnished under the Contract.
 - 2. Instruction of the District's personnel in the maintenance of products and in the operation of equipment and systems.
- B. Contractor shall comply with the requirements of this Specification Section, except where individual Specification Sections requirements are more stringent.

1.02 SUBMITTAL PROCEDURES

- A. Preliminary: Submit one copy of proposed manuals to the Project Manager at least fifteen (15) days prior to final inspection or acceptance.
- B. Final: Following the indoctrination and instruction of the District's operating and maintenance personnel, review proposed revisions to the manual with the Project Manager.
 - 1. Submit three copies of accepted data in final form 10 days after final inspection. Approval of submittal is a pre-requisite at Substantial Completion prior to the District's agendizing project for acceptance by the Governing Board.

PART 2 – PRODUCTS

2.01 FORMAT

- A. Size: minimum 4 inch three-ring binders for 8-1/2 inch by 11 inch punched pages, completely clear plastic covered for insertion of labels on spines and covers.
- B. Provide identifying tabbed pages. Classify by Division and by Section. All tabbing shall be in numerical order.
- C. Drawings:
 - 1. Provide reinforced punched binder tab. Bind drawings with text.
 - 2. Fan fold larger drawings to size of text pages, for easy foldout.
- D. Cover: Identify each volume with typed or printed label, List:
 - 1. Title of Project
 - 2. Identify of separate structures as applicable.
 - 3. Identify of general subject matter covered in the manual.

- E. Spine: Identify each volume with typed or printed label stating OPERATING AND MAINTENANCE INSTRUCTIONS, GUARANTEES AND SERVICE CONTRACTS and the following information:
 - 1. Title of Project.
 - 2. Divisions and Sections included within volume.
 - 3. Volume number (i.e. "1 of 4)

PART 3 – EXECUTION

3.01 CONTENT OF MANUAL

- A. Table of Contents:
 - 1. List of each product indexed to the content of the volume.
 - 2. List with each product the name, address, and the telephone number of:
 - a. Subcontractor and installer.
 - b. Maintenance contractor, as appropriate.
 - c. Local sources of supply for parts and replacement.
- B. Product Data: Annotate each sheet to clearly identify the data applicable to the installation. Delete references to inapplicable information
- C. Drawings:
 - 1. Supplement product data with Drawings as necessary to illustrate the following:
 - a. Relationship of component parts of equipment and systems.
 - b. Control and flow diagrams.
 - 2. Do not include Project Record Drawings as maintenance drawings.
- D. Instructions: Provide written text, as required to supplement product data for the particular installation.
- E. Warranties, Guaranties, Bonds, and Service Contracts: Include a copy of each warranty, guarantee, bond and service contract issued.
 - 1. Provide information sheet for the District's personnel describing the following:
 - a. Propose procedures in the event of failure or emergencies.
 - b. Circumstances under which the validity of warranties, guaranties, or bonds might be compromised.

3.02 MANUAL FOR MATERIALS AND FINISHES

- A. Instructions for Care and Maintenance: Include manufacturer's data as follows:

1. Recommendations for types of cleaning agents and methods.
2. Cautions against cleaning agents and methods which are detrimental to the product.
3. Recommended schedule for cleaning and maintenance.

3.03 MANUAL FOR EQUIPMENT AND SYSTEMS

A. Content, for each unit of mechanical equipment and system, as appropriate:

1. Description of Unit and Component Parts:
 - a. Function, normal operating characteristics, and limiting conditions.
 - b. Performance curves, engineering data, and tests.
 - c. Complete nomenclature and commercial number of replacement parts.
2. Operating Procedures:
 - a. Start-up, break-in, routine, and normal operating instructions.
 - b. Regulation, control, stopping, shut-down, and emergency instructions.
 - c. Summer and winter operation instructions.
3. Maintenance Procedures:
 - a. Routine operations.
 - b. Guide to "trouble-shooting."
 - c. Disassembly, repair, and reassemble.
 - d. Alignment, adjusting, and checking.
4. Servicing and lubrication schedule including list of lubricants required.
5. Manufacturer's printed operating and maintenance Instructions.
6. Description of sequence of operation by control manufacturer.
7. Original manufacturer's parts list, illustrations, assembly drawings, and diagrams required for maintenance, including:
 - a. Predicted life of parts subject to wear.
 - b. Items recommended to be stocked as spare parts.
8. Control diagrams by manufacturer of controls as installed in project.
9. Coordination Drawings and color coded piping diagrams.

10. Charts of valve tag numbers, with the location and function of each valve.
- B. Content, for each electric and electronic system as appropriate:
1. Description of System and Component Parts:
 - a. Function, normal operating characteristics, and limiting conditions.
 - b. Performance curves, engineering data, and tests.
 - c. Complete nomenclature and commercial number of replaceable parts.
 2. Circuit directories of panelboards:
 - a. Electrical service.
 - b. Controls.
 - c. Communication.
 3. As-installed color coded wiring diagrams.
 4. Operating Procedures:
 - a. Routine and normal operating instructions.
 - b. Sequences required.
 - c. Special operating instructions.
 5. Maintenance Procedures:
 - a. Routine operations.
 - b. Guide to "trouble-shooting."
 - c. Disassembly, repair and re-assembly.
 - d. Adjustment and checking.
 6. Manufacturer's printed Operating and Maintenance Instructions.
 7. List of original manufacturer's spare parts, manufacturer's current prices, and recommended quantities to be maintained in storage.

3.04 INSTRUCTION OF THE DISTRICT'S PERSONNEL

- A. Prior to final inspection or acceptance, fully instruct the District's designated operating and maintenance personnel in the operation, adjustment and maintenance of all products, equipment, and systems installed in project.
1. Provide services of factory trained instructors from the manufacturer of each major item of equipment or system.
- B. Operating and maintenance manual shall constitute the basis of instruction.

1. Review contents of manual with personnel in full detail to explain all aspects of operation and maintenance.
2. Review instruction on how to efficiently use state required energy conservation features, materials, components, and mechanical device.

END OF SECTION

**SECTION 02 41 19
DEMOLITION**

PART 1 - GENERAL

1.01 SUMMARY

- A. Provisions of the General and Supplementary Conditions and Division One apply to this section.
- B. Section Includes: Furnishing all labor, materials and equipment necessary for demolition, dismantling, cutting and alterations as indicated, specified, and required for completion of the Contract, as applicable. Includes items such as the following:
 - 1. Protecting existing work to remain.
 - 2. Cleaning soiled materials that are to remain.
 - 3. Disconnecting and capping utilities.
 - 4. Removing debris and equipment.
 - 5. Removal of items indicated on Drawings.
 - 6. Salvageable items to be retained by the Owner as indicated on the Drawings and during the pre-construction job walk.
- C. Related Sections:
 - 1. Section 01 50 00: Temporary Facilities and Controls.
 - 2. Section 31 10 00: Site Clearing.

1.02 QUALITY ASSURANCE

- A. Comply with the following:
 - 1. Applicable codes, ordinances, regulations of local, municipal, state and federal authorities having jurisdiction.
 - 2. Obtain necessary permits and notices, post where required.
 - 3. Comply with safety requirements of the local fire department.
 - 4. Comply with ANSI A10.6.
 - 5. Comply with Standard Specification for Public Works Const.
- B. Demolition Firm Qualifications: Engage an experienced, licensed firm having a minimum of (5) years full time satisfactory experience in demolition work of similar scope and complexity to that indicated for this Project.
- C. Notify affected utility companies before starting Work and comply with their requirements.
- D. Carefully perform demolition work, by skilled workers experienced in building demolition procedures, using appropriate tools and equipment. Perform work, at all times, under the direct supervision of a supervisor approved by the Owner Inspector.
- E. Coordinate demolition with other trades to ensure correct sequence, limits, and methods of proposed demolition. Schedule work to create the least possible inconvenience to the public and to facility operations.
- F. Pre-Demolition: Conduct conference at Project site 7 days prior to scheduled installation.

1. Conference agenda shall include review and discussion of requirements of authorities having jurisdiction, instructions and requirements of serving utilities, sequencing and interface considerations and Project conditions.
2. Conference shall be attended by supervisory and quality control personnel of Contractor and all subcontractors performing this and directly related work. Submit minutes of meeting to Owner's Representative for Project record purposes.

1.03 DEFINITIONS

- A. Remove: Remove and legally dispose of items except those indicated to be reinstalled, salvaged, or to remain the Owner's property.
- B. Remove and Salvage: Items indicated to be removed and salvaged remain the Owner's property. Remove, clean, and pack or crate items to protect against damage. Identify contents of containers and deliver to location as directed by Owner's Representative.
- C. Remove and Reinstall: Remove items indicated; clean, service, and otherwise prepare them for reuse; store and protect against damage. Reinstall items in locations indicated.
- D. Existing to Remain: Protect construction indicated to remain against damage and soiling during demolition. When permitted by the Owner's Representative, items may be removed to a suitable, protected storage location during demolition and then cleaned and reinstalled in their original locations.

1.04 OWNERSHIP OF MATERIALS

- A. Ownership of Materials: Except for items or materials indicated to be reused, salvaged, or otherwise indicated to remain the Owner's property, demolished materials shall become the Contractor's property and shall be removed from the site with further disposition at the Contractor's option.

1.05 PROJECT CONDITIONS

- A. Drawings may not indicate in detail all demolition work to be carried out. Carefully examine existing conditions to determine full extent of demolition required. All utilities, whether shown on the drawings or not, to be capped at the property line U.N.O.
- B. Repair damage due to demolition activities to existing improvements to remain at no additional cost to the Owner. Repair or replace as directed by the Owner Inspector.
- C. Take measures to avoid excessive damage from inadequate or improper means and methods, or improper shoring, bracing or support. Repair or replace any resulting damage at no additional cost to the owner as directed by the Owner Inspector.
- D. If conditions are encountered that vary from those indicated, notify the Owner Inspector for instructions prior to proceeding. Owner assumes no responsibility for actual condition of structures to be demolished.
- E. Inform Owner immediately upon discovery of asbestos products, radioactive materials, toxic wastes or other hazardous materials. Do not remove hazardous materials without Owner authorization.
- F. Adjacent roadways/passageways:
 1. Maintain fire department access through all phases of the project.
 2. Obstruction of streets, walks or other adjacent facilities will not be allowed.

1.06 DIG ALERT NOTIFICATION

- A. Before any excavation in or near the public right-of-way, the Contractor must contact the Underground Service Alert of Southern California (Dig Alert) at 811 for information on buried utilities and pipelines.
- B. Delineation of the proposed excavation site is mandatory. Mark the area to be excavated with water soluble or chalk based white paint on paved surfaces or with other suitable markings such as flags or stakes on unpaved areas.
- C. Call at least Two (2) full working days prior to digging.
- D. If the members (utility companies) have facilities within the work area, they will mark them prior to the start of your excavation and if not, they will let you know there is no conflict. A different color is used for each utility type (electricity is marked in red, gas in yellow, water in blue, sewer in green, telephone and cable TV in orange).
- E. The Law requires you to hand expose to the point of no conflict 24" (inches) on either side of the underground facility, so you know its exact location before using power equipment.
- F. If caught digging without a Dig Alert ticket you can be fined as much as \$50,000 per California government code 4216.

PART 2 - PRODUCTS

2.01 SOIL MATERIALS

- A. Satisfactory Soil Materials: Soils approved by the testing geotechnical engineer and free of rock or gravel larger than 4 inches in any dimension, debris, waste, vegetation and other deleterious matter and as approved by the Geotechnical Engineer. Rocks or hard lumps larger than approximately 4 inches in diameter should be broken into smaller pieces or should be removed from the site. It is anticipated that most of the on-site soils may be reusable as engineered fill after any vegetation, construction debris, oversized material and deleterious material is removed from the site.
- B. Backfill & Native Fill Materials: The on-site soils may be reused as compacted engineered fill provided they comply to the requirements of "Satisfactory Soil Materials", as described above.
- C. Borrow / Imported Fill Material: Soil excavated from site or imported conforming to requirements for fill material.
- D. Materials for the fill shall be free from vegetable matter and other deleterious substances, shall not contain rocks or lumps of a greater dimension than is recommended by the geotechnical consultant, and shall be approved by the geotechnical consultant.
- E. Imported materials should have a Plasticity Index (PI) not less than 5 nor greater than 15, as determined by ASTM D 4318; and expansion index not exceeding 10, as determined by ASTM D 4829; and a particle size not exceeding 3 inches as determined by ASTM D 422.
- F. Engineered Fill: Satisfactory Soil Materials / Borrow Fill Material, as described above, placed in lifts no greater than 8 inches thick (loose measurements), and compacted to a minimum of 90% of the soil's maximum dry unit weight.
- G. Backfill Material for Trenches:
 - 1. The on-site soils may be used for backfilling utility trenches from one foot above the top of pipe to the surface, provided the material is free of organic matter and deleterious substances. Any soft and/or loose materials or fill encountered at pipe invert should be removed and replaced with properly compacted fill or adequate

bedding material. Also, rocks larger than 6 inches and boulders should not be used as backfill.

2.02 HANDLING OF MATERIALS

- A. Items scheduled for salvage by the Owner shall be delivered to a location designated by the Owner's Authorized Representative. Items shall be cleaned, packaged and labeled for storage.
- B. Items scheduled for reuse shall be stored on site and protected from damage, soiling and theft.

PART 3 - EXECUTION

3.01 GENERAL

- A. Protection: Do not begin demolition until safety partitions, barricades, warning signs and other forms of protection are installed. Provide safeguards, including warning signs, lights and barricades, for protection of occupants and the general public during demolition. Provide and maintain fire extinguishers. Comply with requirements of governing authorities. Maintain existing utilities which are to remain in service and protect from damage during operations.
- B. Safety: If at any time safety of existing construction appears to be endangered, take immediate measures to correct such conditions; cease operations and immediately notify the Owner Inspector. Do not resume demolition until directed by the Owner Inspector.
- C. Noise and Dust Abatement: Exercise all reasonable and necessary means to abate dust, dirt rising and undue noise. Perform necessary sprinkling and wetting of construction site to allay dust as required by applicable codes and ordinances
- D. Dust Control: Use water mist, temporary enclosures, and other suitable methods to limit the spread of dust and dirt. Comply with governing environmental protection regulations. Do not create hazardous or objectionable conditions, such as flooding and pollution, when using water.
- E. Water for Dust Control: Contractor shall obtain and pay for all water required for his dust control operations. This may include, but is not limited to, payment of deposits to utility for construction meter, and payment of all monthly service and water charges. Construction meter shall be in place throughout construction period unless alternative arrangements are made with the Water Department to provide construction water for all purposes. Contractor shall be aware of water moratoriums and restrictions, and shall immediately advise Owner of effects on construction schedules.
- F. An 8 foot high, chain link fence, with visual screen and gates, shall be erected prior to any demolition operations at the construction limits perimeter. Coordinate the exact location with Owner. Comply with specification section 32 31 13: Chain Link Fence.
- G. Debris Removal: Remove and transport debris in a manner that will prevent spillage on adjacent surfaces and areas. Remove debris from elevated portions of building by chute, hoist, or other device that will convey debris to grade level.
- H. Progress Cleaning: Clean adjacent buildings and improvements of dust, dirt, and debris caused by demolition operations. Return adjacent areas to condition existing before start of demolition.

3.02 PREPARATION

- A. Prevent movement or settlement of adjacent structures. Provide bracing and shoring as necessary.

- B. Utilities:
1. The Drawings do not purport to show all below-grade conditions and objects on the site. Contractor shall perform field investigations as necessary to establish location of underground utility services and other features affecting earthwork.
 2. Mark location of underground utilities on asphalt pavement with paint.
 3. Disconnect and cap utility services; comply with requirement of governing authorities.
 4. Contractor shall arrange and notify utility company in advance of date and time when service needs to be disconnected. Do not commence demolition operations until associated disconnections have been completed. Should utilities and other below-grade conditions be encountered which adversely affect the Work, discontinue affected Work and notify Owner's Representative and Architect and request direction. Unforeseen conditions will be resolved in accordance with provisions of the General Conditions of the Contract. Should a utility line or structure be damaged, immediately notify the responsible utility company or agency and notify Owner's Representative and Architect. Repair or replace all damaged utility lines and structures as directed by the responsible utility company or agency. Repair or replacement of damaged utility lines and structures whole location or existence has been made known to the Contractor shall be at no change in the Contract Time and Contract Price.
- C. Structures to be demolished shall be inspected for hazardous materials. Such materials shall be removed and disposed of before general demolition begins.
- D. Do not interrupt existing utilities serving occupied or operating facilities, except when authorized in writing by Owner's Representative and Authority Having Jurisdiction (AHJ). Provide temporary services during interruptions to existing utilities, as acceptable to Owner's Representative and to Authority Having Jurisdiction (AHJ).

3.03 EXPLOSIVES

- A. Explosives: Use of explosives will not be permitted.

3.04 DEMOLITION

- A. Demolition, General:
1. With certain exceptions, the Contractor shall raze, remove and dispose of all structures, paving, fences and other obstructions that lie wholly or partially within the construction limits identified on Drawings. The exceptions are utility-owned equipment and any other items the Owner/Documents may direct the Contractor to leave intact or re-use onsite. Cease demolition immediately if adjacent structures appear to be in danger.
 2. Conduct demolition operations and remove debris to ensure minimum interference with roads, streets, walks, and other adjacent occupied and used facilities.
 3. Do not close or obstruct streets, walks, or other adjacent occupied or used facilities without permission from Owner's Representative and Authority Having Jurisdiction (AHJ). Provide alternate routes around closed or obstructed traffic ways if required by governing regulations.
 4. Conduct demolition operations to prevent injury to people and damage to adjacent buildings and facilities to remain. Ensure safe passage of people around demolition area.
 - a. Erect temporary protection, such as walks, fences, railings, canopies, and covered passageways, where required by authorities having jurisdiction.

- b. Protect existing site improvements, appurtenances, and landscaping to remain.
 - c. Erect a plainly visible fence around drip line of individual trees or around perimeter drip line of groups of trees to remain.
5. Structural Stability: Provide and maintain interior and exterior shoring, bracing, or structural support to preserve stability and prevent movement, settlement, or collapse of buildings to be demolished and adjacent buildings to remain. Strengthen or add new supports when required during progress of demolition.
 6. Below-Grade Construction: Demolish foundation walls and other below-grade construction, as follows:
 - a. Remove below-grade construction, including foundation walls and footings, to at least 18-inches below grade, but at least to bottom of footing or foundation wall.
 - b. Completely remove below-grade construction, including foundation walls and footings.
 7. Filling Below-Grade Areas: Completely fill below-grade areas and voids resulting from demolition of buildings and pavements with soil materials according to requirements specified in Section 31 20 00 - Earthwork.
 8. Damages: Promptly repair damages to adjacent facilities caused by demolition operations.
 9. Unless otherwise indicated on the plans, remove all demolished material from the site and dispose of at approved disposal sites. Comply with all requirements for recycling of demolished material as called for in Division 1 of this Specification. The contractor shall obtain necessary permits for the transportation of material from the site.

3.05 REMOVAL OF EXISTING PLUMBING AND ELECTRICAL EQUIPMENT AND SERVICES

- A. Remove existing plumbing and electrical equipment fixtures and services not indicated for reuse and not necessary for completion of work. Remove abandoned lines and cap unused portions of existing lines. The Contractor is responsible for completely surveying the site and locating all existing utilities, above and below ground, before contracting to perform the work.
- B. Asbestos – Cement (A-C) Pipe Removal and Disposal: The plans for the project may indicate that existing asbestos-cement pipe is to be removed from the ground. Where so indicated the Contractor shall excavate with care, expose the pipeline and remove the A-C pipe to the nearest joint. Should the plans not call out the removal of the A-C pipe and A-C pipe is encountered, the Contractor shall obtain approval from the Owner as to whether or not the A-C pipe is to be removed or can be left in place. Cutting of the pipe shall only be done if absolutely there is no other way to expose the length of pipe to the nearest joint that be separated and the Owner approves the cutting of the pipe. Cutting of the pipe shall be done with a mechanical saw with a pressure water source to dampen the pipe and the dust from the cutting. To remove a coupling, the coupling may have to be broken in the trench. The pipe once removed from the trench may be broken for handling. The breaking shall be done within a plastic bagging or sheeting material to minimize the release of asbestos fibers into the atmosphere. Once removed and broken, if necessary, the A-C material shall be bagged and disposed of legally with the Owner to be given a copy of all Contractor paperwork as to the legal disposal of the material. If the A-C pipe section(s) are removed intact the pipe can be removed by the Contractor from the project site and become the property and responsibility of the Contractor.

3.06 CLEANING

- A. Clean existing materials to remain, using appropriate tools and materials.

- B. Protect adjacent materials and equipment during cleaning operations.

3.07 PATCHING AND RESTORATION

- A. Patching: Where removals leave holes and damaged surfaces that will be exposed in the completed construction, such holes and damaged surfaces shall be patched and restored to match adjacent finished surfaces.
 - 1. Where new finish construction is applied over existing holes and damaged surfaces, patching and restoration shall be performed to the extent to make the substrate suitable for the provision of new finish construction.
 - 2. Surfaces of patched and restored areas shall be flush with the adjacent existing surfaces and shall closely match existing adjacent surfaces in texture and finish.
- B. Restoration of Site Finishes:
 - 1. Concrete paving: Where it is necessary to excavate a trench across make a cut in concrete paved areas, cut concrete cutting saw, full depth of paving.
 - 2. Bituminous paving: Where it is necessary to excavate a trench across make a cut in bituminous paved areas, either first score paving with a concrete cutting saw, in neat straight lines, prior to removing paving or make straight cuts with pneumatic spade.
 - 3. Restoration of paving: Restore all paved areas to their original condition using material of like type and quality as the removed paving. Paving in public ways shall conform to applicable requirements of authorities having jurisdiction. Repaired surfaces shall match existing adjacent paving except minimum depth shall be 3-1/2 inches where existing paving is less than 3-1/2 inches.
 - 4. Restoration of landscape planting: Restore soil and plant materials to match original condition, including additional topsoil, topsoil grading and preparation, new plant materials and plant maintenance during establishment period.

3.08 MAINTENANCE

- A. Install and maintain all erosion control devices, including sandbag and gravel bag dikes, silt fences, de-silting basins, inlet barricades, vehicle wash traps, and other features as required per Specification Section 01060.

3.09 CLEAN-UP/DISPOSAL

- A. Coordinate building access with the Owner Inspector. Review and schedule waste storage and removal, include truck access to site.
- B. Debris shall be dampened by fog water spray prior to transporting by truck.
- C. Debris pick-up area shall be kept broom-clean and shall be washed daily with clean water.
- D. Remove waste and debris, other than items to be salvaged. Turn over salvaged items to Owner, or store and protect for reuse where scheduled. Continuously clean-up and remove items as demolition work progresses. Do not allow waste and debris to accumulate in building or on site.

END OF SECTION

**SECTION 05 50 00
METAL FABRICATIONS**

PART 1 - GENERAL

1.01. SUMMARY

A. Section Includes:

1. Miscellaneous steel framing and supports.

B. Products furnished, but not installed, under this Section:

1. Anchor bolts, steel pipe sleeves, slotted-channel inserts, and wedge-type inserts indicated to be cast into concrete or built into unit masonry.
2. Steel weld plates and angles for casting into concrete.

1.02. PERFORMANCE REQUIREMENTS

C. Delegated Design: Design ladders, including comprehensive engineering analysis by a qualified professional engineer, using performance requirements and design criteria indicated.

D. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes acting on exterior metal fabrications by preventing buckling, opening of joints, overstressing of components, failure of connections, and other detrimental effects.

1. Temperature Change: 120 deg F (67 deg C), ambient; 180 deg F (100 deg C), material surfaces.

1.03. SUBMITTALS

E. Product Data: For the following:

1. Paint products.
2. Grout.

F. Shop Drawings: Show fabrication and installation details for metal fabrications.

1. Include plans, elevations, sections, and details of metal fabrications and their connections. Show anchorage and accessory items.

PART 2 - PRODUCTS

2.01. METALS, GENERAL

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

2.02. FERROUS METALS

- B. Recycled Content of Steel Products: Provide products with average recycled content of steel products so postconsumer recycled content plus one-half of preconsumer recycled content is not less than **25** percent.
- C. Steel Plates, Shapes, and Bars: ASTM A 36/A 36M.
- D. Steel Tubing: ASTM A 500, cold-formed steel tubing.
- E. Steel Pipe: ASTM A 53/A 53M, standard weight (Schedule 40) unless otherwise indicated.
- F. Slotted Channel Framing: Cold-formed metal box channels (struts) complying with MFMA-4.
 - 1. Size of Channels: 1-5/8 by 1-5/8 inches (41 by 41 mm).
 - 2. Material: Galvanized steel, ASTM A 653/A 653M, structural steel, Grade 33 (Grade 230)], with G90 (Z275) coating; 0.079-inch (2-m nominal thickness).
 - 3. Material: Cold-rolled steel, ASTM A 1008/A 1008M, structural steel, Grade 33 (Grade 230); 0.0677-inch (1.7-mm) minimum thickness; hot-dip galvanized after fabrication.
- G. Cast Iron: Either gray iron, ASTM A 48/A 48M, or malleable iron, ASTM A 47/A 47M.

2.03. NONFERROUS METALS

- H. Aluminum Extrusions: ASTM B 221 (ASTM B 221M), Alloy 6063-T6.
- I. Aluminum-Alloy Rolled Tread Plate: ASTM B 632/B 632M, Alloy 6061-T6.
- J. Aluminum Castings: ASTM B 26/B 26M, Alloy 443.0-F.
- K. Bronze Extrusions: ASTM B 455, Alloy UNS No. C38500 (extruded architectural bronze).
- L. Bronze Castings: ASTM B 584, Alloy UNS No. C83600 (leaded red brass) or No. C84400 (leaded semired brass).
- M. Nickel Silver Castings: ASTM B 584, Alloy UNS No. C97600 (20 percent leaded nickel bronze).

2.04. FASTENERS

- N. General: Unless otherwise indicated, provide Type 304 stainless-steel fasteners for exterior use and zinc-plated fasteners with coating complying with ASTM B 633 or ASTM F 1941 (ASTM F 1941M), Class Fe/Zn 5, at exterior walls.
- O. Cast-in-Place Anchors in Concrete: Either threaded type or wedge type unless otherwise indicated; galvanized ferrous castings, either ASTM A 47/A 47M malleable iron or ASTM A 27/A 27M cast steel. Provide bolts, washers, and shims as needed, all hot-dip galvanized per ASTM F 2329.
- P. Post-Installed Anchors: Torque-controlled expansion anchors.

1. Material for Interior Locations: Carbon-steel components zinc plated to comply with ASTM B 633 or ASTM F 1941 (ASTM F 1941M), Class Fe/Zn 5, unless otherwise indicated.
2. Material for Exterior Locations and Where Stainless Steel is Indicated: Alloy Group 1 (A1) stainless-steel bolts, ASTM F 593 (ASTM F 738M), and nuts, ASTM F 594 (ASTM F 836M).

Q. Slotted-Channel Inserts: Cold-formed, hot-dip galvanized-steel box channels (struts) complying with MFMA-4, 1-5/8 by 7/8 inches (41 by 22 mm) by length indicated with anchor straps or studs not less than 3 inches (75 mm) long at not more than 8 inches (200 mm) o.c. Provide with temporary filler and tee-head bolts, complete with washers and nuts, all zinc-plated to comply with ASTM B 633, Class Fe/Zn 5, as needed for fastening to inserts.

2.05. MISCELLANEOUS MATERIALS

- R. Shop Primers: Provide primers that comply with Division 9 painting Sections.
- S. Galvanizing Repair Paint: High-zinc-dust-content paint complying with SSPC-Paint 20 and compatible with paints specified to be used over it.
- T. Bituminous Paint: Cold-applied asphalt emulsion complying with ASTM D 1187.
- U. Nonshrink, Nonmetallic Grout: Factory-packaged, nonstaining, noncorrosive, nongaseous grout complying with ASTM C 1107. Provide grout specifically recommended by manufacturer for interior and exterior applications.

2.06. FABRICATION, GENERAL

- V. Shop Assembly: Preassemble items in the shop to greatest extent possible. Use connections that maintain structural value of joined pieces.
- W. Cut, drill, and punch metals cleanly and accurately. Remove burrs and ease edges. Remove sharp or rough areas on exposed surfaces.
- X. Weld corners and seams continuously to comply with the following:
1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
 2. Obtain fusion without undercut or overlap.
 3. Remove welding flux immediately.
 4. At exposed connections, finish exposed welds and surfaces smooth and blended.
- Y. Form exposed connections with hairline joints, flush and smooth, using concealed fasteners or welds where possible. Locate joints where least conspicuous.
- Z. Fabricate seams and other connections that will be exposed to weather in a manner to exclude water. Provide weep holes where water may accumulate.
- AA. Where units are indicated to be cast into concrete or built into masonry, equip with integrally welded steel strap anchors not less than 24 inches o.c.

2.07. MISCELLANEOUS FRAMING AND SUPPORTS

- BB. General: Provide steel framing and supports not specified in other Sections as needed to complete the Work.
- CC. Fabricate units from steel shapes, plates, and bars of welded construction unless otherwise indicated. Fabricate to sizes, shapes, and profiles indicated and as necessary to receive adjacent construction.

2.08. MISCELLANEOUS STEEL TRIM

- DD. Unless otherwise indicated, fabricate units from steel shapes, plates, and bars of profiles shown with continuously welded joints and smooth exposed edges. Miter corners and use concealed field splices where possible.
- EE. Provide cutouts, fittings, and anchorages as needed to coordinate assembly and installation with other work.
- FF. Galvanize **exterior** miscellaneous steel trim.

2.09. FINISHES, GENERAL

- GG. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.
- HH. Finish metal fabrications after assembly.

2.10. STEEL AND IRON FINISHES

- II. Galvanizing: Hot-dip galvanize items as indicated to comply with ASTM A 153/A 153M for steel and iron hardware and with ASTM A 123/A 123M for other steel and iron products.
- JJ. Shop prime iron and steel items not indicated to be galvanized unless they are to be embedded in concrete, sprayed-on fireproofing, or masonry, or unless otherwise indicated.
 - 1. Shop prime with primers specified in Division 9 painting Sections
- KK. Preparation for Shop Priming: Prepare surfaces to comply with requirements indicated below:
 - 1. Exterior Items: SSPC-SP 6/NACE No. 3, "Commercial Blast Cleaning."
 - 2. Items Indicated to Receive Zinc-Rich Primer: SSPC-SP 6/NACE No. 3, "Commercial Blast Cleaning."
 - 3. Items Indicated to Receive Primers Specified in Division 9 Section "High-Performance Coatings": SSPC-SP 6/NACE No. 3, "Commercial Blast Cleaning."
 - 4. Other Items: SSPC-SP 3, "Power Tool Cleaning."
- LL. Shop Priming: Apply shop primer to comply with SSPC-PA 1, "Paint Application Specification No. 1: Shop, Field, and Maintenance Painting of Steel," for shop painting.

PART 3 - EXECUTION

3.01. INSTALLATION, GENERAL

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

3.02. ADJUSTING AND CLEANING

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

END OF SECTION

**SECTION 06 10 00
ROUGH CARPENTRY**

PART 1 – GENERAL

1.01 SECTION INCLUDES

- A. Supply and install Rough Carpentry work as indicated.

1.02 RELATED SECTIONS

- A. Section 01 43 00: Quality Control.
- B. Section 01 45 29: Testing and Laboratory Services.
- C. Section 03 30 00: Cast-In-Place Concrete.
- D. Section 06 20 00: Finish Carpentry.
- E. Section 09 29 00: Gypsum Board.

1.03 SUBMITTALS

- A. Submittals: Submit in accordance with Section 01 33 00.

1.04 QUALITY ASSURANCE

- A. All work shall be performed in accordance with the local codes and the most current DSA requirements. Where there is a question between the specifications, Architect/Contractor shall conform to the most constrictive requirement.
- B. Douglas fir, larch or hemlock structural and framing lumber shall be graded in accordance with the "Standard Grading Rules" of the West Coast Lumber Inspection Bureau (WCLIB) or the "Western Lumber Grading Rules" of the Western Wood Products Association (WWPA) latest editions.
- C. Redwood structural and framing lumber shall be graded in accordance with "Standard Specifications for Grades of California Redwood Lumber" of the Redwood Inspection Service, latest edition.
- D. Each piece of lumber shall bear official grade mark of the association under whose rules it was graded, or official grade mark of another recognized grading agency using grading rules herein specified.
- E. All 2x structural and framing members shall be air-dried to a moisture content not to exceed 19% before use.
- F. Work of this Section shall comply with provisions of current edition of UBC and Title 24, see Section 01 45 29: Testing and Inspection.
- G. Plywood shall conform to requirements of "Product Standard PS 1 issued by the U.S. Department of Commerce, and shall be grade marked by a recognized grading agency (APA and PTL).

- H. Each piece of preservative treated lumber shall be identified by the Quality Mark of an approved inspection agency in accordance with Title 24, see Section 01 45 29: Testing and Inspection.

PART 2 – PRODUCTS

2.01 MATERIALS

- A. Lumber: Structural and framing lumber shall be of the following species and grades unless noted otherwise on the drawings:

USE	SPECIES	GRADE	
1.	Subfloor, wall sheathing, roof sheathing and ceiling stripping.	Douglas Fir	"Construction" Board, Structural #1 only WCLIB; WWPA
2.	Beams, girders and truss members (5" and thicker, rectangular, width more than 2" greater than thickness) where exposed as finish members.	Douglas Fir WWPA	Select Structural
3.	Joists, rafters, lintels, posts, mullions and members (2" to 4" thick, 2" to 4" wide)	Douglas Fir	"Structural No. 1 Structural Light Framing, WCLIB;
4.	Other lumber (2" to 4" thick, 2" to 4" wide) not specified in subparagraph 5 above.	Douglas Fir	"Structural No. 1" and Framing WCLIB; WWPA
5.	Framing lumber (2" to 4" thick, 5" and wider).	Douglas Fir	"No. 1" and better Joists and Planks, WCLIB; WWPA.
6.	Mudsills and plates in contact with soil.	Douglas Fir treated	Same as subparagraphs 5 and 6.
7.	Sills or plates resting on concrete or masonry surfaces 6" or less above soil or finish grade.	Douglas Fir treated	Same as subparagraphs 5 and 6.
8.	Sills, foundations plates & sleepers which rest on concrete, masonry foundations, or are laid on concrete on concrete slab in direct contact with soil.	Douglas Fir treated	Same as subparagraphs 4 and 5.
9.	Miscellaneous nailing strips and blocks embedded in concrete or masonry.	Douglas Fir treated	Same as subparagraphs 4 and 5.

- B. Plywood: Plywood used for structural purposes, shall be APA grade Structural I plywood. Plywood used for non-structural exterior purposes shall be exterior type, or Exposure 1. Plywood used for non-structural interior purposes shall be 3/8" AC plywood.
- C. Preservative Treated Wood:
 - 1. Wood and plywood specified as treated wood shall be pressure treated wood in accordance with CBC 2303.1.8."
 - 2. Seasoning: Treated lumber shall be air seasoned after treatment, for a minimum of 2 weeks before use.
 - 3. Creosote shall not be used for treating wood in contact with painted or plastered surfaces.
 - 4. When treated wood member has been notched, dapped, drilled or in any way cut into, such newly cut surfaces shall be painted with a heavy coat of same preservative material used in treatment of wood member.
- D. Fire Retardant Protection: Wood and plywood specified as "Fire Retardant Protected Wood" shall be treated by approved methods and materials, and shall be dried, following treatment, to a maximum moisture content as follows: Solid sawn lumber 2" in thickness or less to 19%; and plywood to 15%.
- E. Mineral Fiber Panels: Shall be asbestos free, thickness as indicated.
- F. Reused Materials: Sound lumber and timber which has been used for formwork may not be reused for stress carrying or non-stress carrying members. May not be used in any construction other than formwork.

PART 3 – EXECUTION

3.01 FASTENINGS

- A. Nails and Spikes:
 - 1. Use only common wire nails or spikes.
 - 2. Whenever necessary to prevent splitting, holes shall be prebored for nails and spikes.
 - 3. Nails in plywood shall not be overdriven.
 - 4. Machine Applied Nailing: Use of machine nailing is subject to a satisfactory jobsite demonstration for each project and approval by the Project Architect or Structural Engineer and the Division of the State Architect Field Representative. Approval is subject to continued satisfactory performance. Machine nailing will not be approved in 5/16" plywood. If nailheads penetrate outerply more than would be normal for a hand hammer or if minimum allowable edge distances are not maintained, performance will be deemed unsatisfactory and material may be scrapped.

B. Lag Screws:

1. When placing lag screws in a wood member, prebore lead hole as recommended in CBC Title 24 Sec 23.
2. Lag screws which bear on wood shall be fitted with standard steel plate washers under head. Lag screws shall be screwed and not driven into place.
3. Lag screws applied in moisture rich environments or "wet" timber shall be galvanized to prevent degradation of both the lag screw and the material.

C. Bolts:

1. Lumber and timber to be fastened together with bolts shall be clamped together and holes for bolts bored true to line.
2. Bolts shall be fitted with steel plates or standard cut washers under heads and nuts. Bolts shall be tightened when installed and again just before completion of work.
3. Bolts applied in moisture rich environments or "wet" timber shall be galvanized to prevent degradation of both the bolt and the material.

D. Wood Screws: When placing wood screws, lead holes shall be prebored as recommended in CBC Title 24. Wood screws shall be appropriately selected for the application and treated as necessary to prevent corrosion

E. Framing Anchors: Framing anchors, joist hangers, ties and other mechanical fastenings shall be galvanized or have a rust-inhibitive coating. Nails and fastenings shall be of type recommended by manufacturer.

3.02 ERECTION

A. Stud Walls, Partitions and Furring:

1. Wood stud walls, partitions and vertical furring shall be constructed of members of size and spacing indicated. Provide single plate at bottom and double plate at top unless otherwise indicated. Interior, nonbearing non-shear partitions may be capped with a single top plate, installed to provide overlapping at corners and at intersections with other wall and partitions or by metal ties as detailed.
2. Walls and partitions shall have horizontal staggered blocking not less than 2" nominal thickness and same width as studs, fitted snugly, and nailed into studs. Blocking shall be at mid-height of partition or not more than 7'-0" on center vertically. Install wood backing on top of top plate wherever necessary for nailing of lath or gypsum board.
3. Walls, partitions and furred spaces shall have 2" nominal thickness wood firestops, same width as space to be firestopped, at ceiling line, mid-height of partition and at floor line. Firestops at floor line are not required when floor is concrete. If width of opening is such that more than one piece of lumber is necessary, provide 2 thicknesses of 1" nominal material laid with staggered joints.
4. Firestops shall be placed in all stud walls and partitions, including furred spaces, so that maximum dimension of any concealed space is not over 10'-0".

5. Corners, and where wood stud walls and wood vertical furring meet, shall be formed of triple studs. Openings in stud walls and partitions shall have headers as indicated and a minimum of 2 studs at jambs, one stud of which may be cut to support header in bearing.
 6. Where wood masonry or concrete walls intersect, end stud shall be fastened at top, bottom and midheight with one 1/2" diameter bolt through stud and embedded in masonry or concrete a minimum of 4". Bolts shall have washers under nuts.
 7. Sills under bearing, exterior or shear walls shall be bolted to concrete with 5/8" rd. by 12" long bolts spaced not more than 4'-0" on center. There shall be a bolt within 9" of each end of each piece of sill. Sills shall be placed and leveled with shims and washers placed and nuts tightened to level bearing after which space between sill and concrete shall be dry packed with cement grout. Non-bearing interior plates may be fastened to concrete with low velocity powder driven fasteners provided Structural Engineer's approval is obtained in writing, prior to use.
- B. Furring: Where metal furring is not indicated or specified, provide wood furring at all points indicated and required for concealing conduit, piping, structural framing or other unfinished materials. Wood furring shall be 2x studs of required width. Vertical members contacting concrete or masonry shall be attached as specified for anchoring interior wood stud partitions.
- C. Nailing Strips and Plates:
1. Provide wood nailing strips, plates and blocking indicated or required. Nailing strips in connection with metal work shall be bolted to metal. Wood nailing blocks for securing grounds shall be built into concrete, or masonry.
 2. Nailing schedule shall comply to Title 24, see Section 01 45 29: Testing and Laboratory Services.
- D. Wood Backing: Provide wood backing as indicated and as required to receive plumbing, electrical fixtures and equipment, cabinets, door stop plates and other fixed equipment.

END OF SECTION

SECTION 07 27 29
LIQUID-APPLIED ROUGH OPENING FLASHING MEMBRANE

PART 1 - GENERAL

1.01 SUMMARY:

A. Section Includes:

1. Windows and doors rough opening flashing, using a liquid applied air and water barrier membrane system, and accessory materials for application to exterior building envelope substrates.

B. Related Requirements:

1. Section 01 33 00 - Submittal Procedures.
2. Section 01 45 29 - Testing and Inspection.
3. Section 07 62 00 – Sheet Metal Flashing and Trim.

1.02 PERFORMANCE REQUIREMENTS:

A. Performance requirements: Comply with the specified performance requirements and characteristics as herein specified.

B. Performance description:

1. Wall penetrations (windows, doors, etc.) shall be constructed with a continuous, air and water barrier to control water and air leakage into and out of the conditioned space around the [existing] [new] windows and doors replacements.
2. Joints, penetrations and paths of water and air infiltration shall be made watertight and airtight.
3. System shall be capable of withstanding positive and negative combined wind, stack and HVAC pressures on the rough openings and building envelope without damage or displacement.
4. System shall be installed in an airtight and flexible manner, allowing for the relative movement of remediated systems due to thermal and moisture variations.

1.03 SUBMITTALS:

- A. Product data: Submit manufacturer's product data and installation guidelines including membrane and accessory material types, technical and test data, composition, descriptions and properties, installation instructions and substrate preparation requirements.
- B. Qualifications: Submit letters of verification that manufacturer and installer meet qualifications as herein specified.
- C. LEED submittal: Submit statement of applicable LEED credit compliance and VOC compliance if not on the published product data sheet and compliance with LEED requirements.

1.04 QUALITY ASSURANCE:

- A. Applicable standards, as referenced herein: ASTM International (ASTM).
- B. Manufacturer's qualifications: Air and water barrier systems shall be manufactured and marketed by a firm with an Air Barrier Association of America membership for at least five [5] years. Manufacturers proposed for use, but not named in these specifications shall submit evidence of ability to meet all requirements specified, and include certification of ABAA membership for a least five [5] years.
- C. Installer's qualifications: The installer shall demonstrate qualifications to perform the work of this section by submitting the following:

1. Verification that installer has been trained by and is approved to perform work as herein specified by air and water barrier system manufacturer.
 2. List of at least three (3) projects completed of similar scope and complexity to this project carried out by the firm and site supervisor.
- C. Inspection and testing: Cooperate and coordinate with the Owner's inspection and testing agency. Do not cover installed products or assemblies until they have been inspected, tested and approved.
- D. Sole source: Obtain materials within the scope of this specification from a single manufacturer.
- E. Regulations: Provide products which comply with all state and local regulations controlling use of volatile organic compounds (VOC)
- F. Mock-up:
1. Prior to installation and start of Work of the fluid applied rough opening system a field-constructed mock-up shall be applied to verify details and tie-ins, to demonstrate the required installation.
 - a. Construct a typical exterior wall section, 8 feet long and 8 feet wide, incorporating backup wall, cladding, window, door frame, sill, penetrations, insulation, flashing and any other critical junction.
 - b. Allow 72 hours for inspection and testing of mock-up before proceeding with water and air barrier work.
 - c. Coordinate construction of mockups to permit inspection by [Architect] [Owner's Representative] of air barrier before beginning installation.
 - d. Approved, undamaged mock-up must remain as part of the work.
- G. Pre-installation conference: Prior to beginning installation of the fluid applied rough opening system, hold a pre-installation conference to review work to be accomplished.
1. Owner's Representative, Contractor, Architect, installing subcontractor, membrane system manufacturer's representative, roofing and foundation subcontractors, waterproofing subcontractors, and all subcontractors who have materials penetrating membrane system or finishes covering membrane system shall be present.
 2. Contractor shall notify Architect at least seven days prior to time for conference.
 3. Contractor shall record minutes of meeting and distribute to attending parties.
 4. Agenda: As a minimum discuss:
 - a. Surface preparation of area and surrounding wall interfaces.
 - b. Substrate condition and pretreatment.
 - c. Minimum curing period.
 - d. Special details and/or sheet flashing for liquid applied rough opening installation.
 - e. Sequence of construction, responsibilities, and schedule for subsequent repair operations.
 - f. Installation procedures.
 - g. Inspection procedures.
 - h. Protection and repair procedures.
 - i. Review and approval of all glazing applications to include the installation of the windows and related interior perimeter sealant joint.

1.05 DELIVERY, STORAGE, AND HANDLING:

- A. Deliver materials and products in labeled packages. Store and handle in strict compliance with manufacturer's instructions and recommendations. Protect from damage, weather, excessive temperatures and construction operations. Remove damaged material from site and dispose of in accordance with applicable regulations.
- B. Protect air and water barrier components from freezing and extreme heat.
- C. Sequence deliveries to avoid delays, and to minimize on-site storage.

1.06 PROJECT CONDITIONS:

- A. Weather conditions: Perform work only when existing and forecasted weather conditions are within the limits established by the manufacturer of the materials used.
- B. Proceed with installation only when the substrate construction and preparation work is complete and in condition to receive the membrane system.

1.07 WARRANTY:

- A. Manufacturer's warranty requirements:
 - 1. Submit manufacturer's ten (10) year limited warranty stating:
 - a. The products have been tested in accordance with national standards for air and water-resistive barriers and passed those tests with effectiveness and durability indicating their suitability for performance as an air and water-resistive barrier system when properly applied.
 - b. The products shall be free from defects in material for a period of [ten] years after the substantial completion of the material application.
 - c. That the products will not disintegrate and will maintain their integrity over the life of the warranty.
- B. Warranty period: Ten (10) years from Date of Substantial Completion.

PART 2 – PRODUCTS

2.01 WATER BASED PRIMER FOR RAW GYPSUM BOARD EDGES

- A. Acceptable product: PROSOCO R-Guard® GypPrime, manufactured by PROSOCO, Inc., Lawrence, KS, (800) 255-4255, www.prosoco.com or acceptable equal.
- B. Description: GypPrime seals the cut edges of gypsum wall boards where they are exposed in rough openings for windows and doors. The sealed edge makes a compatible surface for easy application of liquid applied fiber-reinforced fill coat and seam treatment for through-wall components.
- C. Characteristics:
 - 1. Breathable liquid primer.
 - 2. Comply with national, state and district AIM VOC regulations and be 100 g/L or less.
 - 3. Total solids: 16 percent

2.02 LIQUID APPLIED FILL COAT AND SEAM FILLER

- A. Acceptable product: PROSOCO R-Guard® Joint & Seam Filler, manufactured by PROSOCO, Inc., Lawrence, KS, (800) 255-4255, www.prosoco.com (NO SUBSTITUTE)
- B. Description: Joint & Seam Filler is a high modulus, gun-grade, crack and joint filler, adhesive and detailing compound that combines the best silicone and polyurethane properties. This single-component, fiber-reinforced, Silyl-Terminated-Poly-Ether (STPE) prepares open joints,

seams and cracks before installing primary water and air barrier system to prevent the movement of water and air through building envelopes.

C. Characteristics:

1. Living Building Challenge 2.0/2.1 Red List.
2. Comply with national, state and district AIM VOC regulations and be 30 g/L or less.
3. Water vapor transmission: Minimum 19 perms at 20 mils when tested in accordance with ASTM E-96.
4. Tensile strength: 70 psi when tested in accordance with ASTM D412.
5. Elongation at break: 180% when tested in accordance with ASTM D412.
6. Peel strength: Greater than 25 pli when tested in accordance with ASTM D1781.
7. Total solids: 99 percent

2.03 LIQUID-APPLIED FLASHING

- A. Acceptable product: PROSOCO R-Guard® FastFlash®, manufactured by PROSOCO, Inc., Lawrence, KS, (800) 255-4255, www.prosoco.com (NO SUBSTITUTE)
- B. Description: FastFlash® is a gun-grade waterproofing, adhesive and detailing compound that combines the best of silicone and polyurethane properties. This single component, Silyl-Terminated-Poly-Ether (STPE) produces a highly durable, seamless, elastomeric flashing membrane in rough openings, to fill joints and seams, to counter flash and transition waterproofing and air barrier components in new wall assemblies, and to seal around penetrations or protect countersunk fasteners.

C. Characteristics:

1. Living Building Challenge 2.0/2.1 Red List.
2. AAMA 714-12 Voluntary Specification for Liquid-Applied Flashing Used to Create a Water-Resistive Seal Around Exterior Wall Openings in Buildings.
3. ICC-ES AC 212 Acceptance Criteria for Water-Resistive Coatings Used as Water-Resistive Barriers Over Exterior Sheathing.
4. Comply with national, state and district AIM VOC regulations and be 30 g/L or less.
5. Water vapor transmission: 21 perms when tested in accordance with ASTM E96.
6. Tensile strength: Greater than 150 psi when tested in accordance with ASTM D412.
7. Elongation at break: Greater than 350% when tested in accordance with ASTM D412.
8. Total Solids: 99 percent

2.04 INTERIOR SEALANT FOR WINDOWS AND DOORS

- A. Acceptable product: PROSOCO R-Guard® AirDam®, manufactured by PROSOCO, Inc., Lawrence, KS, (800) 255-4255, www.prosoco.com (NO SUBSTITUTE)
- B. Description: AirDam® is a gun-grade waterproofing sealant that combines the best of silicone and polyurethane properties. This single component, Silyl-Terminated-Poly-Ether (STPE) is easy to gun and tool in all weather conditions. AirDam® cures quickly to produce a durable, high performance, high movement elastomeric sealant that stops the movement of moist air through cracks surrounding windows and doors.

C. Characteristics:

1. Living Building Challenge 2.0/2.1 Red List.
2. Health Product Declaration v1.0 Standard.

3. Comply with national, state and district AIM VOC: less than 30 grams per Liter.
 4. Sealant Validation from Sealant Waterproofing & Restoration Institute (SWRI).
 5. Elongation at break: 1000% when tested in accordance with ASTM D412.
 6. Peel strength: 25 pli when tested in accordance with ASTM C794.
 7. Total solids: 98 percent.
- D. Backer rod: In deep joints, control sealant depth by installing closed cell backer rod. Diameter of the soft-backer rod should be 25 percent greater than the joint width. Do not puncture backer rod.

PART 3 – EXECUTION

3.01 EXAMINATION AND SURFACE PREPARATION

- A. Examine conditions for compliance with system manufacturer’s requirements for installation, and other specific conditions affecting performance of air and water barrier system.
- B. All surfaces must be sound, clean and free of grease, dirt, excess mortar or other contaminants. Fill or bridge damaged surfaces, voids or gaps.
1. Treat joints ranging from one-quarter (1/4) to one-half (1/2) inch with backer rod before applying FastFlash. Alternatively, R-Guard Joint & Seam Filler may be used in place of backer rod. Joints ranging from one-half (1/2) to one (1) inch require backer rod and R-Guard Joint & Seam Filler. Joints greater than one (1) inch must be structurally improved or addressed with an appropriate transition membrane.
 2. Surfaces to receive Joint & Seam Filler, FastFlash, and AirDam may be dry, damp or wet to the touch. Brush away any standing water present before application. The products will tolerate rain immediately after application
- C. Refer to manufacturer’s product data sheets for requirements for condition of and preparation of substrates.
1. Surfaces shall be sound and free of voids, spalled areas, loose aggregate and sharp protrusions.
 2. Remove contaminants such as grease, oil and wax from exposed surfaces.
 3. Remove dust, dirt, loose stone and debris.
 4. Use repair materials and methods that are acceptable to manufacturer of the air and water-resistive barrier system.
 5. The PROSOCO R-Guard product line includes several options for preparing structural walls to receive the primary air and water resistive barrier. Refer to manufacturer’s product data sheets and R-Guard Installation Guidelines for additional information.
- D. Exterior sheathing:
1. Ensure that sheathing is properly installed with ends, corners and edges properly fastened. Remove and replace damaged sheathing.
 2. Mechanical fasteners used to secure sheathing boards or penetrate sheathing boards shall be set flush with sheathing, and spot overdriven fasteners with R-Guard Joint & Seam Filler and/or R-Guard FastFlash.
 3. Seal the cut edges of gypsum wall boards exposed in rough openings for windows and doors at corners, as recommended by manufacturer.
- A. Masonry and concrete substrates:
1. Masonry head and bed joints should be fully filled and tooled.

2. Mechanically remove loose mortar fins, mortar accumulations and protrusions, and debris.
3. Fill cracks, joints and gaps with R-Guard Joint & Seam Filler and/or R-Guard FastFlash as herein specified.

3.02 LIQUID APPLIED FILL COAT AND SEAM FILLER

- A. General: Comply with air and water barrier manufacturer's installation instructions, temperature limitations, product data and shop drawings.
- B. Apply R-Guard Joint & Seam Filler and/or FastFlash for seams, joints, cracks, gaps, primed rough gypsum edges at sheathing, and rough openings per manufacturer's written instructions.

3.03 LIQUID APPLIED FLASHING

- A. General: Comply with air and water barrier manufacturer's installation instructions, temperature limitations, product data and shop drawings.
- B. Apply R-Guard FastFlash to seal and waterproof rough openings, and over surfaces prepared with R-Guard Joint & Seam Filler, as necessary, per manufacturer's written instructions.

3.04 FLUID-APPLIED FLASHING TRANSITIONS

- A. General: Comply with water and air barrier manufacturer's installation instructions, temperature limitations, product data and shop drawings.
- B. Apply R-Guard FastFlash as a liquid flashing membrane to waterproof the transitions in rough opening and between dissimilar materials per manufacturer's written instructions.
 1. Apply a bead of R-Guard FastFlash to the top edge of the flashing leg.
 2. Spread the wet R-Guard FastFlash to create a monolithic "cap-flash" flashing membrane per manufacturer's written instructions.
 3. Apply additional coats as needed to achieve void- and pinhole-free surface.
 4. Allow treated surfaces to skin before installing other wall assembly, waterproofing or air barrier components.

3.05 INTERIOR SEALANT FOR WINDOWS AND DOORS INSTALLATION

- A. General: Comply with air and water barrier manufacturer's installation instructions, temperature limitations, product data and shop drawings.
- B. Apply R-Guard AirDam per manufacturer's written instructions.
 1. Install Backer rod: Compressible, closed cell rod stock as recommended by manufacturer for compatibility with sealant. Install Backer Rod as necessary per manufacturer's written instructions.
 2. Apply AirDam in continuous beads without gaps or air pockets.

END OF SECTION

SECTION 07 51 13
COLD APPLIED BITUMINOUS ROOFING (PATCH AND REPAIR)

PART 1 – GENERAL

1.01. RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.02. SUMMARY

- A. This Section includes the following:
1. Patch-repair, patch-back or tie-in work on existing cold applied built-up roof membrane.
 2. Roofing insulation.
 3. Roofing insulation.
 4. Aggregate ballast.
- B. Related Sections include the following:
1. Division 6 Section "Rough Carpentry" for wood blocking, curbs, cants, and nailers; and wood-based, structural-use roof deck panels.
 2. Division 7 Section "Joint Sealants."
- C. Unit Prices: Refer to Division 1 Section "Unit Prices" for description of Work in this Section that is affected by unit prices.

1.03. DEFINITIONS

- A. Roofing Terminology: Refer to ASTM D 1079 for definitions of terms related to roofing work not otherwise defined in this Section.
- B. Cold Applied Built Up Roofing – An asbestos free formulation of asphalt, solvent, thixotrope, mineral stabilizer and reinforcing fibers used as an interply adhesive and surface coat.

1.04. PERFORMANCE REQUIREMENTS

- A. General: Install a watertight, built-up roofing and base flashing roofing system with compatible components that will not permit the passage of liquid water and will withstand wind loads, thermally induced movement, and exposure to weather without failure.
- B. FM Listing: Although the School is not FM Insured, they choose to follow FM criteria where applicable. To that end, provide built-up roofing, base flashings, and component materials that comply with requirements of FM 4450 and FM 4470 and FM 1-49 Loss Prevention Data Sheet as part of a roofing system and that are listed in FM's "Approval Guide" for Class 1 or noncombustible construction, as applicable. Identify materials with FM markings.
1. Roofing system shall comply with the following:
 - a. Fire/Windstorm Classification: FM Class 1A-90.
 - b. FM 1-49 Loss Prevention Data Sheet - Perimeter Flashing

- c. FM 1-28 Loss Prevention Data Sheet - Wind Loads to Roof Systems and Decks
- d. FM 1-29 Loss Prevention Data Sheet - Above Deck Components
- e. ASCE 7 – Section 6: Wind Forces on Buildings and other Structures

1.05. SUBMITTALS

- A. Product Data: For each type of roofing product specified. Include data substantiating that materials comply with requirements.
- B. Shop Drawings: Include plans, sections, details, and attachments to other work, for the following:
 - 1. Base flashings, cants, and membrane terminations.
 - 2. Tapered insulation, including slopes.
 - 3. Crickets, saddles, and tapered edge strips, including slopes.
- C. Samples for Verification: Of the following products, if requested by Owner:
 - 1. 12-by-12-inch square of roofing insulation.
 - 2. 3 lb of aggregate surfacing material.
 - 3. 6 insulation fasteners of each type, length, and finish.
- D. Installer Certificates: Signed by roofing system manufacturer certifying that Installer is approved, authorized, or licensed by manufacturer to install specified roofing system and is eligible to conduct the repairs or modifications in accordance with and to preserve the roofing manufacturer's warranty currently in place.
- E. Inspection Report: Copy of roofing system manufacturer's inspection report of completed roofing installation.

1.06. QUALITY ASSURANCE

- A. Installer Qualifications: Engage an experienced installer to perform Work of this Section who has specialized in installing roofing similar to that required for this Project; who is approved, authorized, or licensed by the roofing system manufacturer to install manufacturer's product; and who is eligible to receive the standard roofing manufacturer's warranty.
- B. Manufacturers Technical Services: Contractor shall provide the Roofing System Manufacturers Technical Services Inspections. The job site inspections are to be performed by the Manufacturers full time employees. Inspections shall be documented in writing. Provide a minimum of three (3) job site inspection per school site.
- C. Fire-Test-Response Characteristics: Provide roofing materials with the fire-test-response characteristics indicated as determined by testing identical products per test method indicated below by UL, FM, or another testing and inspecting agency acceptable to authorities having jurisdiction. Identify materials with appropriate markings of applicable testing and inspecting agency.
 - 1. Exterior Fire-Test Exposure: Class A; complying with ASTM E 108/UL 790, for application and slopes indicated.
- D. Preliminary Roofing Conference: Before starting roof deck construction, conduct conference at Project site. Meet with the same participants and review the same items listed for the pre-

installation conference. In addition, review status of submittals and coordination of work related to roof construction. Notify participants at least 5 working days before conference.

- E. Pre-installation Conference: Before installing roofing system, conduct conference at Project site to comply with requirements of Division 1 Section "Project Meetings." Notify participants at least 5 working days before conference.
1. Meet with Owner; Architect; Owner's insurer, if applicable; testing and inspecting agency representative; roofing Installer; roofing system manufacturer's representative; deck Installer; and installers whose work interfaces with or affects roofing, including installers of roof accessories and roof-mounted equipment.
 2. Review methods and procedures related to roofing installation, including manufacturer's written instructions.
 3. Examine deck substrate conditions and finishes for compliance with requirements, including flatness and attachment to structural members.
 4. Review loading limitations of deck during and after roofing.
 5. Review flashings, special roofing details, roof drainage, roof penetrations, equipment curbs, and condition of other construction that will affect roofing.
 6. Review governing regulations and requirements for insurance, certifications, and inspection and testing, if applicable.
 7. Review temporary protection requirements for roofing system during and after installation.
 8. Review roof observation and repair procedures after roofing installation.
 9. Document proceedings, including corrective measures or actions required, and furnish copy of record to each participant.

1.07. DELIVERY, STORAGE, AND HANDLING

- A. Store roofing materials in a dry, warm, well-ventilated, weathertight location according to roofing system manufacturer's written instructions. Store rolls of felt and other sheet materials on end on pallets or other raised surfaces. Do not double-stack rolls.
1. Handle and store roofing materials and place equipment in a manner to avoid significant or permanent damage to deck or structural supporting members.
- B. Do not leave unused felts and other sheet materials on the roof overnight or when roofing work is not in progress unless protected from weather and moisture and unless maintained at a temperature exceeding 50 deg F.
- C. Deliver and store liquid materials in their original undamaged containers in a clean, dry, protected location and within the temperature range required by roofing system manufacturer.
- D. Protect roofing insulation materials from physical damage and from deterioration by sunlight, moisture, soiling, and other sources. Store in a dry location. Comply with insulation manufacturers written instructions for handling, storing, and protecting during installation.

1.08. PROJECT CONDITIONS

- A. Weather Limitations: Proceed with roofing work only when existing and forecasted weather conditions permit roofing to be installed according to manufacturers' written instructions and warranty requirements.

1.09. WARRANTY

- A. General Warranty: The warranties specified in this Article shall not deprive the Owner of other rights the Owner may have under other provisions of the Contract Documents and shall be in addition to, and run concurrent with, other warranties made by the Contractor under requirements of the Contract Documents.

- 1. Warranty Period: Continuance of Existing Tremco Warranty.
- 2. Letter sign by Manufacture that work repair work or patch work was completed per Manufactures long-term warranty guidelines.

- B. Contractors Warranty

- 1. Contractors Warranty shall cover all labor and materials required to install the specified assemblies. Warranty period shall be 2 years from Substantial Completion

PART 2 – PRODUCTS

2.01. MANUFACTURERS

- A. Manufacturers: Materials are to be compatible with the existing materials and capable of inclusion into the long-term warranty. Subject to compliance with requirements, provide products by the following: The Existing Roofing systems are Tremco.

- 1. Built-up Asphalt Roofing Products and systems:
 - a. **BURmastic 100 system by Tremco, Inc.**
- 2. Polyisocyanurate Board Insulation & Taper Panels (*Where required*):
 - a. **Tremco or Approved Generic by Manufacture.**
- 3. Wood-Fiber-Board Insulation:
 - a. **Tremco Structo-Deck, ½” thick by largest panel size available.**

2.02. BASE-SHEET MATERIALS

- A. Sheathing Paper: Red-rosin type, minimum 3 lb/100 sq. ft.
- B. Base Sheet: Unperforated, asphalt-impregnated and -coated, glass-fiber reinforced sheet, dusted with fine mineral surfacing on both sides, complying with ASTM D 4601, Type II.
 - 1. **BURmastic Composite Ply HT.**

2.03. ROOF MEMBRANE PLIES

- A. Ply Felt: Asphalt-coated, glass-fiber reinforced felt, complying with ASTM D 4601, Type II. 33 Pounds per square
 - 1. **BURmastic Glass Ply.**

2.04. FLASHING MATERIALS

- A. Backer Sheet: Asphalt- coated glass-fiber and polyester bilaminate reinforced felt, dusted with fine mineral surfacing on both sides, complying with ASTM D 4601, Type II.
 - 1. **BURmastic Composite Ply HT**
- B. Flashing Sheet: White thermoplastic single ply membrane, comprised of an elastomeric Tri-Polymer alloy based blended with CPE and PVC, white on one side and gray on the opposite side, complying with ASTM D 4434.
 - 1. **TPA 60mil; base flashings**
 - 2. **TPA 55mil un-reinforced; misc. pipe and flashing details**
- C. Glass-Fiber Fabric: Woven glass reinforcement treated with organic resin complying with ASTM D 1668, Type III.
 - 1. **BURmesh**
- D. Base Flashing Strip in adhesive used at 3 and 5 coursing with glass-fiber fabric:
 - 1. **Rock-it Adhesive**

2.05. ASPHALT MATERIALS

- A. Asphalt Primer Water-based asphalt primer: **TremPrime WB**
- B. Cold-Applied Adhesive: Roofing system manufacturer's standard asphalt-based, 1-part asbestos-free, cold-applied adhesive specially formulated for compatibility and use with built-up roofing membranes and flashings. Each container labeled with UL and FM logos indicating material was manufactured under the specified UL and FM quality assurance programs.
 - 1. **BURmastic Adhesive** . For use in large roof replacement areas as indicated
 - 2. **BURmastic SF Adhesive**. For use at patch and repair roof areas limited to immediate area around individual mechanical equipment or penetrations outside of large roof replacement areas.

2.06. AUXILIARY MEMBRANE MATERIALS

- A. General: Furnish auxiliary materials recommended by roofing system manufacturer for intended use and compatible with built-up roofing.
 - 1. Furnish liquid-type auxiliary materials that meet VOC limits of authorities having jurisdiction.
- B. Asphalt Roofing Cement: ASTM D 4586, asbestos free, of consistency required by roofing system manufacturer for application
 - 1. **ELS Mastic**
- C. Elastomeric Flashing Adhesive Butyl rubber based, trowel grade
 - 1. **Sheeting Bond.**

- D. Fasteners: Factory-coated steel fasteners and metal or plastic plates complying with corrosion-resistance provisions of FM 4470; designed for fastening base sheets and base flashings and for backnailing ply felts to substrate; tested by manufacturer for required pullout strength; and acceptable to roofing system manufacturer.
 - 1. Type and kind as required for the deck area in the area of work.
- E. Wood Nailer Strips: Furnish wood nailer strips complying with requirements of Division 6 Section "Rough Carpentry."
- F. Cants: Cellulosic-fiber board, complying with ASTM C 208, Type 2.
- G. Walkway Pads: Mineral-surfaced asphaltic composition panels, factory formed, nonporous, with a slip-resisting surface texture, manufactured specifically for adhering to built-up roofing as a protection course for foot traffic, of the following thickness:
 - 1. **TremTred**
 - 2. **Thickness: 1/2 inch**
- H. Aggregate Surfacing: Clean, dry, double washed, water-worn gravel, complying with ASTM D 1863. Color and size to match existing.
- I. Miscellaneous Accessories: Provide miscellaneous accessories recommended by roofing system manufacturer for intended use.

2.07. INSULATION MATERIALS

- A. Polyisocyanurate Board Insulation: Rigid, cellular polyisocyanurate thermal insulation with core formed by using HCFCs as blowing agents complying with ASTM C 1289, classified by facer type as follows:
 - 1. Facer Type: Type IV, cellulosic-fiber insulating board, complying with ASTM C 208, Type II, Grade 2
- B. Cellulosic-Fiber-Board Insulation: Fibrous-felted, rigid insulation boards of wood fiber or other cellulosic-fiber and water-resistant binders, asphalt impregnated, chemically treated for deterioration, complying with ASTM C 208, Type II, Grade 2. **Structo-Dek**

2.08. INSULATION ACCESSORIES

- A. General: Furnish roofing insulation accessories recommended by insulation manufacturer for intended use and compatible with sheet roofing material.
- B. Insulation Adhesive: Solvent free, bituminous urethane adhesive
 - 1. **Low Rise Insulation Adhesive by Tremco.**
- C. Fasteners: Factory-coated steel fasteners and metal or plastic plates complying with corrosion-resistance provisions of FM 4470, designed for fastening roofing insulation to substrate, tested by manufacturer for required pullout strength, and acceptable to roofing system manufacturer.
- D. Tapered Edge Strips: Rigid, cellulosic-fiber insulation board, complying with ASTM C 208, Type 2.
- E. Tapered Edge Strips: Rigid, glass-fiber insulation board, complying with ASTM C 726.

- F. Substrate Joint Tape: 6 or 8 inches wide, coated, glass-fiber joint tape.

PART 3 – EXECUTION

3.01. EXAMINATION

- A. Examine substrates, areas, and conditions under which roofing will be applied, with Installer present, for compliance with requirements.
- B. Verify that roof openings and penetrations are in place and set and braced and that roof drains are properly clamped into position.
- C. Verify that wood blocking, curbs, and nailers are securely anchored to roof deck at roof penetrations and terminations and match the thicknesses of insulation required.
 - 1. Verify that wood nailer strips are located perpendicular to roof slope and spaced according to requirements of roofing system manufacturer.
- D. Do not proceed with installation until after the minimum concrete curing period recommended by roofing system manufacturer.
- E. Verify that flatness and fastening of metal roof decks comply with installation tolerances specified in Division 5 Section "Steel Deck."
- F. Do not proceed with installation until unsatisfactory conditions have been corrected.

3.02. PREPARATION

- A. Clean around area where new penetration has occurred. Remove aggregate surfacing and all materials that will prevent proper adhesion of new materials.
- B. Roofing Contractor shall cut existing membrane in manner to provide clean even edges. Take necessary precautions to prevent tearing and lifting of membrane to remain in place. General Contractor shall be responsible for maintaining openings in a weather tight condition.
- C. The existing Manufacturers Warranty shall be placed in suspension until all roofing work has been completed and accepted by the Manufacturer. Upon acceptable completion, the Warranty shall be re-instated as applicable.
- D. Clean substrate of dust, debris, and other substances detrimental to roofing installation according to roofing system manufacturer's written instructions. Remove sharp projections.
- E. Prevent materials from entering and clogging roof drains and conductors and from spilling or migrating onto surfaces of other construction. Remove roof-drain plugs when no work is taking place or when rain is forecast.

3.03. GENERAL INSTALLATION REQUIREMENTS

- A. Install built-up roofing membrane system according to roofing system manufacturer's written instructions and applicable recommendations of ARMA/NRCA's "Quality Control Guidelines for the Application of Built-Up Roofing."
 - 1. Install roofing system according to applicable specification plates of NRCA's "The NRCA Roofing and Waterproofing Manual."
- B. Start installation of built-up roofing membrane in presence of roofing system manufacturer's technical personnel.

- C. Cants: Install and secure preformed 45-degree wood cants at junctures of built-up roofing membrane system with vertical surfaces or angle changes greater than 45 degrees.
- C. Cooperate with inspecting and testing agencies engaged or required to perform services for installing built-up roofing membrane system.
- D. Coordinate installing roofing system components so insulation and roofing plies are not exposed to precipitation or left exposed at the end of the workday or when rain is forecast.
 - 1. Provide cutoffs at end of each day's work to cover exposed ply sheets and insulation with course of coated felt with joints and edges sealed.
 - 2. Complete terminations and base flashings and provide temporary seals to prevent water from entering completed sections of roofing system.
 - 3. Remove and discard temporary seals before beginning work on adjoining roofing.
- A. Cold process adhesive heating:
 - 1. An in-line heat exchange unit may be used to facilitate application
 - a. Maximum adhesive temperature: 100° F. Do not exceed the flash point of the adhesive.
 - 2. Heat exchange unit: Filled with heat transfer oil approved by equipment manufacturer.
 - 3. Follow operation procedures as recommended by equipment manufacturer.
- B. Surfacing Adhesive
 - 1. Aggregate Surfacing: Limit temperature of cold adhesive surface coat to the minimum required for proper embedment of aggregate and the maximum that will permit retention of required coating weight based on slope of surface.
 - 2. Substrate-Joint Penetrations: Prevent roofing adhesive from penetrating substrate joints, entering building, or damaging roofing system components or adjacent building construction. If it is applied directly to substrate, tape substrate joints.

3.04. INSULATION INSTALLATION (Where Occurs)

- A. Coordinate installing roofing system components so insulation is not exposed to precipitation or left exposed at the end of the workday.
- B. Comply with roofing system manufacturer's written instructions for installing roofing insulation.
- C. Install tapered insulation under area of roofing to conform to slopes indicated and to Shop Drawings.
- D. Install tapered edge strips at perimeter edges of roof that do not terminate at vertical surfaces.
- E. Install one or more layers of insulation under area of roofing to achieve required thickness. Where overall insulation thickness is 2 inches or greater, install required thickness in 2 or more layers with joints of each succeeding layer staggered from joints of previous layer a minimum of 6 inches in each direction.
- F. Trim surface of insulation where necessary at roof drains so completed surface is flush with ring of drain.

- G. Install insulation with long joints of insulation in continuous straight lines with end joints staggered between rows, abutting edges and ends between boards. Fill gaps exceeding 1/4 inch with insulation.
1. Cut and fit insulation within 1/4 inch of nailers, projections, and penetrations.
- H. Attached Insulation: Over nailable decks, secure first layer of insulation to deck using mechanical fasteners specifically designed and sized for fastening specified board-type roofing insulation to deck type indicated. Over non-nailable decks, prime and install panels using maximum 4' x 4' panel size for first layer. Over LWC, mechanically install a base sheet and then adhere insulation using 4' x 4' maximum panel size for first layer. Install subsequent layers of insulation in a ribbon coverage of solvent free insulation adhesive at a rate of 1-½ gallons per 100 sq. ft. Immediately after placement, walk insulation boards into adhesive to achieve solid contact.
1. Fasten insulation according to requirements of FM's "Approval Guide" for specified Windstorm Resistance Classification and the insulation and roofing system manufacturers' written instructions.
 2. Fasten insulation according to the insulation and roofing system manufacturers' written instructions.
- I. Adhered Insulation: Prime surface of concrete deck with primer at a rate of 150 – 250 sq. ft. per gallon, unless a greater weight is required by roofing system manufacturer, and allow primer to dry. Set each layer of insulation in a ribbon coverage of insulation adhesive at a rate of 1-½ gallons per 100 sq. ft. Immediately after placement, walk insulation boards into adhesive to achieve solid contact.

3.05. BASE-SHEET INSTALLATION

- A. Install one lapped course of base sheet according to roofing system manufacturer's written instructions, extending sheet over and terminating beyond cants. Attach base sheet as follows:
1. Non-Insulated Decks: Mechanically fasten to substrate.
 2. Over insulation, adhere to substrate in a uniform coating of cold adhesive. Where occurs.

3.06. ROOF MEMBRANE INSTALLATION

- A. Install ply felts according to roofing system manufacturer's written instructions, starting at low point of roofing system. Cut roofing ply sheets in 18 – 20 ft. lengths and allow to relax 30 to 60 minutes. Stack lengths. Do not re-roll. Shingle side laps of ply felts uniformly to achieve required number of membrane plies throughout. Shingle in direction to shed water. Extend ply felts over and terminate beyond cants.
1. Install 3 ply felts.
 2. Application: Adhere each ply felt in 2.5 gallons per 100 sq of cold adhesive, applied within temperature range and at rate required by roofing system manufacturer, to form a uniform membrane without ply felts touching each other.
- B. Surfacing Application:
1. Prior to application of surface coat, contractor shall inspect roof with manufacturer's technical representative and repair any deficiencies.

2. Over entire roof surface of new work, apply uniform and continuous surface coat of surfacing adhesive at a rate of 5 gallons per 100 sq. ft.
- C. Aggregate Surfacing: Immediately broadcast minimum of 400 lbs /100 sq. ft. of new, clean roofing gravel. Cover surface coat material completely.

3.07. FLASHING AND STRIPPING INSTALLATION

A. Elastomeric Flashing

1. Adhere elastomeric sheeting completely to flashing surface, cant and roofing with flashing adhesive; allow adhesive to remain open for approx. 15 minutes to flash off solvent prior to setting elastomeric sheeting into flashing adhesive.
2. Apply consistent pressure to entire surface of elastomeric sheeting using a steel hand roller to achieve full adhesion of the sheeting to the flashing substrate. Ensure complete bond and continuity without wrinkles or voids. Lap sheeting ends 4 inches. Adhere laps with flashing adhesive.
3. Elastomeric sheeting width: Sufficient to extend at least 6 inches beyond toe of cant onto new roof.
4. Seal vertical and horizontal edges of sheeting with reinforcing membrane embedded in a base course of flashing adhesive and a top course of modified asphalt mastic.

B. Two Ply stripping for metal flanges:

1. Set flange in asphalt mastic. Seal flange with 2 stripping plies embedded between alternate applications of stripping adhesive/bitumen. Extend first ply 8 inches beyond flange; second ply 6 inches beyond first ply.

3.08. TIE-IN TO EXISTING MEMBRANE

- A. Follow Tremco Roofing standards for the Tie-In detail. Surfacing at existing membrane adjacent to new penetration, shall be removed to expose existing felts
- B. Prime existing felts and allow to flash.
- C. Install one 18-inch wide Composite Ply felt evenly across joint line of new and existing.
- D. Install two ply strip-in using ply felts that extend past the edge of the previous felt a minimum of 6 inches
- E. Choose either E or F to suit the requirements. Delete G if no roof coating is required.
- F. Surface coat and apply surfacing aggregate of same size and color as existing.
- G. Install surfacing sheet in color to match existing where applicable. Butt edge of new surfacing sheet against edge of next higher surfacing sheet as required to prevent the blockage of water flowing across roof. At gravel surfaces match existing as specified elsewhere.

3.09. LONG TERM WARRANTY EXTENSION

- A. Contractor shall review the existing roof conditions of all low slope roofing areas with the Manufacturer of Record, Tremco Roofing (Dan Gilday – dgilday@tremcoinc.com) prior to starting work.

3.10. FIELD QUALITY CONTROL

- A. Owner will engage, at their option, an independent testing and inspecting agency to perform field inspections and quality-assurance tests.
 - 1. The Manufacturer and the Testing Agency shall agree in writing to acknowledge and accept the comments of the other agency.
- B. Correct deficiencies in or remove and replace roof membrane that inspections and test reports indicate does not comply with specified requirements or are capable of being incorporated into the existing warranty.
 - 2. Repair roof membrane that does not comply with specified requirements by re-adhering test specimens back in place and by applying additional plies, equal to the original number of plies specified, over test specimens according to roofing system manufacturer's written instructions.
- C. Test Cuts: Before surface coating and surfacing built-up roofing membrane, test specimens will be removed to evaluate problems observed during quality-assurance inspections of roof membrane as follows:
 - 1. Test specimens will be examined for interply voids according to ASTM D 3617 and to comply with the criteria established in Appendix 3 of ARMA/NRCA'S "Quality Control Guidelines for the Application of Built-up Roofing."
- B. Final Roof Inspection: Arrange for roofing system manufacturer's technical personnel to inspect roofing installation on completion and submit report to Architect.
 - 1. Notify Architect and Owner, General Contractor and Roof System Representative, 48 hours in advance of the date and time of inspection.

3.11 PROTECTING AND CLEANING

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

END OF SECTION

**SECTION 07 84 00
FIRESTOPPING**

PART 1 - GENERAL

1.01 SUMMARY

- A. Section includes: Firestopping for the following.
 - 1. Penetrations through fire-resistance-rated ceiling/ roof construction including both empty openings and openings containing cables, pipes, ducts, conduits, and other penetrating items.
 - 2. Penetrations through fire-resistance-rated walls and partitions including both empty openings and openings containing cables, pipes, ducts, conduits, and other penetrating items.
 - 3. Sealant joints in fire-resistance-rated construction.
- B. Related sections:
 - 1. All other sealants.

1.02 SYSTEM PERFORMANCE REQUIREMENTS

- A. General: Provide firestopping systems produced and installed to resist the spread of fire and the passage of smoke and other gases in compliance with Code.
 - 1. F-rated through-penetration firestop systems: Provide through-penetration firestop systems with F rating, determined in compliance with ASTM E 814, but not less than that equaling or exceeding the fire-resistance rating of the constructions penetrated.
 - 2. T-rated through-penetration firestop systems: Provide through-penetration firestop systems with T rating, in addition to F rating, determined in compliance with ASTM E 814, where systems protect penetrating items exposed to contact with adjacent materials in occupiable floor areas. T-rated assemblies are required where the following conditions exist.
 - a. Where firestop systems protect penetrations located outside of wall cavities.
 - b. Where firestop systems protect penetrations located outside fire-resistive shaft enclosures.
 - c. Where firestop systems protect penetrations located in construction containing doors required to have a temperature-rise rating.
 - d. Where firestop systems protect penetrating items larger than a 4 in. diameter nominal pipe or 15 sq. in. in overall cross-sectional area.
- B. Fire-resistive joint sealants: Provide joint sealants with fire-resistance rating determined in compliance with ASTM E 119, but not less than that equaling or exceeding the fire-resistance rating of the construction in which the joint occurs.

- C. For firestopping exposed to view, traffic, moisture, and physical damage, provide products that will not deteriorate when exposed to these conditions.
 - 1. For piping penetrations for plumbing systems, provide moisture-resistant through-penetration firestop systems.
 - 2. For penetrations with insulated piping, provide through-penetration firestop systems not requiring removal of insulation.
- D. For firestopping exposed to view, provide products with flame-spread values of less than 25 and smoke-developed values of less than 450, as determined in compliance with ASTM E 84.

1.03 DEFINITIONS AND REFERENCE STANDARDS

- A. ASTM E 84, Test Method for Surface Burning Characteristics of Building Materials.
- B. ASTM E 119, Standard Method of Fire Tests of Building Construction and Materials.
- C. ASTM E 814, Fire Tests of Through-Penetration Fire Stops.
- D. UL 1479, Fire Tests of Through-Penetration Firestops.
- E. UL Building Materials Directory: Through-Penetration Firestops Systems (XHEZ), and Fill, Void, or Cavity Materials (XHHW).

1.04 SUBMITTALS

- A. Procedure: In accordance with Section 01 33 00.
- B. Data: Manufacturer's product data for all materials and prefabricated devices and manufacturer's installation instructions.
- C. Certification: Letter of certification, or certified laboratory test report that the material or combination of materials proposed for use meets the requirements specified in ASTM E 814, are so classified in UL Building Materials Directory, and are acceptable to DSA and comply with Title 24.
- D. Certificates: Product certificates signed by manufacturers of firestopping products certifying that their products comply with specified requirements.
- E. Reports: Product test reports from, and based on tests performed by a qualified testing and inspecting agency evidencing compliance of firestopping with requirements based on comprehensive testing of current products.

1.05 QUALITY ASSURANCE

- A. Installer's qualifications: Firm with at least 2 years experience with systems proposed for use, who has successfully completed firestopping installations similar in material, design, and extent to that indicated for Project on at least 5 comparable projects.
 - 1. Where firestopping manufacturer selected has training/ certification program installer shall be certified, licensed, or otherwise qualified by the firestopping manufacturer as having the necessary experience, staff and training to install manufacturer's products as specified.

- B. Single-source responsibility: Obtain through-penetration firestop systems, for each kind of penetration and construction condition indicated, from a single manufacturer.
- C. Certifications and Code approvals: Materials proposed for use shall be approved by DSA and Title 24 CAC for their intended use.
- D. Compatibility: Provide firestop systems that are compatible with one another and with substrates under conditions of application and service, as demonstrated by manufacturer, based on testing and field experience.

1.06 PRODUCT HANDLING

- A. Store and handle materials to prevent their deterioration or damage. Do not use damaged and contaminated materials.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

- A. One or a combination of the following, depending on the condition of use:
 - 1. 3M Fire Protection Products.
 - 2. Bio Fireshield, Inc.
 - 3. Hevi-Duty/Nelson.
 - 4. Tremco, Inc.
 - 5. Specified Technologies, Inc.
 - 6. United States Gypsum Co. (USG).

2.02 MATERIALS

- A. Accessories:
 - 1. Provide components for each firestopping system that are needed to install fill materials and to comply with Article 1.02 above.
 - 2. Use only components specified by the firestopping manufacturer and approved by the qualified testing and inspecting agency for the designated fire-resistance-rated systems.
 - 3. Accessories include but are not limited to the following items:
 - a. Permanent forming/damming/backing materials including the following:
 - 1) Semi-refractory fiber (mineral wool) insulation.
 - 2) Ceramic fiber.
 - 3) Sealants used in combination with other forming/damming materials to prevent leakage of fill materials in liquid state.
 - 4) Fire-rated formboard.

- 5) Joint fillers for joint sealants.
- b. Temporary forming materials:
- 1) Substrate primers.
 - 2) Collars.
 - 3) Steel sleeves.
- B. Applications: Provide firestopping systems composed of materials specified in this Section that comply with system performance and other requirements.

2.03 FILL MATERIALS FOR THROUGH-PENETRATION FIRESTOP SYSTEMS

- A. Ceramic-fiber and mastic coating: Ceramic fibers in bulk form formulated for use with mastic coating, and ceramic fiber manufacturer's mastic coating.
- B. Ceramic-fiber sealant: Single-component formulation of ceramic fibers and inorganic binders.
- C. Endothermic, latex compound sealant: Single-component, endothermic, latex formulation.
- D. Intumescent, latex sealant: Single-component, intumescent, latex formulation.
- E. Intumescent putty: Non-hardening, dielectric, water-resistant putty containing no solvents, inorganic fibers, or silicone compounds.
- F. Intumescent wrap strips: Single-component, elastomeric sheet with aluminum foil on one side.
- G. Job-mixed vinyl compound: Pre-packaged vinyl-based powder product for mixing with water at Project site to produce a paintable compound, passing ASTM E 136, with flame-spread and smoke-developed ratings of zero per ASTM E 84.
- H. Mortar: Pre-packaged dry mix composed of a blend of inorganic binders, fillers, and lightweight aggregate formulated for mixing with water at Project site to form a non-shrinking, homogenous mortar.
- I. Silicone foam: 2-component, silicone-based liquid elastomer that, when mixed, expands and cures in place to produce a flexible, non-shrinking foam.
- J. Silicone sealant: Moisture-curing, single-component, silicone-based, neutral-curing elastomeric sealant.
- K. Solvent-release-curing intumescent sealant: Solvent-release-curing, single-component, synthetic-polymer-based sealant.
- L. Color: Where firestopping material is exposed to view in the work, provide material color selected by the Architect from the manufacturer's palette, unless material will be field-painted.

2.04 MIXING

- A. For products requiring mixing prior to application, comply with firestopping manufacturer's directions for accurate proportioning of materials, water (if required), type of mixing equipment, selection of mixer speeds, mixing containers, mixing time, and other procedures needed to produce firestopping products of uniform quality with optimum performance characteristics for application indicated.

PART 3 - EXECUTION

3.01 PREPARATION

- A. Clean surfaces to be in contact with firestopping materials of dirt, grease, oil, loose materials, rust, and other substances that may affect proper fitting or the required fire-resistance.
- B. Verify conditions and measurements affecting the work of this Section at site. Make sure that detrimental conditions are corrected before proceeding with installation.

3.02 INSTALLATION

- A. General: Install materials in compliance with their manufacturer's instructions and comply with printed instructions of UL Fire Resistance Directory.
- B. Surface cleaning: Clean-out openings and joints immediately prior to installing firestopping to comply with recommendations of firestopping manufacturer and the following requirements.
 - 1. Remove foreign materials from surfaces of opening and joint substrates and from penetrating items that could interfere with adhesion of firestopping.
 - 2. Clean opening and joint substrates and penetrating items to produce clean, sound surfaces capable of developing optimum bond with firestopping. Remove loose particles remaining from cleaning operation.
 - 3. Remove laitance and form release agents from concrete.
- C. Priming: Prime substrates where recommended by firestopping manufacturer using manufacturer's recommended products and methods. Confine primers to areas of bond. Do not allow spillage and migration on exposed surfaces.
- D. Masking tape:
 - 1. Use masking tape to prevent firestopping from contacting adjoining surfaces that will remain exposed and that would otherwise be permanently stained or damaged by such contact or by cleaning methods used to remove smears from firestopping materials.
 - 2. Remove tape as soon as it is possible to do so without disturbing firestopping's seal with substrates.

3.03 INSTALLING THROUGH-PENETRATION FIRESTOPS

- A. Forming/damming materials and accessories:
 - 1. Install as required to support fill materials during their application in position

needed to produce the cross-sectional shapes and depths required to achieve fire ratings of firestop systems.

2. After installing fill materials, remove combustible forming materials and other accessories not indicated as permanent components of firestop systems.
- B. Install fill materials for through-penetration firestop system to produce the following results:
1. Completely fill voids and cavities formed by openings, forming materials, accessories, and penetrating items.
 2. Apply materials so they contact and adhere to substrates formed by openings and penetrating items.
 3. For fill materials that will remain exposed after completing work, finish to produce smooth, uniform surfaces, flush with adjoining finishes.

3.04 INSTALLING FIRE-RESISTIVE JOINT SEALANTS

- A. Install joint fillers to provide support of sealants during application and to produce the cross sectional shapes and depths of installed sealants that allow optimum sealant movement capability and develop fire-resistance rating required.
- B. Install sealants so that they will directly contact and fully wet joint substrates, completely filling recesses provided for each joint configuration, and providing uniform, cross-sectional shapes and depths relative to joint width. Install sealants at the same time joint fillers are installed.
- C. Tool non-sag sealants immediately after sealant application and before skinning or curing begins. Form smooth, uniform beads. Eliminate air pockets, and ensure contact and adhesion of sealants with sides of joint.
1. Remove excess sealant from surfaces adjacent to joint.
 2. Do not use tooling agents that discolor sealants or adjacent surfaces or are not approved by sealant manufacturer.

3.05 FIELD QUALITY CONTROL

- A. Examine firestopped areas to ensure proper installation prior to concealing or enclosing firestopped areas.
- B. Repair damaged areas and restore the integrity of the assembly.
- C. Keep areas of work accessible until inspection and approval by applicable code authorities.

3.06 CLEANING

- A. Clean-up spills of liquid components.
- B. Cut and trim excess materials neatly, flush with adjacent surfaces.

END OF SECTION

**SECTION 07 92 00
JOINT SEALANTS**

PART 1 - GENERAL

1.01. SUMMARY

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

1.02. PRECONSTRUCTION TESTING

- B. Preconstruction Compatibility and Adhesion Testing: Submit to joint-sealant manufacturers eight samples of materials that will contact or affect joint sealants. Use ASTM C 1087 or manufacturer's standard test method to determine whether priming and other specific joint preparation techniques are required to obtain rapid, optimum adhesion of joint sealants to joint substrates.
- C. Preconstruction Field-Adhesion Testing: Before installing sealants, field test their adhesion to Project joint substrates. Test joint sealants according to Method A, Field-Applied Sealant Joint Hand Pull Tab, in Appendix X1 in ASTM C 1193 or Method A, Tail Procedure, in ASTM C 1521.

1.03. SUBMITTALS

- D. Product Data: For each joint-sealant product indicated.
- E. Samples: For each kind and color of joint sealant required.
- F. 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.
- G. Product test reports.
- H. Preconstruction compatibility and adhesion test reports.
- I. Preconstruction field-adhesion test reports.
- J. Field-adhesion test reports.

K. Warranties.

1.04. QUALITY ASSURANCE

L. Testing Agency Qualifications: Qualified according to ASTM C 1021 to conduct the testing indicated.

M. Preinstallation Conference: Conduct conference at Project site.

1.05. WARRANTY

N. Special Installer's Warranty: Manufacturer's standard form in which Installer agrees to repair or replace joint sealants that do not comply with performance and other requirements specified in this Section within specified warranty period.

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

PART 2 - PRODUCTS

2.01. MATERIALS, GENERAL

A. VOC Content of Interior Sealants: Provide sealants and sealant primers for use inside the weatherproofing system that comply with the following limits for VOC content when calculated according to 40 CFR 59, Part 59, Subpart D (EPA Method 24):

1. Architectural Sealants: 250 g/L.
2. Sealant Primers for Nonporous Substrates: 250 g/L.
3. Sealant Primers for Porous Substrates: 775 g/L.

B. Liquid-Applied Joint Sealants: Comply with ASTM C 920 and other requirements indicated for each liquid-applied joint sealant specified, including those referencing ASTM C 920 classifications for type, grade, class, and uses related to exposure and joint substrates.

1. Suitability for Immersion in Liquids. Where sealants are indicated for Use I for joints that will be continuously immersed in liquids, provide products that have undergone testing according to ASTM C 1247. Liquid used for testing sealants is deionized water, unless otherwise indicated.

C. Stain-Test-Response Characteristics: Where sealants are specified to be nonstaining to porous substrates, provide products that have undergone testing according to ASTM C 1248 and have not stained porous joint substrates indicated for Project.

2.02. SILICONE JOINT SEALANTS

D. Neutral-Curing Silicone Joint Sealant : ASTM C 920.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

- a. BASF Building Systems.
 - b. Dow Corning Corporation.
 - c. GE Advanced Materials - Silicones.
 - d. Pecora Corporation.
 - e. Polymeric Systems, Inc.
 - f. Schnee-Morehead, Inc.
 - g. Sika Corporation; Construction Products Division.
 - h. Tremco Incorporated.
2. Type: Single component (S) or multicomponent (M).
 3. Grade: Pourable (P) or nonsag (NS).
 4. Class: 100/50.
 5. Uses Related to Exposure: Traffic (T).

2.03. LATEX JOINT SEALANTS

- E. Latex Joint Sealant [LS-#>]: Acrylic latex or siliconized acrylic latex, ASTM C 834, Type OP, Grade NF.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. BASF Building Systems.
 - b. Bostik, Inc.
 - c. Pecora Corporation.
 - d. Schnee-Morehead, Inc.
 - e. Tremco Incorporated.

2.04. JOINT SEALANT BACKING

- F. Cylindrical Sealant Backings: ASTM C 1330, Type C (closed-cell material with a surface skin) and of size and density to control sealant depth and otherwise contribute to producing optimum sealant performance.
- G. Bond-Breaker Tape: Polyethylene tape or other plastic tape recommended by sealant manufacturer.

2.05. MISCELLANEOUS MATERIALS

- H. 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.
- I. Cleaners for Nonporous Surfaces: Chemical cleaners acceptable to manufacturers of sealants and sealant backing materials.
- J. Masking Tape: Nonstaining, nonabsorbent material compatible with joint sealants and surfaces adjacent to joints.

PART 3 - EXECUTION

3.01. PREPARATION

- A. Surface Cleaning of Joints: Clean out joints immediately before installing joint sealants to comply with joint-sealant manufacturer's written instructions.
 - 1. Remove laitance and form-release agents from concrete.
 - 2. 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.
- 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.

3.02. INSTALLATION

- D. Sealant Installation Standard: Comply with recommendations in ASTM C 1193 for use of joint sealants as applicable to materials, applications, and conditions indicated.
- E. Install sealant backings of kind indicated to support sealants during application and at position required to produce cross-sectional shapes and depths of installed sealants relative to joint widths that allow optimum sealant movement capability.
 - 1. Do not leave gaps between ends of sealant backings.
 - 2. Do not stretch, twist, puncture, or tear sealant backings.
 - 3. Remove absorbent sealant backings that have become wet before sealant application and replace them with dry materials.

- F. Install bond-breaker tape behind sealants where sealant backings are not used between sealants and backs of joints.
- G. 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.
- H. Tooling of Nonsag Sealants: Immediately after sealant application and before skinning or curing begins, tool sealants according to requirements specified in subparagraphs below to form smooth, uniform beads of configuration indicated; to eliminate air pockets; and to ensure contact and adhesion of sealant with sides of joint.
 - 1. Remove excess sealant from surfaces adjacent to joints.
 - 2. Use tooling agents that are approved in writing by sealant manufacturer and that do not discolor sealants or adjacent surfaces.
 - 3. Provide concave joint profile per Figure 8A in ASTM C 1193, unless otherwise indicated.
- I. Acoustical Sealant Installation: Comply with ASTM C 919 and with manufacturer's written recommendations.
- J. 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.

3.03. FIELD QUALITY CONTROL

- K. Field-Adhesion Testing: Field test joint-sealant adhesion to joint substrates as follows:
 - 1. Extent of Testing: Test completed and cured sealant joints as follows:
 - a. Perform 5 tests for the first 500 feet (300 m)] of joint length for each kind of sealant and joint substrate.
 - b. Perform 1 test for each 1000 feet (300 m) of joint length thereafter.
 - 2. Test Method: Test joint sealants according to Method A, Field-Applied Sealant Joint Hand Pull Tab, in Appendix X1 in ASTM C 1193 or Method A, Tail Procedure, in ASTM C 1521.
- L. Evaluation of Field-Adhesion Test Results: Sealants not evidencing adhesive failure from testing or noncompliance with other indicated requirements will be considered satisfactory. Remove sealants that fail to adhere to joint substrates during testing or to comply with other requirements. Retest failed applications until test results prove sealants comply with indicated requirements.

3.04. JOINT-SEALANT SCHEDULE

M. Joint-Sealant Application: Exterior joints in horizontal traffic surfaces.

1. Joint Locations:
 - a. Isolation and contraction joints in cast-in-place concrete slabs.
 - b. Tile control and expansion joints.
 - c. Joints between different materials listed above.
 - d. Other joints as indicated.
2. Joint Sealant: Silicone.
3. Joint-Sealant Color: As selected by Architect from manufacturer's full range of colors.

N. Joint-Sealant Application: Exterior joints in vertical surfaces and horizontal nontraffic surfaces.

1. Joint Locations:
 - a. Construction joints in cast-in-place concrete.
 - b. Control and expansion joints in unit masonry.
 - c. Joints between different materials listed above.
 - d. Perimeter joints between materials listed above and frames of doors, windows and louvers.
 - e. Control and expansion joints in ceilings and other overhead surfaces.
 - f. Other joints as indicated.
2. Joint Sealant: Silicone.
3. Joint-Sealant Color: As selected by Architect from manufacturer's full range of colors.

O. Joint-Sealant Application: Interior joints in horizontal traffic surfaces.

1. Joint Locations:
 - a. Isolation joints in cast-in-place concrete slabs.
 - b. Control and expansion joints in tile flooring.
 - c. Other joints as indicated.
2. Joint Sealant: Silicone.
3. Joint-Sealant Color: As selected by Architect from manufacturer's full range of colors

P. Joint-Sealant Application: Interior joints in vertical surfaces and horizontal nontraffic surfaces.

1. Joint Locations:

- a. Control and expansion joints on exposed interior surfaces of exterior walls.
 - b. Perimeter joints of exterior openings where indicated.
 - c. Tile control and expansion joints.
 - d. Vertical joints on exposed surfaces of interior unit masonry, concrete, walls and partitions.
 - e. Perimeter joints between interior wall surfaces and frames of interior doors windows and elevator entrances.
 - f. Other joints as indicated.
2. Joint Sealant: Latex.
 3. Joint-Sealant Color: As selected by Architect from manufacturer's full range of colors.
- Q. Joint-Sealant Application: Mildew-resistant interior joints in vertical surfaces and horizontal nontraffic surfaces.
1. Joint Sealant Location:
 - a. Joints between plumbing fixtures and adjoining walls, floors, and counters.
 - b. Tile control and expansion joints where indicated.
 - c. Other joints as indicated.
 2. Joint Sealant: Silicone.
 3. Joint-Sealant Color: As selected by Architect from manufacturer's full range of colors.

END OF SECTION

**SECTION 08 31 13
ACCESS DOORS AND FRAMES**

PART 1 - GENERAL

1.01. SUMMARY

- A. This Section includes access doors and frames for walls and ceilings.

1.02. SUBMITTALS

- B. Product Data: For each type of access door and frame indicated.
- C. Shop Drawings: Include plans, elevations, sections, details, and attachments to other work.
- D. Samples: For each door face material in specified finish.
- E. Schedule: Types, locations, sizes, latching or locking provisions, and other data pertinent to installation.

1.03. QUALITY ASSURANCE

- F. Fire-Rated Access Doors and Frames: Units complying with NFPA 80 that are identical to assemblies tested for fire-test-response characteristics per the following test method and that are listed and labeled by UL or another testing and inspecting agency acceptable to authorities having jurisdiction:
 - 1. NFPA 252 for vertical access doors and frames.
 - 2. ASTM E 119 for horizontal access doors and frames.

1.04. COORDINATION

- G. If retaining this Article, also retain "Schedule" Paragraph in "Submittals" Article.
- H. Verification: Determine specific locations and sizes for access doors needed to gain access to concealed plumbing, mechanical, or other concealed work, and indicate in the schedule specified in "Submittals" Article.

PART 2 - PRODUCTS

2.01. STEEL MATERIALS

- A. Steel Plates, Shapes, and Bars: ASTM A 36/A 36M.
 - 1. ASTM A 123/A 123M, for galvanizing steel and iron products.

2. ASTM A 153/A 153M, for galvanizing steel and iron hardware.
- B. Rolled-Steel Floor Plate: ASTM A 786/A 786M, rolled from plate complying with ASTM A 36/A 36M or ASTM A 283/A 283M, Grade C or D.
1. ASTM A 123/A 123M, for galvanizing steel and iron products.
 2. ASTM A 153/A 153M, for galvanizing steel and iron hardware.
- C. Steel Sheet: **electrolytic zinc-coated, ASTM A 591/A 591M with** cold-rolled steel sheet substrate complying with ASTM A 1008/A 1008M, Commercial Steel (CS), exposed.
- D. Metallic-Coated Steel Sheet: ASTM A 653/A 653M, Commercial Steel (CS) with **A60 (ZF180)** zinc-iron-alloy (galvannealed) coating or **G60 (Z180)** mill-phosphatized zinc coating.
- E. Steel Finishes: Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.
1. Factory-Primed Finish: Manufacturer's standard shop primer.
 2. Baked-Enamel Finish: Minimum dry film thickness of **2 mils (0.05 mm)**.
 3. Powder-Coat Finish: Thickness not less than **1.5 mils (0.04 mm)**.
- F. Drywall Beads: **0.0299-inch (0.76-mm)** zinc-coated steel sheet to receive joint compound.
- G. Plaster Beads: **0.0299-inch (0.76-mm)** zinc-coated steel sheet with flange of expanded metal lath.
- H. Manufacturer's standard finish.

2.02. ALUMINUM MATERIALS

- I. Aluminum Extrusions: **ASTM B 221 (ASTM B 221M)**, Alloy 6063-T6, mill finish.
- J. Aluminum-Alloy Rolled Tread Plate: ASTM B 632/B 632M, Alloy 6061-T6, mill finish.
- K. Aluminum Sheet: **ASTM B 209 (ASTM B 209M)**.
1. Mill finish.
 2. Anodic Finish: **Class II, clear anodic coating complying with AAMA 611 Class I, clear anodic coating complying with AAMA 611**.
 3. Baked-Enamel Finish: Manufacturer's standard.

2.03. ACCESS DOORS AND FRAMES FOR WALLS AND CEILINGS

- L. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
- M. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Acudor Products, Inc.
2. Babcock-Davis; A Cierra Products Co.
3. Bar-Co, Inc. Div.; Alfab, Inc.
4. Cendrex Inc.
5. Dur-Red Products.
6. Elmdor/Stoneman; Div. of Acorn Engineering Co.
7. Jensen Industries.
8. J. L. Industries, Inc.
9. Karp Associates, Inc.
10. Larsen's Manufacturing Company.
11. MIFAB, Inc.
12. Milcor Inc.
13. Nystrom, Inc.
14. Williams Bros. Corporation of America (The).

N. Flush Access Doors and Trimless Frames: Fabricated from **steel** sheet.

1. Locations: **Wall and ceiling** surfaces.
2. Door: Minimum **0.060-inch- (1.5-mm-)** thick sheet metal.
3. Frame: Minimum **0.060-inch- (1.5-mm-)** thick sheet metal with **drywall /plaster** bead flange.
4. Hinges: **Continuous piano**.
5. Latch: **Cam latch**with interior release.
6. Lock: **Mortise cylinder**.

O. Fire-Rated, Insulated, Flush Access Doors and Frames with Exposed Trim: Fabricated from **steel** sheet.

1. Locations: **Wall and ceiling** surfaces.
2. Fire-Resistance Rating: Not less than **that of adjacent construction** .
3. Temperature Rise Rating: **250 deg F (139 deg C)** at the end of 30 minutes.
4. Door: Flush panel with a core of mineral-fiber insulation enclosed in sheet metal with a minimum thickness of **0.036 inch (0.9 mm)**.
5. Frame: Minimum **0.060-inch- (1.5-mm-)** thick sheet metal with **1-inch- (25-mm-)** wide, surface-mounted trim.
6. Hinges: **Continuous piano**.

7. Automatic Closer: Spring type.
8. Latch: Self-latching device operated by **flush key** with interior release.
9. Lock: Self-latching device with **mortise cylinder** lock.
 - a. Lock Preparation: Division 08 Section "**Door Hardware.**"

2.04. FABRICATION

- P. General: Provide access door and frame assemblies manufactured as integral units ready for installation.
- Q. Metal Surfaces: For metal surfaces exposed to view, provide materials with smooth, flat surfaces without blemishes.
- R. Doors and Frames: Grind exposed welds smooth and flush with adjacent surfaces. Furnish attachment devices and fasteners of type required to secure access panels to types of supports indicated.
- S. Recessed Access Doors: Form face of panel to provide recess for application of applied finish. Reinforce panel as required to prevent buckling.
- T. Latching Mechanisms: Furnish number required to hold doors in flush, smooth plane when closed.
 1. For cylinder lock, furnish two keys per lock and key all locks alike.
 2. For recessed panel doors, provide access sleeves for each locking device. Furnish plastic grommets and install in holes cut through finish.
- U. Extruded Aluminum: After fabrication, apply manufacturer's standard protective coating on aluminum that will come in contact with concrete.

PART 3 - EXECUTION

3.01. INSTALLATION

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

3.02. ADJUSTING AND CLEANING

- D. Adjust doors and hardware after installation for proper operation.
- E. Remove and replace doors and frames that are warped, bowed, or otherwise damaged.

END OF SECTION

**SECTION 08 51 13
ALUMINUM WINDOWS**

PART 1 - GENERAL

1.01 Summary

A. Section includes:

1. Aluminum Windows

B. Related Sections:

1.02 References

A. American Architectural Manufacturers Association (AAMA)

B. American Society for Testing and Materials (ASTM)

C. Aluminum Association (AA)

D. National Wood Window & Door Association (NWWDA)

1.03 System Description

A. General: In addition to requirements shown or specified, comply with:

1. Applicable provisions of AAMA Windows and Sliding Glass Doors Manual for design, materials, fabrication and installation of component parts.

B. Design Requirements: Arcadia ULT-500 Series HS-HC70/AW50 (thermal/nonthermal) Heavy Commercial Sliding Windows 4-inch depth.

C. Performance Requirements: Each assembly shall be tested by a recognized testing laboratory or agency in accordance with specified test methods.

1. Conformance to HS-HC70/AW50 specifications in AAMA/NWWDA 101/I.S. 2-97.

- a. Air Infiltration: Accordance with ASTM E 283.
- b. Water Resistance: Accordance with ASTM E 331.

1.04 Quality Assurance

A. Single Source Responsibility:

- 1. Obtain entrances, storefronts, ribbon walls, window walls, curtain walls, window systems, and finish through one source from a single manufacturer.

B. Provide test reports from AAMA accredited laboratories certifying the performances as specified in 1.03.

1.05 Warranty

- A. Warranted against failure and/or deterioration of metals due to manufacturing process for a period of two (2) years.

PART 2 – PRODUCTS

2.01 Manufacturers

A. Acceptable Manufacturers:

- 1. Arcadia Architectural Products, Inc., 60 Bonner Street, Stamford, CT. 203-316-8000, fax 203-316-8200.
- 2. Or approved equal

B. Acceptable Products:

- 1. Arcadia, ULT-500 Series (thermal/nonthermal) Heavy Commercial Sliding Windows, 4" depth.
- 2. Or approved equal

2.02 Materials

- A. All windows shall be fabricated from aluminum extrusions of 6063-T6 alloy and temper with a minimum wall thickness of 0.100" for the sill member and a minimum of 0.072" for all other members, including frame, sash and optional sash dividers. The aluminum shall be free of defects which impair strength and appearance.
- B. Component parts and accessories shall be of aluminum alloy, stainless steel or non-metallic materials which will neither deteriorate nor promote corrosion.
- C. Thermal break barrier shall provide a continuous uninterrupted thermal separation around the entire perimeter of the frame and sash and shall not be bridged by any metal conductor at any point. Thermal barrier shall consist of a two-part, chemically curing, high-strength urethane.
- D. Sill shall have a full-length nylon track cap.
- E. Sash members shall have a minimum of 3/4" glass penetration into the aluminum to provide extra protection against "blow out" during high wind conditions.
- F. Operable sash shall be equipped with two steel tandem ball bearing (all stainless steel tandem rollers and housings optional).
- G. Locking device Adams-Rite MS+1847 stainless steel mortise lock operated by a custom flush pull handle set available in either black or metallic gray powder coat.
- H. Horizontal member shall have two contact points incorporating silicone treated woven pile with mylar center fins. Vertical members shall have four contact points of silicone treated woven pile with mylar center fins. All shall be held in integral extruded slots and secured to prevent movement or loss while operating sash.
- I. Fixed and/or sliding sash members shall be constructed to allow for either factory or field glazing. Sash glazing shall be accomplished using a "marine" style reusable, wraparound black flexible polyvinyl chloride material per commercial standard CS230-60 without the need for separate glazing beads or putty style bedding compounds. The glazing channel shall be provided with the unit for either 1" insulating glass or 1/4" single glass.
- J. All assembly and installation screws shall be 18-8 or 410 stainless steel.
- K. Screens made of extruded aluminum frame and screened with 18 x 16 fiber mesh.

2.03 Finish

- A. Finish all exposed areas of aluminum and components as indicated.

- 1. Clear Anodized Class II (204 R1-0.4-0.7 mils thick) meeting AAMA 607.1.
- (or)
- (or)
- 1. Dark Bronze Anodized Class 1 (0.7 mils thick) meeting AAMA 608.1.
- (or)
- 1. Standard finish is White PPG UC-71533 – baked-on enamel – polycron – AAMA 2603.2.
- (or)
- 1. Standard finish is Quaker Bronze PPG UC-72867 – baked-on enamel – polycron – AAMA 2603.2.
- 1. Custom colors in a baked-on enamel or Duranar finish are also available – AAMA 2604.2 and AAMA 2605.2.

2.04 Fabrication

- A. Primary frame must be a minimum of 4" deep.
- B. Frame corner joint shall be secured with two stainless steel screws and must be back caulked under the frame jambs to insure a weather-resistant seal.
- C. Profile of the fixed jamb and the latching jamb shall include two weather-stripped pockets to receive the fixed and latching stiles.
- D. Fixed and sliding panels shall have a nominal 1-1/2" depth and shall have overlapped joints as well as the mortise type to provide strong interlocking, mechanically fastened hairline joints.
- E. Interlockers and latching stiles shall be heavy gauge tubular sections assuring precise alignment and to resist twisting under load conditions.

PART 3 – EXECUTION

3.01 Examinations

- A. Examine conditions and verify substrate conditions are acceptable for product installation.

3.02 Installation

- A. Install in accordance with approved shop drawings and manufacturers installation instructions.

3.03 Field Quality Control

- A. Contractor's responsibility to make all necessary final adjustments to attain normal operation of each window and its mechanical hardware.

END OF SECTION

**SECTION 08 80 00
GLASS AND GLAZING**

PART 1 - GENERAL

1.01. SUMMARY

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

1. Windows.
2. Doors.

1.02. PERFORMANCE REQUIREMENTS

- B. Delegated Design: Design glass, including comprehensive engineering analysis according to ASTM E 1300 and the most recent addition of the California Building Code by a qualified professional engineer, using the following design criteria:

1. Design Wind Pressures: As indicated on Drawings.
2. Vertical Glazing: For glass surfaces sloped 15 degrees or less from vertical, design glass to resist design wind pressure based on glass type factors for short-duration load.
3. Differential Shading: Design glass to resist thermal stresses induced by differential shading within individual glass lites.

1.03. PRECONSTRUCTION TESTING

- C. Preconstruction Adhesion and Compatibility Testing: Test each glazing material type, tape sealant, gasket, glazing accessory, and glass-framing member for adhesion to and compatibility with elastomeric glazing sealants.

1. Testing will not be required if data are submitted based on previous testing of current sealant products and glazing materials matching those submitted.

1.04. SUBMITTALS

- D. Product Data: For each glass product and glazing material indicated.
- E. Glass Samples: For each type of glass product other than clear monolithic vision glass; 12 inches (300 mm) square.
- F. Glazing Schedule: List glass types and thicknesses for each size opening and location. Use same designations indicated on Drawings.

- G. Delegated-Design Submittal: For glass indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.
- H. Preconstruction adhesion and compatibility test report.

1.05. QUALITY ASSURANCE

- I. Glazing Publications: Comply with published recommendations of glass product manufacturers and organizations below, unless more stringent requirements are indicated. Refer to these publications for glazing terms not otherwise defined in this Section or in referenced standards.
 - 1. GANA Publications: GANA's "Glazing Manual."
 - 2. IGMA Publication for Insulating Glass: SIGMA TM-3000, "North American Glazing Guidelines for Sealed Insulating Glass Units for Commercial and Residential Use."
- J. Safety Glazing Labeling: Where safety glazing labeling is indicated, permanently mark glazing with certification label of the SGCC or another certification agency acceptable to authorities having jurisdiction or the manufacturer. Label shall indicate manufacturer's name, type of glass, thickness, and safety glazing standard with which glass complies.
- K. Insulating-Glass Certification Program: Permanently marked either on spacers or on at least one component lite of units with appropriate certification label of IGCC.

1.06. WARRANTY

- L. Manufacturer's Special Warranty for Coated-Glass Products: Manufacturer's standard form in which coated-glass manufacturer agrees to replace coated-glass units that deteriorate within specified warranty period. Deterioration of coated glass is defined as defects developed from normal use that are not attributed to glass breakage or to maintaining and cleaning coated glass contrary to manufacturer's written instructions. Defects include peeling, cracking, and other indications of deterioration in coating.
 - 1. Warranty Period: **10** years from date of Substantial Completion.
- M. Manufacturer's Special Warranty on Insulating Glass: Manufacturer's standard form in which insulating-glass manufacturer agrees to replace insulating-glass units that deteriorate within specified warranty period. Deterioration of insulating glass is defined as failure of hermetic seal under normal use that is not attributed to glass breakage or to maintaining and cleaning insulating glass contrary to manufacturer's written instructions. Evidence of failure is the obstruction of vision by dust, moisture, or film on interior surfaces of glass.
 - 1. Warranty Period: **10** years from date of Substantial Completion.

PART 2 - PRODUCTS

2.01. GLASS PRODUCTS, GENERAL

- A. Thickness: Where glass thickness is indicated, it is a minimum. Provide glass lites in thicknesses as needed to comply with requirements indicated.

- B. Strength: Where float glass is indicated, provide annealed float glass, Kind HS heat-treated float glass, or Kind FT heat-treated float glass as needed to comply with "Performance Requirements" Article. Where heat-strengthened glass is indicated, provide Kind HS heat-treated float glass or Kind FT heat-treated float glass as needed to comply with "Performance Requirements" Article. Where fully tempered glass is indicated, provide Kind FT heat-treated float glass.
- C. Thermal and Optical Performance Properties: Provide glass with performance properties specified and as indicated in manufacturer's published test data.

2.02. GLASS PRODUCTS

- D. Float Glass: ASTM C 1036, Type I, Quality-Q3, ¼" thickness, Class I (clear) unless otherwise indicated.
 - 1. Products: Subject to compliance with requirements, **available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:**
 - a. AFG Industries, Inc.; Krystal Klear.
 - b. Guardian Industries Corp.; Ultrawhite.
 - c. Pilkington North America; Optiwhite.
 - d. PPG Industries, Inc.; Starphire.
- B. Insulating Glass: Factory-assembled units consisting of sealed lites of glass separated by a dehydrated interspace, qualified according to ASTM E 2190, and complying with other requirements specified.
 - 1. Products: Subject to compliance with requirements, **available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:**
 - a. AFG Industries, Inc.; Krystal Klear.
 - b. Guardian Industries Corp.; Ultrawhite.
 - c. Pilkington North America; Optiwhite.
 - d. PPG Industries, Inc.; Starphire.
- C. Laminated Safety Glass: ASTM C 1172, and complying with testing requirements in 16 CFR 1201 for Category II materials, and with other requirements specified. 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 or cast-in-place and cured-transparent-resin interlayer** to comply with interlayer manufacturer's written recommendations.
 - 2. Interlayer Thickness: Provide thickness not less than that indicated and as needed to comply with requirements.
 - 3. Interlayer Color: Clear unless otherwise indicated.

2.03. GLAZING GASKETS

- E. Dense Compression Gaskets: Molded or extruded gaskets of profile and hardness required to maintain watertight seal, made from **one of** the following:
 - 1. Neoprene complying with ASTM C 864.
 - 2. EPDM complying with ASTM C 864.
 - 3. Silicone complying with ASTM C 1115.
 - 4. Thermoplastic polyolefin rubber complying with ASTM C 1115.
- F. Soft Compression Gaskets: Extruded or molded, closed-cell, integral-skinned neoprene, silicone or thermoplastic polyolefin rubber gaskets complying with ASTM C 509, Type II, black; of profile and hardness required to maintain watertight seal.
 - 1. Application: Use where soft compression gaskets will be compressed by inserting dense compression gaskets on opposite side of glazing or pressure applied by means of pressure-glazing stops on opposite side of glazing.

2.04. GLAZING SEALANTS

- G. General:
 - 1. Compatibility: Provide glazing sealants that are compatible with one another and with other materials they will contact, including glass products, seals of insulating-glass units, and glazing channel substrates, under conditions of service and application, as demonstrated by sealant manufacturer based on testing and field experience.
 - 2. Suitability: Comply with sealant and glass manufacturers' written instructions for selecting glazing sealants suitable for applications indicated and for conditions existing at time of installation.
 - 3. VOC Content: For sealants used inside of the weatherproofing system, not more than 250 g/L when calculated according to 40 CFR 59, Subpart D.
 - 4. Colors of Exposed Glazing Sealants: As indicated by manufacturer's designations.
- H. Glazing Sealant: Neutral-curing silicone glazing sealant complying with ASTM C 920, Type S, Grade NS, Class 100/50, Use NT.
- I. Glazing Sealants for Fire-Rated Glazing Products: Products that are approved by testing agencies that listed and labeled fire-resistant glazing products with which they are used for applications and fire-protection ratings indicated.

2.05. GLAZING TAPES

- J. Back-Bedding Mastic Glazing Tapes: Preformed, butyl-based, 100 percent solids elastomeric tape; nonstaining and nonmigrating in contact with nonporous surfaces; with or without spacer rod as recommended in writing by tape and glass manufacturers for application indicated; and complying with ASTM C 1281 and AAMA 800 for products indicated below:
 - 1. AAMA 804.3 tape, where indicated.

2. AAMA 806.3 tape, for glazing applications in which tape is subject to continuous pressure.
 3. AAMA 807.3 tape, for glazing applications in which tape is not subject to continuous pressure.
- K. Expanded Cellular Glazing Tapes: Closed-cell, PVC foam tapes; factory coated with adhesive on both surfaces; and complying with AAMA 800 for the following types:
1. AAMA 810.1, Type 1, for glazing applications in which tape acts as the primary sealant.
 2. AAMA 810.1, Type 2, for glazing applications in which tape is used in combination with a full bead of liquid sealant.

2.06. MISCELLANEOUS GLAZING MATERIALS

- L. Cleaners, Primers, and Sealers: Types recommended by sealant or gasket manufacturer.
- M. Setting Blocks: Elastomeric material with a Shore, Type A durometer hardness of 85, plus or minus 5.
- N. Spacers: Elastomeric blocks or continuous extrusions of hardness required by glass manufacturer to maintain glass lites in place for installation indicated.
- O. Edge Blocks: Elastomeric material of hardness needed to limit glass lateral movement (side walking).
- P. Cylindrical Glazing Sealant Backing: ASTM C 1330, Type O (open-cell material), of size and density to control glazing sealant depth and otherwise produce optimum glazing sealant performance.
- Q. Perimeter Insulation for Fire-Resistive Glazing: Product that is approved by testing agency that listed and labeled fire-resistant glazing product with which it is used for application and fire-protection rating indicated.

2.07. GLASS TYPES

- R. Vision Glass Components:
1. Clear (interior Glazing):
 - a. Strength: Annealed or tempered, as required by code.
 - b. Thickness: ¼-inch thick, unless otherwise indicated.
 - c. Locations: Provide at single glazed interior openings and as scheduled.
 - 1) Provide at interior vision glass locations, and as scheduled.
 - d. Performance Values:
 - 1) Visible Light Transmittance: 88 percent.

- 2) Shading Coefficient: 0.94
- 3) Winter U-Value: 1.09.

S. Coated Solar Control Types

1. Low-E2 (Exterior Glazing):

- a. Type: PPG Solarban 60 (3). Provide insulated glass in accordance with dual-glazed assembly type specified above with low emissivity (low-E2) pyrolytic coating conforming to ASTM C 1376, tempered or heat strengthened where required by code. Locate coating on surface designated by number in parenthesis starting from exterior surface.
- b. Thickness: 1/4-inch thickness, or as required by code.
- c. Locations: Provide at exterior vision glass locations, and as scheduled.
- d. Performance Values:
 - 1) Visible Light Transmittance: 52 percent.
 - 2) Shading Coefficient: 0.35.
 - 3) Winter U-Value: 0.29.

T. Special Purpose Types

1. Laminated:

- a. Type: Tinted laminated glass with two plies of fully tempered float glass.
- b. Thickness of Each Glass Ply: 1/4"
- c. Interlayer Thickness: 1/4"
- d. Provide safety glazing labeling.
- e. Locations: Provide at exterior glazing for Gymnasium.

PART 3 - EXECUTION

3.01. GLAZING, GENERAL

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

damage or other imperfections that, when installed, could weaken glass and impair performance and appearance.

- D. Apply primers to joint surfaces where required for adhesion of sealants, as determined by preconstruction testing.
- E. Install setting blocks in sill rabbets, sized and located to comply with referenced glazing publications, unless otherwise required by glass manufacturer. Set blocks in thin course of compatible sealant suitable for heel bead.
- F. Do not exceed edge pressures stipulated by glass manufacturers for installing glass lites.
- G. Provide spacers for glass lites where length plus width is larger than 50 inches (1270 mm).
- H. Provide edge blocking where indicated or needed to prevent glass lites from moving sideways in glazing channel, as recommended in writing by glass manufacturer and according to requirements in referenced glazing publications.

3.02. TAPE GLAZING

- I. Position tapes on fixed stops so that, when compressed by glass, their exposed edges are flush with or protrude slightly above sightline of stops.
- J. Install tapes continuously, but not necessarily in one continuous length. Do not stretch tapes to make them fit opening.
- K. Cover vertical framing joints by applying tapes to heads and sills first and then to jambs. Cover horizontal framing joints by applying tapes to jambs and then to heads and sills.
- L. 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.
- M. Apply heel bead of elastomeric sealant.
- N. Center glass lites in openings on setting blocks and press firmly against tape by inserting dense compression gaskets formed and installed to lock in place against faces of removable stops. Start gasket applications at corners and work toward centers of openings.
- O. Apply cap bead of elastomeric sealant over exposed edge of tape.

3.03. GASKET GLAZING (DRY)

- P. Cut compression gaskets to lengths recommended by gasket manufacturer to fit openings exactly, with allowance for stretch during installation.
- Q. Insert soft compression gasket between glass and frame or fixed stop so it is securely in place with joints miter cut and bonded together at corners.
- R. Installation with Drive-in Wedge Gaskets: Center glass lites in openings on setting blocks and press firmly against soft compression gasket by inserting dense compression gaskets formed and installed to lock in place against faces of removable stops. Start gasket applications at corners and work toward centers of openings. Compress gaskets to produce a weathertight

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

- S. Installation with Pressure-Glazing Stops: Center glass lites in openings on setting blocks and press firmly against soft compression gasket. Install dense compression gaskets and pressure-glazing stops, applying pressure uniformly to compression gaskets. Compress gaskets to produce a weathertight seal without developing bending stresses in glass. Seal gasket joints with sealant recommended by gasket manufacturer.
- T. Install gaskets so they protrude past face of glazing stops.

3.04. SEALANT GLAZING (WET)

- U. Install continuous spacers, or spacers combined with cylindrical sealant backing, between glass lites and glazing stops to maintain glass face clearances and to prevent sealant from extruding into glass channel and blocking weep systems until sealants cure. Secure spacers or spacers and backings in place and in position to control depth of installed sealant relative to edge clearance for optimum sealant performance.
- V. Force sealants into glazing channels to eliminate voids and to ensure complete wetting or bond of sealant to glass and channel surfaces.
- W. Tool exposed surfaces of sealants to provide a substantial wash away from glass.

3.05. CLEANING AND PROTECTION

- X. Protect exterior glass from damage immediately after installation by attaching crossed streamers to framing held away from glass. Do not apply markers to glass surface. Remove nonpermanent labels and clean surfaces.
- Y. Protect glass from contact with contaminating substances resulting from construction operations. If, despite such protection, contaminating substances do come into contact with glass, remove substances immediately as recommended in writing by glass manufacturer.
- Z. Examine glass surfaces adjacent to or below exterior concrete and other masonry surfaces at frequent intervals during construction, but not less than once a month, for buildup of dirt, scum, alkaline deposits, or stains; remove as recommended in writing by glass manufacturer.
- AA. Remove and replace glass that is broken, chipped, cracked, or abraded or that is damaged from natural causes, accidents, and vandalism, during construction period.

END OF SECTION

**SECTION 08 91 00
STATIONARY BLADE WALL LOUVERS**

PART 1 – GENERAL

1.01. SECTION INCLUDES

- A. Extruded aluminum stationary louvers with drainable blades.

1.02. RELATED SECTIONS

- A. Section 03 30 00 - Cast-In-Place Concrete.
- B. Section 06 10 00 - Rough Carpentry.
- C. Section 07 42 00 - Metal Wall Panels.
- D. Section 07 60 00 - Flashing and Sheet Metal.
- E. Section 07 92 00 - Joint Sealants.
- F. Section 09 90 00 - Paints.

1.03. REFERENCES

- A. AAMA 2604 – High Performance Organic Coatings on Architectural Extrusions and Panels.
- B. AAMA 2605 - High Performance Organic Coatings on Architectural Extrusions and Panels
- C. AAMA 611 – Voluntary Specification for Anodized Architectural Aluminum.
- D. AMCA 500 - Test Methods for Louvers, Dampers and Shutters.
- E. AMCA 511 - Certified Ratings Program for Air Control Devices.
- F. ASCE 7 - Minimum Design Loads for Buildings and Other Structures
- G. ASTM B209 – Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate.
- H. ASTM B221 – Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes.
- I. ASTM D822 - Standard Practice for Filtered Open-Flame Carbon-Arc Exposures of Paint and Related Coatings.
- J. ASTM D4214 - Standard Test Methods for Evaluating the Degree of Chalking of Exterior Paint Films.
- K. ASTM D2244 - Standard Test Method for Calculation of Color Differences From Instrumentally Measured Color Coordinates.

1.04. DEFINITIONS

- A. Louver Terminology: Definitions of terms for metal louvers contained in AMCA 501 apply to this Section unless otherwise defined in this Section or in referenced standards.

- B. Horizontal Louver: Louver with horizontal blades; i.e., the axes of the blades are horizontal.
- C. Vertical Louver: Louver with vertical blades; i.e., the axes of the blades are vertical.
- D. Drainable-Blade Louver: Louver with blades having gutters that collect water and drain it to channels in jambs and mullions, which carry it to bottom of unit and away from opening.
- E. Rain-Resistant Louver: Louver that provides specified wind-driven rain performance, as determined by testing according to AMCA 500-L.

1.05. ACTION SUBMITTALS

- A. Submit under provisions of Section 01 30 00.
- B. Product Data: For each product to be used, including:
 - 1. Manufacturer's product data including performance data.
 - 2. Preparation instructions and recommendations.
 - 3. Storage and handling requirements and recommendations.
 - 4. Installation methods.
- C. Shop Drawings:
 - 1. Submit shop drawings indicating materials, construction, dimensions, accessories, and installation details.
- D. Product Schedule: For louvers. Use same designations indicated on Drawings.

1.06. INFORMATIONAL SUBMITTALS

- A. Qualification Data: For manufacturer and Installer.
- B. Product Test Reports: For each type of louver, for tests performed by a qualified testing agency.
- C. Field quality-control reports.
- D. Sample Warranties: For manufacturer's warranties.

1.07. QUALITY ASSURANCE

- A. Manufacturer Qualifications:
 - 1. The manufacturer shall have implemented the management of quality objectives, continual improvement, and monitoring of customer satisfaction to assure that customer needs and expectations are met.
 - 2. Manufacturer shall be International Organization for Standardization (ISO) 9001 accredited.
- B. Product Qualifications:
 - 1. Louvers licensed to bear AMCA Certified Ratings Seal. Ratings based on tests and

procedures performed in accordance with AMCA 511 and comply with AMCA Certified Ratings Program. AMCA Certified Ratings Seal applies to air performance and water penetration ratings.

2. Louvers shall be factory engineered to withstand the specified seismic loads.
 - a. Minimum design loads shall be calculated to comply with ASCE – 7, or local requirements of Authority Having Jurisdiction (AHJ).
3. Recycled Content: Provide louver that incorporate recycled content materials. The louver shall consist of the following recycled content:
 - a. Fabricated aluminum recycled content 73% by weight. 18% post-consumer, 55 % pre-consumer.

1.08. DELIVERY, STORAGE, AND HANDLING

- A. Store products in manufacturer's unopened packaging until ready for installation.
- B. Store materials in a dry area indoors, protected from damage and in accordance with manufacturer's instructions.
- C. Handling: Protect materials and finishes during handling and installation to prevent damage.
- D. Store and dispose of solvent-based materials, and materials used with solvent-based materials, in accordance with requirements of local authorities having jurisdiction.

1.09. PROJECT CONDITIONS

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

1.10. WARRANTY

- A. Manufacturer shall provide standard limited warranty for louver systems for a period of five years (60 months) from date of installation, no more than 60 months after shipment from manufacturing plant. When notified in writing from the Owner of a manufacturing defect, manufacturer shall promptly correct deficiencies without cost to the Owner.
- B. Manufacturer shall provide 20 year limited warranty for fluoropolymer-based finish on extruded aluminum substrates.
 1. Finish coating shall not peel, blister, chip, crack or check.
 2. Chalking, fading or erosion of finish when measured by the following tests:
 - a. Finish coating shall not chalk in excess of 8 numerical ratings when measured in accordance with ASTM D4214.
 - b. Finish coating shall not change color or fade in excess of 5 NBS units as determined by ASTM D2244 and ASTM D822.
 - c. Finish coating shall not erode at a rate in excess of 10%/ 5 year as determined by Florida test sample.

- C. Manufacturer shall provide a 5 year limited warranty for Class I and a 3 year limited warranty for Class II anodized finish on extruded aluminum substrates.
 - 1. Seller warrants the Finish under normal atmospheric conditions.
 - a. Will not crack, craze, flake or blister
 - b. Will not change or fade more than (5) Delta-E Hunter units as determined by ASTM method D-2244
 - c. Will not chalk in excess of ASTM D-4214-07 number (8) rating, determined by the procedure outlined in ASTM D-4214-07 specification test.
 - 2. Any forming or welding must be done prior to finishing. Post forming or welding will void the warranty.
 - 3. This Warranty applies only if the anodized aluminum product is installed in strict accordance with Seller's recommended practices and maintained in accordance with AAMA (American Architectural Manufacturers Association) publication number 609 and 610-09 ("Cleaning and Maintenance Guide for Architecturally Finished Aluminum").

PART 2 – PRODUCTS

2.01. MANUFACTURERS

- A. Acceptable Manufacturer: Ruskin Company; 3900 Dr. Greaves Road, Kansas City, Missouri 64030. Tel: (816) 761-7476.
- B. Requests for substitutions will be considered in accordance with provisions of Section 01 63 00.

2.02. STATIONARY BLADE LOUVER

- A. Model: ELF6375DX as manufactured by Ruskin Company.
- B. Model: ELF6375DXH as manufactured by Ruskin Company.
- C. Fabrication:
 - 1. Design: Stationary drainable louver type with drain gutters in each blade and head with downspouts in jambs and mullions with all welded construction. Hidden vertical supports to allow continuous line appearance up to 120 inches (3,048 mm). Steeply angled integral sill.
 - 2. Frame:
 - a. Frame Depth: 6 inches (152 mm).
 - b. Wall Thickness: 0.125 inch (3.2 mm), nominal.
 - c. Material: Extruded aluminum, Alloy 6063-T6.
 - 3. Blades:
 - a. Style: Drainable. 37.5 degrees at 5-29/32 inches (150 mm), nominal.

- b. Wall Thickness: 0.125 inch (3.2 mm), nominal.
 - c. Material: Extruded aluminum, Alloy 6063-T6.
4. Minimum Assembly Size: 12 inches wide by 12 inches high (305 mm x 305 mm).
 5. Maximum Factory Assembly Size: Single sections shall not exceed 120 inches wide by 90 inches high (3048 mm x 2286 mm) or 90 inches wide by 120 inches high (2286 mm x 3048). Louvers larger than the maximum single size shall be require field assembly of smaller sections.
 6. Recycled Content: 18% post-consumer. 55% pre-consumer, post-industrial. 73% total by weight.
- A. Performance Data:
1. Based on testing 48 inch x 48 inch (1,219 mm x 1,219 mm) size unit in accordance with AMCA 500.
 2. Free Area: 57 percent, nominal.
 3. Maximum Recommended Air Flow through Free Area: 1023 feet per minute (5.2 m/s).
 4. Air Flow: 9289 cubic feet per minute (263 m³/s).
 5. Maximum Pressure Drop (Intake): 0.15 inches w.g. (0.035 kPa).
 6. Water Penetration: Maximum of 0.01 ounces per square foot (3.1 g/m²) of free area at an air flow of 1,023 feet per minute (5.2 m/s) free area velocity when tested for 15 minutes.
- B. Louvers shall be factory engineered to withstand the specified seismic loads.
1. Minimum design loads shall be calculated to comply with ASCE – 7, or local requirements of Authority Having Jurisdiction (AHJ).

2.03. ACCESSORIES

- A. Aluminum Blank-Off Panels: 0.040 (1 mm) aluminum sheet, factory installed with removable fasteners and neoprene gaskets.
- B. Hinged Frame: Continuous piano hinge attached to angle subframe.

2.04. FINISHES

- A. Anodized Finish:
 1. Class I Clear Anodized.
 - a. Comply with Aluminum Association AA-C21A41. Clear anodized finish 215-R1.
 - b. Apply finish following chemical etching and pretreatment.
 - c. Minimum Thickness: 0.7 mils (0.018 mm), 60 minute anodizing process.

PART 3 – EXECUTION

3.01. EXAMINATION

- A. Inspect areas to receive louvers. Notify the Architect of conditions that would adversely affect the installation or subsequent utilization of the louvers. Do not proceed with installation until unsatisfactory conditions are corrected.
- B. If opening preparation is the responsibility of another installer, notify Architect of unsatisfactory preparation before proceeding.

3.02. PREPARATION

- A. Clean opening thoroughly prior to installation.
- B. Prepare surfaces using the methods recommended by the manufacturer for achieving the best result for the substrate under the project conditions.

3.03. INSTALLATION

- A. Install louvers at locations indicated on the drawings and in accordance with manufacturer's instructions.
- B. Install louvers plumb, level, in plane of wall, and in alignment with adjacent work.
- C. The supporting structure shall be designed to accommodate the point loads transferred by the louvers when subject to the design wind loads.
- D. Install joint sealants as specified in Section 07 92 00.
- E. Apply field topcoat within 6 months of application of shop prime coat. Apply field topcoat as specified in Section 09 91 00.

3.04. CLEANING

- A. Clean louver surfaces in accordance with manufacturer's instructions.
- B. Touch-up, repair or replace damaged products before Substantial Completion.

END OF SECTION

**SECTION 09 24 00
PORTLAND CEMENT PLASTER**

PART 1 - GENERAL

1.01. SUMMARY

- A. Section Includes:
1. Exterior portland cement plasterwork (stucco) on metal lath.

1.02. SUBMITTALS

- B. Product Data: For each type of product indicated.
- C. Shop Drawings: Show locations and installation of control and expansion joints including plans, elevations, sections, details of components, and attachments to other work.
- D. Samples : For each type of factory-prepared finish coat indicated.

1.03. QUALITY ASSURANCE

- E. Fire-Resistance Ratings: Where indicated, provide portland cement plaster assemblies identical to those of assemblies tested for fire resistance per ASTM E 119 by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.
- F. Mockups: Before plastering, install mockups of at least 100 sq. ft. (9.3 sq. m) in surface area to demonstrate aesthetic effects and set quality standards for materials and execution.
1. Approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.04. PROJECT CONDITIONS

- G. Comply with ASTM C 926 requirements.
- H. Factory-Prepared Finishes: Comply with manufacturer's written recommendations for environmental conditions for applying finishes.

PART 2 - PRODUCTS

2.01. METAL LATH

- A. Expanded-Metal Lath: ASTM C 847 with ASTM A 653/A 653M, G60 (Z180), hot-dip galvanized zinc coating.
1. Diamond-Mesh Lath: Self-furring, 2.5 lb/sq. yd. (1.4 kg/sq. m).

B. Paper Backing: FS UU-B-790, Type I, Grade D, Style 2 vapor-permeable paper.

1. Provide paper-backed lath at exterior locations.

2.02. ACCESSORIES

C. General: Comply with ASTM C 1063 and coordinate depth of trim and accessories with thicknesses and number of plaster coats required.

D. Metal Accessories:

1. Foundation Weep Screed: Fabricated from hot-dip galvanized-steel sheet, ASTM A 653/A 653M, G60 (Z180) zinc coating.
2. Cornerite: Fabricated from metal lath with ASTM A 653/A 653M, G60 (Z180), hot-dip galvanized zinc coating.
3. External-Corner Reinforcement: Fabricated from metal lath with ASTM A 653/A 653M, G60 (Z180), hot-dip galvanized zinc coating.
4. Cornerbeads: Fabricated from zinc-coated (galvanized) steel.
 - a. Small-nose style; use unless otherwise indicated.
5. Casing Beads: Fabricated from 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 (6.34 to 16 mm) wide; with perforated flanges.

E. Plastic Accessories: Fabricated from high-impact PVC.

1. Cornerbeads: With perforated flanges.
 - a. Small-nose style; use unless otherwise indicated.
2. Casing Beads: With perforated flanges in depth required to suit plaster bases indicated and flange length required to suit applications indicated.
 - a. Square-edge style; use unless otherwise indicated.
3. Control Joints: 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.
4. Expansion Joints: Two-piece type, formed to produce slip-joint and square-edged 1/2-inch- (13-mm-) wide reveal; with perforated concealed flanges.

2.03. MISCELLANEOUS MATERIALS

- F. Water for Mixing: Potable and free of substances capable of affecting plaster set or of damaging plaster, lath, or accessories.
- G. Fiber for Base Coat: Alkaline-resistant glass or polypropylene fibers, 1/2 inch (13 mm) long, free of contaminants, manufactured for use in portland cement plaster.
- H. Steel Drill Screws: For metal-to-metal fastening, ASTM C 1002 or ASTM C 954, as required by thickness of metal being fastened; with pan head that is suitable for application; in lengths required to achieve penetration through joined materials of no fewer than three exposed threads.
- I. Fasteners for Attaching Metal Lath to Substrates: Complying with ASTM C 1063.
- J. Wire: ASTM A 641/A 641M, Class 1 zinc coating, soft temper, not less than 0.0475-inch (1.21-mm) diameter, unless otherwise indicated.

2.04. PLASTER MATERIALS

- K. Portland Cement: ASTM C 150, Type I.
- L. Lime: ASTM C 206, Type S; or ASTM C 207, Type S.
- M. Sand Aggregate: ASTM C 897.
 - 1. Color for Job-Mixed Finish Coats: as indicated on drawings.
- N. Acrylic-Based Finish Coatings: Factory-mixed acrylic-emulsion coating systems, formulated with colorfast mineral pigments and fine aggregates; for use over portland cement plaster base coats. Include manufacturer's recommended primers and sealing topcoats for acrylic-based finishes.
 - 1. Color: As selected by Architect from manufacturer's full range.

2.05. PLASTER MIXES

- O. General: Comply with ASTM C 926 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.
- P. 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. Masonry Cement Mixes:
 - a. Scratch Coat: 1 part masonry cement and 2-1/2 to 4 parts aggregate.
 - b. Brown Coat: 1 part masonry cement and 3 to 5 parts aggregate, but not less than volume of aggregate used in scratch coat.
- 3. Portland and Masonry Cement Mixes:
 - a. Scratch Coat: 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.
 - b. Brown Coat: For cementitious material, mix 1 part portland cement and 1 part masonry cement. Use 3 to 5 parts aggregate per part of cementitious material, but not less than volume of aggregate used in scratch coat.
- 4. Plastic Cement Mixes:
 - a. Scratch Coat: 1 part plastic cement and 2-1/2 to 4 parts aggregate.
 - b. Brown Coat: 1 part plastic cement and 3 to 5 parts aggregate, but not less than volume of aggregate used in scratch coat.
- 5. Portland and Plastic Cement Mixes:
 - a. Scratch Coat: For cementitious material, mix 1 part plastic cement and 1 part portland cement. Use 2-1/2 to 4 parts aggregate per part of cementitious material.
 - b. Brown Coat: For cementitious material, mix 1 part plastic cement and 1 part portland cement. Use 3 to 5 parts aggregate per part of cementitious material, but not less than volume of aggregate used in scratch coat.
- Q. Factory-Prepared Finish-Coat Mixes: For acrylic-based finish coatings, comply with manufacturer's written instructions.

PART 3 - EXECUTION

3.01. PREPARATION

- A. Protect adjacent work from soiling, spattering, moisture deterioration, and other harmful effects caused by plastering.
- B. Prepare solid substrates for plaster that are smooth or that do not have the suction capability required to bond with plaster according to ASTM C 926.

3.02. INSTALLATION, GENERAL

- C. Fire-Resistance-Rated Assemblies: Install components according to requirements for design designations from listing organization and publication indicated on Drawings.

- D. Sound Attenuation Blankets: Where required, install blankets before installing lath unless blankets are readily installed after lath has been installed on one side.

3.03. INSTALLING ACCESSORIES

- E. Install according to ASTM C 1063 and at locations indicated on Drawings.
- F. Reinforcement for External Corners:
 - 1. Install lath-type, external-corner reinforcement at exterior locations.
 - 2. Install cornerbead at exterior locations.
- G. Control Joints: Install control joints at locations indicated on Drawings.
 - 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.

3.04. PLASTER APPLICATION

- H. General: Comply with ASTM C 926.
- I. Walls; Base-Coat Mixes for Use over Metal Lath: Scratch and brown coats for three-coat plasterwork, 3/4-inch (19-mm) thickness.
 - 1. Portland cement mixes.
 - 2. Masonry cement mixes.
 - 3. Portland and masonry cement mixes.
 - 4. Plastic cement mixes.
 - 5. Portland and plastic cement mixes.
- J. Ceilings; Base-Coat Mixes for Use over Metal Lath: Scratch and brown coats for three-coat plasterwork; 1/2 inch (13 mm) thick.
 - 1. Portland cement mixes.

2. Masonry cement mixes.
 3. Portland and masonry cement mixes.
 4. Plastic cement mixes.
 5. Portland and plastic cement mixes.
- K. Plaster Finish Coats: Apply to provide finish to match existing building.
- L. Acrylic-Based Finish Coatings: Apply coating system, including primers, finish coats, and sealing topcoats, according to manufacturer's written instructions.
- 3.05. PLASTER REPAIRS
- M. 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.

END OF SECTION

**SECTION 09 29 00
GYPSUM BOARD**

PART 1 - GENERAL

1.01. RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.02. SUMMARY

- A. This Section includes the following:

- 1. Interior gypsum board.
- 2. Exterior gypsum board for ceilings and soffits.
- 3. Tile backing panels.

- B. Related Sections include the following:

- 1. Division 6 Section "Rough Carpentry" for wood framing and furring that supports gypsum board.
- 2. Division 9 painting Sections for primers applied to gypsum board surfaces.

1.03. SUBMITTALS

- A. Product Data: For each type of product indicated.

- B. Samples: For the following products:

- 1. Trim Accessories: Full-size Sample in 12-inch- (300-mm-) long length for each trim accessory indicated.
- 2. Textured Finishes: **Manufacturer's standard size** for each textured finish indicated and on same backing indicated for Work.

1.04. QUALITY ASSURANCE

- A. Fire-Resistance-Rated Assemblies: For fire-resistance-rated assemblies, provide materials and construction identical to those tested in assembly indicated according to ASTM E 119 by an independent testing agency.
- B. STC-Rated Assemblies: For STC-rated assemblies, provide materials and construction identical to those tested in assembly indicated according to ASTM E 90 and classified according to ASTM E 413 by an independent testing agency.

- C. Mockups: Before beginning gypsum board installation, install mockups of at least 100 sq. ft. (9 sq. m) in surface area to demonstrate aesthetic effects and set quality standards for materials and execution.
 - 1. Install mockups for the following:
 - a. Each level of gypsum board finish indicated for use in exposed locations.
 - b. Each texture finish indicated.
 - 2. Apply or install final decoration indicated, including painting and wallcoverings, on exposed surfaces for review of mockups.
 - 3. Simulate finished lighting conditions for review of mockups.
 - 4. Approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.05. STORAGE AND HANDLING

- A. Store materials inside under cover and keep them dry and protected against damage from weather, condensation, direct sunlight, construction traffic, and other causes. Stack panels flat to prevent sagging.

1.06. PROJECT CONDITIONS

- A. Environmental Limitations: Comply with ASTM C 840 requirements or gypsum board manufacturer's written recommendations, whichever are more stringent.
- B. Do not install interior products until installation areas are enclosed and conditioned.
- C. Do not install panels that are wet, those that are moisture damaged, and those that are mold damaged.
 - 1. Indications that panels are wet or moisture damaged include, but are not limited to, discoloration, sagging, or irregular shape.
 - 2. Indications that panels are mold damaged include, but are not limited to, fuzzy or splotchy surface contamination and discoloration.

PART 2 - PRODUCTS

2.01. PANELS, GENERAL

- A. Recycled Content: Provide gypsum panel products with recycled content such that postconsumer recycled content plus one-half of preconsumer recycled content constitutes a minimum of percent by weight.
- B. Size: Provide in maximum lengths and widths available that will minimize joints in each area and that correspond with support system indicated.

2.02. INTERIOR GYPSUM BOARD

- A. General: Complying with ASTM C 36/C 36M or ASTM C 1396/C 1396M, as applicable to type of gypsum board indicated and whichever is more stringent.

1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
2. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. American Gypsum Co.
 - b. National Gypsum Company.
 - c. USG Corporation.

B. Type X:

1. Thickness: As indicated (15.9 mm).
2. Long Edges: **Tapered and featured (rounded or beveled) for prefilling.**

C. Type C:

1. Thickness: As required by fire-resistance-rated assembly indicated on Drawings.
2. Long Edges: Tapered.

D. Flexible Type: Manufactured to bend to fit radii and to be more flexible than standard regular-type gypsum board of same thickness.

1. Thickness: 1/4 inch (6.4 mm).
2. Long Edges: Tapered.

E. Ceiling Type: Manufactured to have more sag resistance than regular-type gypsum board.

1. Thickness: 1/2 inch (12.7 mm).
2. Long Edges: Tapered.

F. Moisture- and Mold-Resistant Type: With moisture- and mold-resistant core and surfaces.

1. Core: as indicated (15.9 mm), Type X.
2. Long Edges: Tapered.

2.03. TILE BACKING PANELS

A. Water-Resistant Gypsum Backing Board: ASTM C 630/C 630M or ASTM C 1396/C 1396M.

1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
2. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

- a. American Gypsum Co.
 - b. National Gypsum Company.
 - c. USG Corporation.
3. Core: **As indicated on Drawings.**
- B. Cementitious Backer Units: ANSI A118.9.
1. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, the following:
 2. Products: Subject to compliance with requirements, provide one of the following:
 - a. Custom Building Products; Wonderboard.
 - b. FinPan, Inc.; Util-A-Crete Concrete Backer Board.
 - c. USG Corporation; DUROCK Cement Board.
 3. Thickness: **1/2 inch (12.7 mm).**

2.04. TRIM ACCESSORIES

- A. Interior Trim: ASTM C 1047.
1. Material: **Galvanized or aluminum-coated steel sheet or rolled zinc.**
 2. Shapes:
 - d. Cornerbead.
 - e. Bullnose bead.
 - f. LC-Bead: J-shaped; exposed long flange receives joint compound.
 - g. L-Bead: L-shaped; exposed long flange receives joint compound.
 - h. U-Bead: J-shaped; exposed short flange does not receive joint compound.
 - i. Expansion (control) joint.
 - j. Curved-Edge Cornerbead: With notched or flexible flanges.
- B. Aluminum Trim: Extruded accessories of profiles and dimensions indicated.
1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 2. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - k. Fry Reglet Corp.

3. Aluminum: Alloy and temper with not less than the strength and durability properties of ASTM B 221 (ASTM B 221M), Alloy 6063-T5.
4. Finish: **Corrosion-resistant primer compatible with joint compound and finish materials specified.**

2.05. JOINT TREATMENT MATERIALS

- A. General: Comply with ASTM C 475/C 475M.
- B. Joint Tape:
 1. Interior Gypsum Wallboard: 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 Wallboard: For each coat use formulation that is compatible with other compounds applied on previous or for successive coats.
 1. Prefilling: At open joints, **rounded or beveled panel edges**, and damaged surface areas, use setting-type taping compound.
 2. Embedding and First Coat: For embedding tape and first coat on joints, fasteners, and trim flanges, use **setting-type taping** or **drying-type, all-purpose** compound.
 - a. Use setting-type compound for installing paper-faced metal trim accessories.
 3. Fill Coat: For second coat, use **setting-type, sandable topping** or **drying-type, all-purpose** compound.
 4. Finish Coat: For third coat, use **setting-type, sandable topping** or **drying-type, 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. Exterior Gypsum Soffit Board: Use setting-type taping compound and setting-type, sandable topping compound.
 2. Glass-Mat Gypsum Sheathing Board: As recommended by sheathing board manufacturer.
- E. Joint Compound for Tile Backing Panels:
 1. Water-Resistant Gypsum Backing Board: Use setting-type taping compound and setting-type, sandable topping compound.

2. Glass-Mat, Water-Resistant Backing Panel: As recommended by backing panel manufacturer.
3. Cementitious Backer Units: As recommended by backer unit manufacturer.

2.06. AUXILIARY MATERIALS

- A. General: Provide auxiliary materials that comply with referenced installation standards and manufacturer's written recommendations.
- B. Laminating Adhesive: Adhesive or joint compound recommended for directly adhering gypsum panels to continuous substrate.
 1. Use adhesives that have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
- C. Steel Drill Screws: ASTM C 1002, unless otherwise indicated.
 1. Use screws complying with ASTM C 954 for fastening panels to steel members from 0.033 to 0.112 inch (0.84 to 2.84 mm) thick.
 2. For fastening cementitious backer units, use screws of type and size recommended by panel manufacturer.
- D. Sound Attenuation Blankets: ASTM C 665, Type I (blankets without membrane facing) produced by combining thermosetting resins with mineral fibers manufactured from glass, slag wool, or rock wool.
 1. Fire-Resistance-Rated Assemblies: Comply with mineral-fiber requirements of assembly.
 2. Recycled Content: Provide blankets with recycled content such that postconsumer recycled content plus one-half of preconsumer recycled content constitutes a minimum of 25 percent by weight.
- E. Acoustical Sealant: As specified in Division 7 Section "Joint Sealants."
 1. Provide sealants that have a VOC content of **250** g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
- F. Thermal Insulation: As specified in Division 7 Section "Building Insulation."
- G. Vapor Retarder: As specified in Division 7 Section "Building Insulation."

2.07. TEXTURE FINISHES

- A. Primer: As recommended by textured finish manufacturer.
- H. Polystyrene Aggregate Ceiling Finish: Water-based, job-mixed, polystyrene aggregate finish with flame-spread and smoke-developed indexes of not more than 25 when tested according to ASTM E 84.

1. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, the following:
 2. Products: Subject to compliance with requirements, provide one of the following:
 - a. G-P Gypsum; Georgia-Pacific Regency Ceiling Textures/Polystyrene.
 - b. National Gypsum Company; Perfect Spray.
 - c. USG Corporation; SHEETROCK Ceiling Spray Texture, QT.
 3. Texture: **Fine**.
- I. Aggregate Finish: Water-based, job-mixed, aggregated, drying-type texture finish for spray application.
1. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, the following:
 2. Products: Subject to compliance with requirements, provide one of the following:
 - a. G-P Gypsum; Georgia-Pacific Ceiling Textures/Vermiculite.
 - b. USG Corporation; SHEETROCK Wall and Ceiling Spray Texture (Aggregated).
 3. Texture: **Light spatter**.
- J. Acoustical Finish: Water-based, chemical-setting or drying-type, job-mixed texture finish for spray application.
1. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, the following:
 2. Products: Subject to compliance with requirements, provide one of the following:
 - a. International Cellulose Corp.; SonaSpray "fc."
 - b. USG Corporation; USG Acoustical Plaster Finish.
 3. Application Thickness: **[1/2 inch (12.7 mm)]**
 4. Fire-Test-Response Characteristics: Indices when tested according to ASTM E 84 as follows:
 - a. Flame Spread: Less than **25**.
 - b. Smoke Developed: Less than **450**.
 5. NRC: **0.55** according to ASTM C 423.

PART 3 - EXECUTION

3.01. EXAMINATION

- A. Examine areas and substrates, with Installer present, and including welded hollow-metal frames and framing, for compliance with requirements and other conditions affecting performance.
- B. Examine panels before installation. Reject panels that are wet, moisture damaged, and mold damaged.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02. APPLYING AND FINISHING PANELS, GENERAL

- A. Comply with ASTM C 840.
- B. Install ceiling panels across framing to minimize the number of abutting end joints and to avoid abutting end joints in central area of each ceiling. Stagger abutting end joints of adjacent panels not less than one framing member.
- C. Install panels with face side out. Butt panels together for a light contact at edges and ends with not more than 1/16 inch (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, except floors. 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. Wood Framing: Install gypsum panels over wood framing, with floating internal corner construction. Do not attach gypsum panels across the flat grain of wide-dimension lumber,

including floor joists and headers. Float gypsum panels over these members, or provide control joints to counteract wood shrinkage.

- J. STC-Rated Assemblies: Seal construction at perimeters, behind control joints, and at openings and penetrations with a continuous bead of acoustical sealant. Install acoustical sealant at both faces of partitions at perimeters and through penetrations. Comply with ASTM C 919 and with manufacturer's written recommendations for locating edge trim and closing off sound-flanking paths around or through assemblies, including sealing partitions above acoustical ceilings.
- K. Install sound attenuation blankets before installing gypsum panels, unless blankets are readily installed after panels have been installed on one side.

3.03. APPLYING INTERIOR GYPSUM BOARD

- A. Install interior gypsum board in the following locations:

1. Regular Type: **Vertical surfaces, unless otherwise indicated.**
2. Type X: **As indicated on Drawings and Where required for fire-resistance-rated assemblies.**
3. Flexible Type: **Apply in double layer at curved assemblies.**
4. Ceiling Type: **Ceiling surfaces.**
5. Abuse-Resistant Type: **As indicated on Drawings.**

- B. Single-Layer Application:

1. On ceilings, apply gypsum panels before wall/partition board application to greatest extent possible and at right angles to framing, unless otherwise indicated.
2. On partitions/walls, apply gypsum panels **vertically (parallel to framing)**, 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. On Z-furring members, apply gypsum panels vertically (parallel to framing) with no end joints. Locate edge joints over furring members.
4. Fastening Methods: Apply gypsum panels to supports with steel drill screws.

- C. Multilayer Application:

1. On ceilings, apply gypsum board indicated for base layers before applying face layers on walls/partitions; apply face layers in same sequence. Apply base layers at right angles to framing members and offset face-layer joints 1 framing member, 16 inches (400 mm) minimum, from parallel base-layer joints, unless otherwise indicated or required by fire-resistance-rated assembly.

2. On partitions/walls, apply gypsum board indicated for base layers and face layers vertically (parallel to framing) with joints of base layers located over stud or furring member and face-layer joints offset at least one stud or furring member with base-layer joints, unless otherwise indicated or required by fire-resistance-rated assembly. Stagger joints on opposite sides of partitions.
 3. On Z-furring members, apply base layer vertically (parallel to framing) and face layer either vertically (parallel to framing) or horizontally (perpendicular to framing) with vertical joints offset at least one furring member. Locate edge joints of base layer over furring members.
 4. Fastening Methods: **Fasten base layers and face layers separately to supports with screws.**
- D. Laminating to Substrate: Where gypsum panels are indicated as directly adhered to a substrate (other than studs, joists, furring members, or base layer of gypsum board), comply with gypsum board manufacturer's written recommendations and temporarily brace or fasten gypsum panels until fastening adhesive has set.
- E. Curved Surfaces:
1. Install panels horizontally (perpendicular to supports) and unbroken, to extent possible, across curved surface plus 12-inch- (300-mm-) long straight sections at ends of curves and tangent to them.
 2. For double-layer construction, fasten base layer to studs with screws 16 inches (400 mm) o.c. Center gypsum board face layer over joints in base layer, and fasten to studs with screws spaced 12 inches (300 mm) o.c.
- 3.04. APPLYING TILE BACKING PANELS
- A. Water-Resistant Gypsum Backing Board: Install at tile walls where wall is partially tiled. Install with 1/4-inch (6.4-mm) gap where panels abut other construction or penetrations.
 - B. Cementitious Backer Units: ANSI A108.11, at **locations indicated to receive tile.**
 - C. Areas Not Subject to Wetting: Install regular-type gypsum wallboard panels to produce a flat surface except at showers, tubs, and other locations indicated to receive water-resistant panels.
 - D. Where tile backing panels abut other types of panels in same plane, shim surfaces to produce a uniform plane across panel surfaces.
- 3.05. INSTALLING TRIM ACCESSORIES
- A. General: For trim with back flanges intended for fasteners, attach to framing with same fasteners used for panels. Otherwise, attach trim according to manufacturer's written instructions.
 - B. Control Joints: Install control joints **at locations indicated on Drawings or according to ASTM C 840 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**.
5. U-Bead: Use **at exposed panel edges**.
6. Curved-Edge Cornerbead: Use at curved openings.

D. Aluminum Trim: Install in locations **indicated on Drawings**.

3.06. FINISHING GYPSUM BOARD

- A. General: Treat gypsum board joints, interior angles, edge trim, control joints, penetrations, fastener heads, surface defects, and elsewhere as required to prepare gypsum board surfaces for decoration. Promptly remove residual joint compound from adjacent surfaces.
- B. Prefill open joints, **rounded or beveled edges**, and damaged surface areas.
- C. Apply joint tape over gypsum board joints, except those with trim having flanges not intended for tape.
- D. Gypsum Board Finish Levels: Finish panels to levels indicated below and according to ASTM C 840:
 1. Level 1: Ceiling plenum areas, concealed areas, and where indicated.
 2. Level 2: **Panels that are substrate for tile**.
 3. Level 3: Not Used.
 4. Level 4: **At panel surfaces that will be exposed to view, unless otherwise indicated**.
 - a. Primer and its application to surfaces are specified in other Division 9 Sections.
 5. Level 5: **Where indicated on Drawings**.
 - b. Primer and its application to surfaces are specified in other Division 9 Sections.
- E. Glass-Mat Gypsum Sheathing Board: Finish according to manufacturer's written instructions for use as exposed soffit board.
- F. Glass-Mat, Water-Resistant Backing Panels: Finish according to manufacturer's written instructions.
- G. Cementitious Backer Units: Finish according to manufacturer's written instructions.

3.07. APPLYING 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.

- B. Texture Finish Application: Mix and apply finish using powered spray equipment, to produce a uniform texture[**matching approved mockup and**] free of starved spots or other evidence of thin application or of application patterns.
- C. Prevent texture finishes from coming into contact with surfaces not indicated to receive texture finish by covering them with masking agents, polyethylene film, or other means. If, despite these precautions, texture finishes contact these surfaces, immediately remove droppings and overspray to prevent damage according to texture-finish manufacturer's written recommendations.

3.08. PROTECTION

- A. Protect installed products from damage from weather, condensation, direct sunlight, construction, and other causes during remainder of the construction period.
- B. Remove and replace panels that are wet, moisture damaged, and mold damaged.
 - 1. Indications that panels are wet or moisture damaged include, but are not limited to, discoloration, sagging, or irregular shape.
 - 2. Indications that panels are mold damaged include, but are not limited to, fuzzy or splotchy surface contamination and discoloration.

END OF SECTION

SECTION 09 51 13
ACOUSTICAL TILE CEILINGS

PART 1 - GENERAL

1.01. SUMMARY

- A. This Section includes acoustical panels and exposed suspension systems for ceilings.

1.02. SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Coordination Drawings: Drawn to scale and coordinating acoustical panel ceiling installation with hanger attachment to building structure and ceiling mounted items:
- C. Samples: For each exposed finish.
- D. Product test reports.
- E. Research/evaluation reports.
- F. Maintenance data.

1.03. QUALITY ASSURANCE

- A. Acoustical Testing Agency Qualifications: An independent testing laboratory or an NVLAP-accredited laboratory.
- B. Fire-Test-Response Characteristics:
 - 1. Fire-Resistance Characteristics: Where indicated, provide acoustical panel ceilings identical to those of assemblies tested for fire resistance per ASTM E 119 by UL or another testing and inspecting agency acceptable to authorities having jurisdiction.
 - a. Identify materials with appropriate markings of applicable testing and inspecting agency.
 - 2. Surface-Burning Characteristics: Acoustical panels complying with ASTM E 1264 for Class **A** materials, when tested per ASTM E 84.
 - a. Smoke-Developed Index: 450 or less.
- C. Seismic Standard: Comply with the following:
 - 1. Standard for Ceiling Suspension Systems Requiring Seismic Restraint: Comply with ASTM E 580.
 - 2. UBC Standard 25-2, "Metal Suspension Systems for Acoustical Tile and for Lay-in Panel Ceilings."

3. ASCE 7, "Minimum Design Loads for Buildings and Other Structures": Section 9, "Earthquake Loads."
 - D. Mockups: Build mockups to verify selections made under sample submittals and to demonstrate aesthetic effects and set quality standards for materials and execution.
 1. Approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.
 - E. Preinstallation Conference: Conduct conference at Project site
- 1.04. EXTRA MATERIALS
- A. Furnish extra materials described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 1. Acoustical Ceiling Panels: Full-size panels equal to 2.0 percent of quantity installed.
 2. Suspension System Components: Quantity of each exposed component equal to 2.0 percent of quantity installed.

PART 2 - PRODUCTS

2.01. ACOUSTICAL PANEL CEILINGS, GENERAL

- A. Acoustical Panel Standard: Comply with ASTM E 1264.
- B. Metal Suspension System Standard: Comply with ASTM C 635.
- C. Attachment Devices: Size for five times the design load indicated in ASTM C 635, Table 1, "Direct Hung," unless otherwise indicated. Comply with seismic design requirements.
 1. Anchors in Concrete: Expansion anchors fabricated from corrosion-resistant materials, 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 per ASTM E 488 or ASTM E 1512 as applicable, conducted by a qualified testing and inspecting agency.
 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 per ASTM E 1190, conducted by a qualified testing and inspecting agency.
- D. Wire Hangers, Braces, and Ties: Zinc-coated carbon-steel wire; ASTM A 641/A 641M, Class 1 zinc coating, soft temper.
 1. Size: Select wire diameter so its stress at 3 times hanger design load (ASTM C 635, Table 1, "Direct Hung") will be less than yield stress of wire, but provide not less than 0.106-inch- (2.69-mm-) diameter wire.
- E. Seismic perimeter stabilizer bars, seismic struts, and seismic clips.

- F. Metal Edge Moldings and Trim: Type and profile indicated or, if not indicated, manufacturer's standard moldings for edges and penetrations that comply with seismic design requirements; formed from sheet metal of same material, finish, and color as that used for exposed flanges of suspension system runners.

2.02. ACOUSTICAL PANELS FOR ACOUSTICAL PANEL CEILING

- A. Products: Subject to compliance with requirements:

- 1. Armstrong World Industries, Inc. or equal.

- B. Model: Cortega 24 x 48 factory finish.

2.03. METAL SUSPENSION SYSTEM FOR ACOUSTICAL PANEL CEILING

- A. Basis-of-Design Product: Subject to compliance with requirements, provide USG Interiors, Inc., Finesline DXF/DXLF or approved equal.

- B. Double-Web, Steel Suspension System: Main and cross runners roll formed from cold-rolled steel sheet, prepainted, electrolytically zinc coated, or hot-dip galvanized according to ASTM A 653/A 653M, not less than G30 (Z90) coating designation, with prefinished 9/16-inch- (15-mm-) wide metal caps on flanges.

- 1. Structural Classification: Heavy-duty system.
- 2. End Condition of Cross Runners: Override (stepped) or butt-edge type.
- 3. Cap Material: Steel cold-rolled sheet.
- 4. Cap Finish: Painted in color as selected from manufacturer's full range.

PART 3 - EXECUTION

3.01. INSTALLATION

- A. Comply with UBC Standard 25-2 and seismic design requirements indicated, per manufacturer's written instructions and CISCA's "Ceiling Systems Handbook."

- B. Measure each ceiling area and establish layout of acoustical panels to balance border widths at opposite edges of each ceiling. Avoid using less-than-half-width panels at borders.

- C. Suspend ceiling hangers from building's structural members, plumb and free from contact with insulation or other objects within ceiling plenum. Splay hangers only where required to miss obstructions; offset resulting horizontal forces by bracing, countersplaying, or other equally effective means. Where width of ducts and other construction within ceiling plenum produces hanger spacings that interfere with location of hangers, use trapezes or equivalent devices. 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.

- 1. Do not support ceilings directly from permanent metal forms or floor deck; anchor into concrete slabs.

2. Do not attach hangers to steel deck tabs.
- D. Install edge moldings and trim of type indicated at perimeter of acoustical ceiling area and where necessary to conceal edges of acoustical panels. 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, leveling with ceiling suspension system to a tolerance of 1/8 inch in 12 feet (3.2 mm in 3.6 m). Miter corners accurately and connect securely.
 - E. Install suspension system runners so they are square and securely interlocked with one another. Remove and replace dented, bent, or kinked members.
 - F. Install acoustical panels with undamaged edges and fit accurately into suspension system runners and edge moldings. Scribe and cut panels at borders and penetrations to provide a neat, precise fit.

END OF SECTION

**SECTION 09 65 19
RESILIENT FLOORING**

PART 1 – GENERAL

1.01. SECTION INCLUDES

- A. Resilient quartz tile flooring.
- B. Resilient top set base.

1.02. REFERENCES

- A. ADAAG - Americans with Disabilities Act (ADA) Accessibility Guidelines for Buildings and Facilities.
- B. CBC - California Building Code, (CCR) California Code of Regulations, Title 24, Part 2, California State Accessibility Standards.
- C. ASTM D2047 - Static Coefficient of Friction of Polish-Coated Floor Surfaces as Measured by the James Machine.
- D. ASTM E648 - Test Method for Critical Radiant Flux of Floor-Covering Systems using a Radiant Energy Source.
- E. ASTM E662 - Test Method for Specific Optical Density of Smoke Generated by Solid Materials.
- F. ASTM F710 - Practice for Preparing Concrete Floors and other Monolithic Floors to Receive Resilient Flooring.
- G. ASTM F1869 - Standard Test Method for Measuring Moisture Vapor Emission Rate of Concrete Subfloor Using Anhydrous Calcium Chloride.

1.03. REGULATORY REQUIREMENTS

- A. Resilient flooring to comply with the following fire performance characteristics as determined by testing products per ASTM test method indicated below:
 - 1. Critical Radiant Flux: 0.45 watts per sq cm or more per ASTM E648.
 - 2. Smoke Density: Less than 450 per ASTM E662.
- B. Products supplied for tile installation shall comply with local regulations controlling use of volatile organic compounds (VOC).
- C. Resilient flooring products shall have a coefficient of friction when tested according to ASTM D2047 of 0.60 for flat floors and 0.80 for ramped surfaces.
- D. Conform to CBC, California Building Code, (CCR) Title 24, Part 2, and ADAAG for accessibility requirements.

1.04. SUBMITTALS

- A. Submit shop drawings and product data under provisions of Section 01 33 00.
- B. Provide seaming and pattern plan.

- C. Submit samples under provisions of Section 01 33 00.
- D. Submit two samples 3 x 3 inches in size, illustrating color and pattern for each floor material specified.
- E. Submit two 2 inch long samples of base material for each material specified.
- F. Submit Owner's written acceptance of final floor finish of vinyl composition tile to Architect under provisions of Section 01 77 00.

1.05. OPERATION AND MAINTENANCE DATA

- A. Submit cleaning and maintenance data under provisions of Section 01 77 00.
- B. Include maintenance procedures, recommended maintenance materials, and suggested schedule for cleaning, stripping, and re-waxing.

1.06. ENVIRONMENTAL REQUIREMENTS

- A. Concrete subfloor to be allowed to cure for a minimum of 90 days to achieve acceptable dryness.
- B. Store materials for three days prior to installation in area of installation to achieve temperature stability.
- C. Maintain ambient temperature required by adhesive manufacturer three days prior to, during, and 24 hours after installation of materials.
- D. Subfloor Moisture Conditions: Moisture emission rate of no more than 3 lb/1000 sq. ft./24 hours when tested by Quantitative Anhydrous Calcium Chloride Test, ASTM F1869, with subfloor temperature not less than 65 degrees F.
- E. Subfloor Alkalinity Conditions: A pH range of between 5 to 9 when subfloor is wetted with potable water and pHdrion paper is applied.

1.07. EXTRA MATERIALS

- A. Provide 120 sq ft of flooring and 40 lineal feet of base of each material specified under provisions of Section 01 77 00.

PART 2 - PRODUCTS

2.01. MANUFACTURERS - RESILIENT QUARTZ TILE FLOORING

- A. Altro, Altro Quartz Tile, www.altrofloors.com.
- B. Substitutions: Under provisions of Section 01 33 00

2.02. RESILIENT QUARTZ TILE FLOORING MATERIALS

- A. Quartz Tile: Versa Quartz Tile, 24 x 24 inch size, 1/8 inch thick; marbled design. Colors as selected by Architect from manufacturer's full range of colors.

2.03. ACCEPTABLE MANUFACTURERS - BASE MATERIALS

- A. Altro Flooring, www.altrofloors.com.

- B. Substitutions: Under provisions of Section 01 33 00.

2.04. BASE MATERIALS

- A. Base: Type TPR rubber; coved; 4 inch high; 0.125 inch thick; top set, in maximum practical lengths.
- B. Manufacturer: Burke

2.05. ACCESSORIES

- A. Subfloor Filler: White premix Portland Cement latex type as recommended by flooring material manufacturer.
- B. Primers and Adhesives: Waterproof; types recommended by flooring manufacturer. Shall meet South Coast Air Quality Management District (SCAQMD) Rule #1168.
- C. Edge Strips: Rubber.
- D. Sealer and Wax: Types recommended by flooring manufacturer. Coordinate selection of floor wax with Owner's maintenance program.

PART 3 – EXECUTION

3.01. EXAMINATION

- A. Verify that concrete slabs comply with ASTM F710 and are as specified herein.
- B. Verify concrete floors exhibit acceptable moisture emission rate; exhibit negative alkalinity, carbonization, or dusting.
- C. Verify that surfaces are smooth and flat and are ready to receive Work.
- D. Beginning of installation means acceptance of existing substrate and site conditions.

3.02. PREPARATION

- A. Remove sub-floor ridges and bumps. Fill low spots, cracks, joints, holes, and other defects with subfloor filler.
- B. Apply, trowel, and float filler to leave a smooth, flat, hard surface.
- C. Prohibit traffic from area until filler is cured.
- D. Vacuum clean substrate.
- E. Apply primer to concrete slab surfaces if recommended by flooring manufacturer.

3.03. INSTALLATION - TILE MATERIAL

- A. Install in accordance with manufacturer's instructions.
- B. Mix tile from container to ensure shade variations are consistent.
- C. Spread only enough adhesive to permit installation of materials before initial set.
- D. Set flooring in place, press with heavy roller to attain full adhesion.

- E. Install tile to pattern indicated on drawings.
- F. Pattern grain parallel for all units and parallel to length of room. Allow minimum 1/2 full size tile width at room or area perimeter.
- G. Terminate flooring at centerline of door openings where adjacent floor finish is dissimilar.
- H. Install edge strips at unprotected or exposed edges, and where flooring terminates.
- I. Scribe flooring to walls, columns, cabinets, floor outlets, and other appurtenances to produce tight joints.
- J. Install flooring under movable partitions and under cabinetry without interrupting floor pattern.
- K. Install flooring in open cabinet recesses.

3.04. INSTALLATION - BASE MATERIAL

- A. Fit joints tight and vertical.
- B. Install material in maximum practical lengths.
- C. Maintain minimum measurement of 18 inches between joints.
- D. Miter internal corners.
- E. Field wrap external corners with longest practical lengths. "V" cut back surface to 2/3 its thickness.
- F. Install base on solid backing. Bond tight to wall and floor surfaces.
- G. Scribe and fit to door frames and other interruptions.

3.05. CLEANING

- A. Remove excess adhesive from floor, base and wall surfaces without damage.
- B. Sweep or vacuum floor thoroughly.
- C. Damp mop with a neutral detergent solution.
- D. Carefully remove black marks with a scrubbing pad or brush.

3.06. PROTECTION

- A. Prohibit traffic on floor finish for 48 hours after installation.
- B. Protect floor finish until final completion with a non-asphaltic building paper.
- C. Maintain protective covering until final completion.

3.07. COMPLETION

- A. At final completion, remove floor protection and correct any damage.
- B. Apply 2 coats of sealer to vinyl composition tile.
- C. Apply 4 coats of wax to vinyl composition tile.

- D. Each coat of sealer and wax to be thoroughly dry before installing subsequent coats.
- E. Final coat of wax to be burnished in accordance with manufacturer's recommendations.
- F. Floor finish with 1844 Buckeye (buckeyeinternational.com).
- G. Obtain Owner's written acceptance of final floor finish at completion of sealer and wax application.
- H. Submit copy of Owner's acceptance of floor finish to architect.

END OF SECTION

**SECTION 09 90 00
PAINTING**

PART 1 – GENERAL

1.01 SECTION INCLUDES:

- A. This section covers painting of exposed elements of the project, interior and exterior, Sealing and back priming of wood in the field. Surfaces that are left unfinished by requirements of other sections shall be finished as part of this section.

1.02 SECTION EXCLUDES:

- A. Control panels and control systems.
- B. Fabric connections to fans.
- C. Flexible conduit connections to equipment, miscellaneous name plates, stamping and instruction labels and manufacturer's data.
- D. Equipment and products having a complete factory finish, except as specified or noted on drawings.
- E. Flag, floodlight, parking light poles and loudspeaker poles furnished with a factory finish.
- F. The following items if specified or furnished with galvanized finish shall not be painted: Metal shelving, chain link fencing, areaway and catch basin gratings and frames.
- G. Brass, bronze, lead, stainless steel, and chrome or nickel-plated elements.
- H. Non-metallic walking surfaces unless specifically shown or specified to be painted.
- I. Fire rating labels at fire doors and frames.
- J. Cement masonry units at exterior.

1.03 RELATED SECTIONS:

- A. Section 05 50 00- Metal Fabrications.
- B. Section 06 20 00 - Finish Carpentry.
- C. Section 07 62 00 –Sheet Metal Flashing and Trim
- D. Section 08 11 13 – Hollow Metal Doors and Frames and Window Frames.
- E. Section 08 14 16 – Flush Wood Doors.
- F. Section 09 24 00 – Portland Cement Plaster.
- H. Section 09 29 00– Gypsum Board.

1.04 QUALITY ASSURANCE

- A. Certification of Materials: With every delivery of paint materials, the manufacturer shall certify on the manufacturer's letterhead that materials comply with the requirements of this section.
- B. Paint materials shall comply with the Food and Drug Administration's (F.D.A.) Lead Law and the current rules and regulations of local, state and federal agencies governing the use of paint materials.
- C. Coats: The number of coats specified is the minimum number acceptable. If full coverage is not obtained with the specified number of coats, apply such additional coats as are necessary to produce the required finish.
- D. Employ coats and undercoats for all types of finishes in strict accordance with the recommendations of the paint manufacturer and approved by Architect.

1.05 SUBMITTALS

- A. Submittals shall be made in accordance with Section 01 33 00.
- B. List of Paint Materials: Prior to submittal of samples, submit a complete list of proposed paint materials, identifying each material by manufacturer's name, product name and number, including primers, thinners, and coloring agents, together with manufacturers' catalog data fully describing each material as to contents, recommended usage, and preparation and application methods. Identify surfaces to receive various paint materials. Do not deviate from approved list.
- C. Submit manufacturer's standard color samples for each type of paint used. Once colors have been selected, submit 3 samples of each color selected for each type of paint, on standard 8-1/2 x 11 inch spray-out panel with substrate textures demonstrated.
- D. For transparent and stained finishes, prepare samples (16" long) on same species and quality of wood to be installed on the project, showing system used and each step of the finishing process>.
- E. Manufacturers shall verify that their products conform to latest California Air Resources Board and AQMD regulations.
- F. An MSDS sheet will be included with each individual submittal.

1.06 DELIVERY, STORAGE AND HANDLING

- A. Materials shall be delivered to the project site in original unbroken containers bearing manufacturer's name, brand number and batch number corresponding to description on list of materials as approved.
- B. Open and mix ingredients on the premises in the presence of the District Inspector. Immediately remove rejected materials from the premises.
- C. Storage and Mixing of Materials: Store materials and mix only in spaces designated for the purpose by the District Inspector. Keep such spaces clean and take necessary precautions to prevent fire. Hang out oily rags flat and singly in the open air. Stack paint containers so that manufacturer's labels are clearly displayed.

1.07 ENVIRONMENTAL CONDITIONS

- A. General: Follow mfr.'s printed recommendations for product when they are more stringent than limits stated herein.
- B. Do not apply "paint" to "wet-applied" construction until such work is "dry", and acceptable to Construction Manager and "paint" mfr.
- C. Temperature and Humidity: Do not apply exterior paint in damp, rainy or foggy weather (above 90% relative humidity) or until the surface has thoroughly dried from the effects of such weather. Do not apply paint, interior or exterior, when the temperature is below 50 or above 100 degrees F., or dust conditions are unfavorable to proper workmanship.
- D. Ventilation: As necessary to provide air movement, aid drying, disperse noxious fumes.

1.08 GUARANTEE

- A. Materials and workmanship guarantee shall be in accordance with the requirements of the Contract Documents, except that guarantee shall be furnished jointly by the Contractor and the materials manufacturer.

PART 2 – PRODUCTS

2.01 PAINT MATERIALS

- A. General: All materials used in the work are listed for Dunn-Edwards Paint. PPG has been adopted by the LSD Board of Education as the "sole source" paint for use in the District. Provide PPG products equal to Dunn-Edwards scheduled items.
- B. Regulatory changes may affect the formulation, availability, or use of specified coatings. Verify with supplier or your representative regarding such changes prior to start of painting project.
- C. Use the paint products of one Paint manufacturer unless otherwise specified or approved. In any case, primers, intermediate and finish coats in each painting system must all be the products of the same manufacturer, including thinners and coloring agents, except for materials furnished with shop prime coat by other trades. To the maximum extent feasible, factory mix paint materials to correct color, gloss, and consistency for application. Dunn-Edwards products are specified herein except as otherwise noted, to establish types and qualities.

PART 3 – EXECUTION

3.01 PREPARATION

- A. Inspect surfaces to receive paint finish for surface blemishes and repair as required. Surfaces that are not properly prepared or sandpapered or cleaned or which are not in condition to receive the specified finish, shall be corrected, before priming is done. Wash and rinse walls and trim with T.P.S. before applying any primer. No priming shall be done until District IOR Inspector or the Owner's representative approves the surfaces.

- B. Protect floors and all adjacent surfaces from paint smears, spatters, and accidental droppings. Cover fixtures and remove hardware not to be painted. Mask off areas where necessary. Any accidental spills, over-painting or spatters shall be cleaned up immediately before additional work proceeds.

Hardware: Insure that hardware is removed before painting is started and replaced only when paint finishes are thoroughly dry.

1. Removal and reinstallation of hardware is specified in Section 06200--Finish Carpentry and Millwork.
 2. Items to be removed include, without limitation: Signs and graphics; switch and receptacle plates; escutcheons and plates; all surface-mounted equipment; free-standing equipment blocking access; grilles and louvers at ducts opening into finished spaces; all tape on doors, walls or other District property; and other items as required and directed.
- C. Woodwork shall be thoroughly cleaned, hand sandpapered parallel to the grain, and dusted off. Nail holes, cracks or defects in all work shall be carefully puttied. Caulk all woodwork joints with specified caulking. Wash and rinse trim with T.P.S. both before applying any primer. On stained woodwork the putty shall be colored to match the stain. Puttying shall be done after the first coat of paint, shellac or varnish has been applied.
- D. Gypsum board: Remove all foreign matter. Fill all pits flush and smooth with spackle. Wash and rinse Gypsum board walls with T.P.S. before applying any primer.
- E. Plaster surfaces shall be allowed to dry at least 3 weeks before painting, or plaster shall be allowed to dry sufficiently to receive paint as determined by moisture meter tests. Clean off dirt, dust, excess mortar, encrustation and foreign matter. Fill holes, pits and other imperfections flush and smooth. Wash and rinse Plaster walls with T.P.S. before applying primer.
- F. Concrete Surfaces shall be dry, cleaned of dirt and foreign materials and in proper condition to receive paint. Neutralize spots showing effects of alkali.
- G. Metal surfaces to be painted shall be thoroughly cleaned of rust, corrosion, oil, foreign materials, blisters, and loose paint removed to bright metal. Apply the metal paint preparation coating recommended by the paint manufacturer prior to applying the primer. All shop and field painted metal shall follow these procedures.
- H. Surfaces Not Mentioned: Prepare surfaces according to recommendations of the paint manufacturer and as approved by the Architect or the Owner.
- I. Do not apply painting materials to wet, damp, dusty, dirty, fingermarked, rough, unfinished, or defective surfaces.
- J. Bond breakers and curing agents must be removed and the surface cleaned, as specified is section 3.01-A above, before primers, sealers or finish paints are applied.

3.02 APPLICATION

- A. General: Employ experienced painters supervised by a foreman with a minimum of 5 years' experience in public works projects, thoroughly familiar with code requirements, the best recommendations of the painting materials manufacturer. Utilize the following methods and procedures:

1. Apply material evenly, free from sags, runs, crawls, holidays or defects. Mix to proper consistency, brush out smooth, leaving minimum of brush marks, enamel uniformly flowed on. Sand between enamel coats.
 2. Apply paint by brushes, rollers or spray except rollers shall not be used on wood surfaces or on wood floors. If rollers are used on other surfaces, then all surfaces shall be brushed out by hand. Spraying is not permitted on wood floors. Paint wood floors by using a hand brush, applying the paint at the specified application rate as recommended by the manufacturer. Apply in thin coats allowing proper drying time between coats. The use of two ventilation fans is required in each room to accelerate the drying of the floors. One fan in the door pushing air into the room and one fan in a window exhausting air out of the room. Keep fans running until all paint fume smells and non-existence in the rooms.
 3. Tint all pigmented undercoats to approximately same shade as final coat. Perceptibly increase the depth of shade in successive coats.
 4. Allow each coat to thoroughly dry before succeeding coat application, a minimum of 24 hours. Sand between enamel coats.
 5. Finish all four edges of doors with the same number and kind of coatings as specified for their main surfaces on all new or reused doors. Where opening into rooms have different finishes, finish door edges to match the side into which it swings. The top of all doors that open to the outside shall have a continuous painted top coating to prevent moisture from penetrating the door material.
 6. Finish mill or shop primed items with materials compatible with prime coat.
 7. Mechanical and electrical work shall be cleaned, pretreated and painted with 3 coats or as noted:
 - a. Paint that portion of ductwork or plenum spaces, the interior of which is visible through the grilles: they shall be pretreated and painted with 2 coats of flat black paint.
 - b. Shop primed metal surface of all mechanical and electrical equipment shall receive two finish coats of paint to match adjoining wall or ceiling surfaces. Prime coat, in addition to above, on all unprimed surfaces.
 - c. All other mechanical and electrical equipment exposed to view, such as covered and uncovered piping and ductwork, supports for piping and ductwork, pumps compressors, air conditioning equipment, tanks, etc., shall be painted as specified herein, where not supplied finished under other sections.
 8. Miscellaneous painting: Surfaces to be painted and not specifically described herein shall be painted with a product specifically manufactured or prepared for the material and surface; prime coat and two finish coats and subjected to all the conditions previously mentioned above governing painting.
- B. Back-painting: Immediately upon delivery to the building, exterior finish lumber and millwork shall be back-painted on surfaces that will be concealed after installation. Items to be painted shall be back-painted with the priming coat specified under "Priming".
- C. Priming: Wood and metal surfaces specified to receive paint finish shall be primed as specified in section 3.01. Surfaces of miscellaneous metal and steel not embedded in

concrete, and surfaces of unprimed plain sheet metal work shall be primed immediately upon delivery to the project. Galvanized metal work and interior and exterior woodwork shall be primed immediately after erection. Priming of surfaces and priming coat shall be as follows and as specified in schedule.

1. Knots, Pitch and Sap Pockets: Shellac, or approved equivalent, before priming.
 2. Exterior Woodwork: Prime with one coat of exterior water borne emulsion wood primer.
 3. Interior Woodwork: Where indicated to be painted, prime with one coat of water borne wood primer.
 4. Stain: Woodwork indicated to receive a stain and varnish finish shall be stained to an even color with water borne stain. On open-grained hardwood, mix stain with paste filler and completely fill pores in wood.
 5. Galvanized Metal Work: Clean oil, grease and other foreign materials from surfaces. Apply the recommended muratic acid etching solution and thoroughly wash metal. Apply pretreatment coating and follow manufacturer's instructions for drying time, and then prime with one coat of metal primer as specified in section 3.01.
 6. Unprimed Iron, Steel, and Other Uncoated Metals: Where specified to be painted, prime with one coat of metal primer as specified in section 3.01..
 7. Shop Primed Metal Items: Metal shall be primed as specified in section 3.01 and touch up bare and abraded areas with metal primer prior to application of second and third coats.
- D. The number of paint coats specified to be applied are the minimum required. Apply additional coats if required to obtain complete coverage and approved results. Ensure acceptable paint finishes of uniform color, free from cloudy or mottled areas and evident thinness on arises. "Spot" or undercoat surfaces as necessary to produce such results. Conform to the approved Samples. Obtain approval of each coat before applying next coat. If this inspection step is missed, apply an additional coat over entire surface involved at no additional contract cost.
- E. Each coat of painted woodwork and metal, except the last coat, shall be sandpapered smooth when dry. Texture-coated gypsum board shall be sanded lightly to remove surface imperfections after first coat of paint has been applied.
- F. Each coat of paint or enamel shall be a slightly different shade as directed. The District Inspector will inspect each coat of paint, enamel, stain, shellac, and varnish before the next coat is applied. Notify the District Inspector that such work is ready for inspection. If this inspection step is missed, apply an additional coat over entire surface involved at no additional contract cost. FASO will be sent 48 hour notices for paint completion inspection.
- G. Do not "paint-out" underwriters' labels, fusible links, sliding surfaces and identification stamps.
- H. Damaged shop prime coat shall be touched-up with metal primer prior to application of second and third coats.
- I. Apply each coat of material to the manufacturers recommended dry film thickness and spread rate.

3.03 CLEANING

- A. Remove rubbish, waste and surplus material and clean woodwork, hardware, floors and other adjacent work.
- B. Remove paint, varnish and brush marks from glazing material and, upon completion of the painting work, wash and polish the glazing material both sides. Glazing material that is damaged shall be removed and replaced with new material at no cost to the District.
- C. Clean hardware and other unpainted metal surfaces with approved cleaner. Do not use abrasives or edged tools.
- D. Leave paint storage spaces clean and in condition required for equivalent spaces in the project. Specified shelf stock shall consist of new unopened paint containers and shall be turned over to the District per the contract documents.
- E. Collect waste material, which may constitute a fire hazard, place in closed metal containers, and remove daily from site.

3.04 EXTERIOR PAINT SCHEDULE

A. Metal Work; Exterior:

- 1. Galvanized Metal & Galvanized Metal Deck; Exterior:
 - a. Preparation: Before application, properly clean and etch (solvent wash) galvanized surfaces in accordance with preparation instructions for galvanized metal per Articles 3.02 H and 3.04F herein.
 - b. Coat 1: Rust Preventative Metal Primer Bloc-Rust Premium Primer (BRPR00-1)
 - c. Coat 2: 100% Acrylic Semi-Gloss Enamel EVERSIELD (EVSH50), 100% Acrylic Gloss Enamel EVERSIELD (EVSH60)
 - d. Coat 3: EVERSIELD 100% Acrylic Semi-Gloss Enamel-(EVSH50) EVERSIELD, 100% Acrylic Gloss Enamel (EVSH60)
 - e. DFT: 6 mils.
- 2. Ungalvanized Steel; Apply first prime coat immediately after steel is cleaned.
 - a. Coat 1: Rust Inhibitive Primer CORROBAR, White Alkyd Corr. Inhibitive Primer (43-5) Bloc-Rust Premium Primer (BRPR00-1)
 - b. Coat 2: Rust Inhibitive Primer Not Necessary
 - c. DFT for Coats 1 & 2 3.5 mils. Bloc-Rust Premium Primer (BRPR00-1)
 - d. Coat 3: 100% Acrylic Enamel Sash EVERSIELD, 100% Acrylic Semi-Gloss Enamel (EVSH50)
Or EVERSIELD, 100% Acrylic Gloss Enamel (EVSH60)
 - e. Coat 4: 100% Acrylic Enamel Sash EVERSIELD, 100% Acrylic Semi-Gloss Enamel (EVSH500)
Or EVERSIELD, 100% Acrylic Gloss Enamel (EVSH60)
 - f. DFT for coats 3 & 4: 4 mils.
- 3. Ungalvanized Steel: Concealed: Apply prime coat immediately after steel is cleaned.

- a. Scope: Apply to all structural steel surfaces hidden and enclosed, within the building envelope (not exposed to view), except members with flanges 1/4" or thicker and webs 3/16" or thicker need NOT to be painted.
 - b. Prime Coat: Rust Inhibitive Primer Bloc-Rust Premium Primer (BRPR00-1)
 - c. DFT: 2 mils.

- 4. All Shop Primed Metals; Exterior:
 - a. Preparation: Touch up damaged, scratched, or missing prime coat paint using top-quality rust-inhibitive primer recommended by paint mfr. lightly sand smooth, ready to receive finish coats.
 - b. Coat 1: 100% Acrylic Enamel Bloc-Rust Premium Primer -Rust-Preventative Acrylic Primer (BRPR00-1)
 - c. Coat 2: 100% Acrylic Enamel-EVERSHIELD, 100% Acrylic Semi-Gloss Enamel (EVSH50) or EVERSHIELD, 100% Acrylic Gloss Enamel (EVSH60)
 - d. DFT: 4 mils.

- 5. Factory Finished Equipment & Items:
 - a. Coat 1: Acrylic Enamel Sash & Trim EVERSHIELD, 100% Acrylic Semi-Gloss Enamel (EVSH50) or EVERSHIELD, 100% Acrylic Gloss Enamel (EVSH60)
 - b. DFT: 2 mils.

- 6. Aluminum; Where Indicated To Be Painted Or Where Previously Painted:
 - a. Follow paint mfr's. recommendations, and specifications.
 - b. Prepare surface by phosphatizing and cleaning same as for Galvanized Surfaces, Articles 3.02H and 3.04F.
 - c. Coat 1: Oil-Cementious Primer GALV-ALUM, Galv./Alum. Metal Primer GAPROO
 - d. Coat 2: 100% Acrylic Enamel EVERSHIELD, 100% Acrylic Semi-Gloss Enamel (EVSH50) or EVERSHIELD, 100% Acrylic Gloss Enamel (EVSH60)
 - e. Coat 3: 100% Acrylic Enamel EVERSHIELD, 100% Acrylic Semi-Gloss Enamel (EVSH60) or EVERSHIELD, 100% Acrylic Gloss Enamel (W 960V) (EVSH60)
 - f. DFT: 5 mils.

- B. Exterior Work: Other Than Metals: Existing and At Repairs or New to Match Existing; Match Existing Finishes/Paint:
 - 1. Wood (Painted):
 - a. Coat 1: Exterior Wood Primer E-Z Premium PRIME, Ext. 100% Acrylic Wood Primer (EZPR00-0)
 - b. Coat 2: 100% Acrylic Exterior Wood EVERSHIELD, 100% Acrylic Semi-Gloss Enamel (EVSH50) or EVERSHIELD, 100% Acrylic Gloss Enamel (EVSH60)
 - c. Coat 3: 100% Acrylic Exterior Wood EVERSHIELD, 100% Acrylic Semi-Gloss Enamel (EVSH50) or EVERSHIELD, 100% Acrylic Gloss Enamel (EVSH60)

- d. DFT: 5 mils.
2. Wood (Stained/Natural Finish) Smooth or "Rough Surface" Materials, Trim, Boards, Fascia, Etc., Wood Trellis Siding, Trim, Boards, and Fascia:
 - a. Coat 1: Exterior Wood Stain OKON WeatherPro Tinted, (WPT-3)
Prime all surfaces of all new pieces completely before installation (faces, edges, ends). After installation, inspect members; touch-up any damage, cuts, and nail holes.
 - b. Coat 2: Exterior Wood Stain OKON WeatherPro Tinted, (WPT-3)
 - c. Application Rate: 150 sf./per gallon/per coat.
 3. Cement Plaster:
 - a. Coat 1: Masonry Concrete Sealer EFF-STOP PERMIUM Masonry Primer/Sealer (ESPR00)
 - b. Coat 2: Exterior Masonry Finish SPARTASHIELD, Exterior 100% Acrylic Flat Finish (SSHL10)
or EVERSIELD , 100% Acrylic Ext. Masonry Finish (EVSH10)
 - c. Coat 3: Exterior Masonry Finish SPARTASHIELD, Exterior 100% Acrylic Flat Finish (SSHL10)
or EVERSIELD, 100% Acrylic Ext. Masonry Finish (EVHS10)
 - d. DFT: 4.0 mils.
 4. Concrete; Columns, Wall Caps, Beams, Wall Exposed Foundation Walls & Curbs and Where Indicated:
 - a. Coat 1: Masonry/Concrete Sealer, on bare concrete and as required EFF-STOP PERMIUM, (W709) (ESPR00)
 - b. Coat 2: Exterior Masonry Finish EVERSIELD, 100% Acrylic Semi-Gloss Enamel (EVSH50)
 - c. Coat 3: Exterior Masonry Finish EVERSIELD, 100% Acrylic Semi-Gloss Enamel (EVSH50)
or EVERSIELD, 100% Acrylic Gloss Enamel (EVSH60)
 - d. DFT: 3.6 mils.
 5. Concrete Block:
 - a. Coat 1: Masonry Filler BLOCFIL SMOOTH BLOCFIL PREMIUM, Concrete Block Filler, Smooth (SBPR00)
 - b. Coat 2: Concrete Sealer
 - c. Coat 3: Exterior Masonry Finish SPARTASHIELD, Exterior 100% Acrylic Flat Finish (SSHL10)
 - d. Coat 4: Exterior Masonry Finish SPARTASHIELD, Exterior 100% Acrylic Flat Finish (SSHL10)
 - e. DFT for coats 2-4: 3.6mil.
 6. Painted Stripes At Exterior Concrete Stairs; Conform to State HDCP Requirements:
 - a. Stripes: 2" wide, Located 1" max from and parallel to nosing.
 - b. Required Locations: All treads and upper approach of each flight of stairs.

- c. Application Rate: 2 coats of Traffic Paint, at 400 sf/per gallon per coat. VIN-L-STRIPE, (W 801)
- 7 Plastic or Rubber Condensate Piping & Other Plastic Piping Exposed on Roof-Tops:
- a. Coat 1: Multipurpose Primer ULTRA-GRIP PREMIUM, Multi-Purpose Latex Primer (W 715) (UGPR00)
 - b. Coat 2: 100% Acrylic Enamel EVERSIELD, 100% Acrylic Semi-Gloss Enamel (EVSH50)
 - c. Application Rate/DFT for finish coats: As required to cover completely one coat to cover.
8. Painted Stripes At Exterior Concrete Stairs; Conform to State HDCP Requirements:
- a. Required Locations: Bottom tread and upper approach of each flight of stairs, where indicated.
 - b. Stripes: 2" wide, located 1" max from parallel to nosing.
 - c. Applications Rate: 2 coats of Traffic Paint, at 400 sf/ per gallon per coat. VIN-L-STRIPE, (W 801)

3.05 INTERIOR PAINT SCHEDULE

A. Interior Work: Typically Match Existing Finishes/Paint:

- 1. Softwood; Typically, and Medium Density Overlaid (MDO) Doors; Existing and at Repairs or New To Match Existing:
 - a. Coat 1: ULTRA-GRIP PERMIUM, Multi-Purpose Latex Primer (UGRP00)
 - b. Coat 2: 100% Acrylic Semi-Gloss Enamel EVERSIELD, 100% Acrylic Semi-Gloss Enamel (EVSH50) or EVERSIELD, 100% Acrylic Semi-Gloss Enamel (EVSH60)
 - c. Coat 3: 100% Acrylic Semi-Gloss Enamel EVERSIELD, 100% Acrylic Semi-Gloss Enamel (EVSH50) or EVERSIELD, 100% Acrylic Gloss (EVSH60)
 - d. DFT: 4 mils.
- 2. Interior Hardwood Doors, Paneling, Doors, Transom Panels, Trim, Handrails, Softwood Casework, Paneling & Casework & Similar; With Stained/Natural Finish/Transparent Finish and; where not factory finished, Plastic Laminate, or Painted:
 - a. Sealer: At contractors option and expense N/A
 - b. Coat 1: NOT NEEDED ZENITH IS SELF SEALING
 - c. Coat 2: Gloss Varnish ZENITH WB CONVERSION VARNISH (PKC7509)
 - d. Coat 3: Gloss Varnish ZENITH WB CONVERSION VARNISH (PKC7509)
 - e. Coat 4: Satin Varnish Deftthane 2 ZENITH WB CONVERSION VARNISH (PKF7502)
 - f. DFT: 3.5 mils.

- g. Lacquer Option: With specific approval or Architect Construction Manager & District, Lacquer may be used in lieu of varnish. CE-275PRO90
 - h. In existing buildings, match existing finishes unless noted otherwise.
3. "Rough Surface" Wood Trim; Existing and at Repairs or New to Match Existing:
- a. Coat 1: Exterior Wood Stain OKON WeatherPro Tinted, (WPT-3)
 - b. After installation, inspect members; touch-up any damage, cuts and nail holes.
 - c. Coat 2: Exterior Wood Stain OKON WeatherPro Tinted, (WPT-3)
 - d. Application Rate: 150 sf/per gallon per coat.
4. "Smooth Surface" Plywood at Equipment Backboards:
- a. Coat 1: Enamel Undercoater ULTRA-GRIP PREMIUM, Multi-Purpose Latex Primer (W 715) (UGPR00)
 - b. Coat 2: Stipple Enamel, Semi-Gloss EVERSIELD, 100% Acrylic Semi-Gloss Enamel (EVSH50)
or EVERSIELD, Int. 100% Acrylic Semi-Gloss Enamel (EVSH50)
 - c. Coat 3: Enamel, Semi-Gloss EVERSIELD, 100% Acrylic Semi-Gloss Enamel (EVSH50)
or EVERSIELD, Int. 100% Acrylic Semi-Gloss Enamel (EVSH50)
 - d. DFT: 5 mils.
5. Existing Painted Casework and or Painted Wall Paneling:
- a. Coat 1: Enamel Undercoater INTER-KOTE PREMIUM, Int. 100% Acrylic Enamel Undercoater (IKPR00)
or ULTRA-GRIP PREMIUM, Multi-Purpose Latex Primer (UGPR00)
 - b. Coat 2: Enamel, Semi-Gloss EVERSIELD, 100% Acrylic Semi-Gloss Enamel (EVSH50)
or EVERSIELD, Int. 100% Acrylic Semi-Gloss Enamel (EVSH50)
 - c. Coat 3: Enamel, Semi-Gloss EVERSIELD, 100% Acrylic Semi-Gloss Enamel (EVSH50)
or EVERSIELD, Int. 100% Acrylic Semi-Gloss Enamel (EVSH50)
 - d. DFT: 6 mils.
6. Plaster Walls & Ceilings; Existing and at Repairs or New to Match Existing:
- a. Coat 1: Latex Sealer, Pigmented EVERSIELD, 100% Acrylic Ext. Masonry Finish EVSH10)
or ULTRA-GRIP PREMIUM, Multi-Purpose Latex Primer (UGPR00)
 - b. Coat 2: Enamel Undercoater
 - c. Coat 3: Typically match existing: One of the following as applicable or selected by Architect Construction Manager:
 - 1) Enamel Semi-Gloss EVERSIELD, 100% Acrylic Semi-Gloss Enamel (EVSH50)
Or EVERSIELD, Int. 100% Acrylic Semi-Gloss Enamel (EVSH50)
 - 2) Enamel, Low Sheen EVERSIELD, 100% Acrylic Eggshell Low Sheen Enamel (EVSH40)
or SUPREMA, Int. 100% Acrylic Low Sheen Enamel (SPMA40)

- (1) Stipple Enamel, Semi-Gloss. Apply with an Architect approved heavy-texture stipple roller. EVERSIELD, (W901) or EVERSIELD, (EVSH50)
 - d. DFT: 5mils.
- 7. Concrete, Concrete Block and Brick; Existing Painted and at Repairs or New To Match Existing:
 - a. Coat 1: Concrete Sealer EVERSIELD, 100% Acrylic Ext. Masonry Finish (EVSH10)
 - b. Coat 2: Enamel Undercoater SUPREMA, Latex Low Gloss Enamel (SPMA20)
 - c. Coat 3: Match existing: Enamel, Semi-Gloss, Low Sheen, or Velvet or Stipple as selected by Architect Construction Manager. SUPREMA, (SPMA20) or SUPREMA, (SPMA40) or, SUPREMA (SPMA50)
 - d. DFT: 5 mils.
- 8. Drywall Walls: Typical:
 - a. Coat 1: Latex Sealer VINYLASTIC PREMIUM, Interior Pigmented Sealer (VNPR00)
 - b. Coat 2: Stipple Enamel or Flat Latex SUPREMA, Int. 100% Acrylic Semi-Gloss Enamel (SPMA50) or EVERSIELD, Int. 100% Acrylic Low Sheen Enamel (EVSH40)
 - c. Coat 3: Enamel Semi-Gloss or Low Sheen SUPREMA, Int. 100% Acrylic Semi-Gloss Enamel (SPMA50) or SUPREMA, Int. 100% Acrylic Low Sheen Enamel-(SPMA40)
 - (1) Enamel, Semi-Gloss EVERSIELD, 100% Acrylic Semi-Gloss Enamel (EVSH50)
Or EVERSIELD, Int. 100% Acrylic Semi-Gloss Enamel (SPMA50)
 - (2) Enamel, Low Sheen SUPREMA, Int. 100% Acrylic Low Sheen Enamel (W 440V) (SPMA40)
 - (3) Enamel Velvet SUPREMA, Latex Low Gloss Enamel (SPMA20)
 - (4) Flat Wall Latex SUPREMA, Interior Flat Wall Finish (W 401) (SPMA10)
 - d. DFT: 6mils.
- 9. Drywall Ceilings
 - a. Coat 1: Latex Sealer VINYLASTIC PREMIUM, Interior Pigmented Sealer (W 101V) (VNPR00)
 - b. Coat 2: Flat Wall Latex SUPREMA, Interior Velvet Flat Wall Finish (W 401) (SPMA10)
 - c. Coat 3: Flat Wall Latex SUPREMA, Interior Velvet Flat Wall Finish (W 401) (SPMA10)
 - d. DFT: 4 mils.
- 10. Drywall Walls & Ceilings At Toilets, Storage Rooms, and Electrical and Mechanical Rooms:

- a. Coat 1: Latex Sealer VINYLASTIC PREMIUM, Interior Pigmented Sealer (VNPR00)
- b. Coat 2: Enamel Undercoater EVERSIELD, Int. 100% Acrylic Semi-Gloss Enamel (EVSH50)
- c. Coat 3: Stipple Enamel, Semi-Gloss EVERSIELD, Int. 100% Acrylic Semi-Gloss Enamel (EVSH50)
- d. DFT: 5 mils.

B. Metal Work; Interior:

- 1. Galvanized Metal & Galvanized Metal Deck;
 - a. Preparation: Before application, properly clean and etch (solvent wash) galvanized surfaces in accordance with preparation instructions for galvanized metal per Articles 3.02 H and 3.04F herein. (SCME-01)
 - b. Coat 1: Rust Preventative Metal Primer Bloc-Rust Premium Primer (BRPR00-1)
 - c. Coat 2: 100% Acrylic Enamel EVERSIELD 100% Acrylic Semi-Gloss Enamel (EVSH50)
or EVERSIELD, 100% Acrylic Gloss Enamel (EVSH60)
 - d. Coat 3: 100% Acrylic Enamel Enamel EVERSIELD, 100% Acrylic Semi-Gloss Enamel (EVSH50)
Or EVERSIELD, 100% Acrylic Gloss Enamel (EVSH60)
 - e. DFT: 6 mils.
- 2. Ungalvanized Steel Interior Apply prime coat immediately after steel is cleaned.
 - a. Coat 1: Rust Preventative Metal Primer Bloc-Rust Premium Primer (BRPR00-1)
 - b. Coat 2: 100% Acrylic Enamel EVERSIELD 100% Acrylic Semi-Gloss Enamel (EVSH50)
or EVERSIELD, 100% Acrylic Gloss Enamel (EVSH60)
 - c. Coat 3: 100% Acrylic Enamel Enamel EVERSIELD, 100% Acrylic Semi-Gloss Enamel (EVSH50)
Or EVERSIELD, 100% Acrylic Gloss Enamel (EVSH60)
 - d. DFT: 6 mils.
- 3. Ungalvanized Steel Interior: Concealed: Apply prime coat immediately after steel is cleaned.
 - a. Scope: Apply to all structural steel surfaces hidden and enclosed, within the building envelope (not exposed to view), except members with flanges 1/4" or thicker and webs 3/16" or thicker need NOT to be painted.
 - b. Prime Coat: Rust Inhibitive Primer Bloc-Rust Premium Primer (BRPR00-1) DFT: 2 mils.
- 4. All Shop Primed Metals; Interior:
 - a. Preparation: Touch up damaged, scratched, or missing prime coat paint using top-quality rust-inhibitive primer recommended by paint mfr. lightly sand smooth, ready to receive finish coats.
 - b. Coat 1: Rust Preventative Metal Primer Bloc-Rust Premium Primer (BRPR00-1)

- c. Coat 2: 100% Acrylic Enamel EVERSIELD, 100% Acrylic Semi-Gloss Enamel (EVSH50)
or EVERSIELD 100% Acrylic Gloss Enamel (EVSH60)
 - d. DFT: 4 mils.
- 5. All Shop Primed Metals; Interior:
 - a. Preparation: Touch-up damaged, scratched, or missing prime coat paint using top-quality rust-Inhibitive primer recommended by paint mfr. Lightly sand smooth, ready to receive finish coats.
 - b. Coat 1:Sash and Trim Rust Preventative Metal Primer Bloc-Rust Premium Primer (BRPR00-1)
 - c. Coat 2: Sash and Trim Industrial Enamel EVERSIELD, 100% Acrylic Semi-Gloss Enamel (EVSH50)
or EVERSIELD, 100% Acrylic Gloss Enamel (EVSH60)
 - d. DFT: 4 mils.
- 6. Factory Finished Equipment & Items:
 - a. Coat 1:Acrylic Enamel Sash & Trim EVERSIELD, 100% Acrylic Semi-Gloss Enamel (EVSH50)
or EVERSIELD, 100% Acrylic Gloss Enamel (EVSH60)
 - b. DFT: 2 mils.
- 7. Aluminum; Where Indicated To Be Painted Or Where Previously Painted:
 - a. Follow paint mfr's. recommendations and specifications.
 - b. Prepare surface by phosphatizing and cleaning same as for Galvanized Surfaces, Articles 3.02H and 3.04F.
 - c. Coat 1: Oil-Cementious Primer GALV-ALUM PREMIUM, Galv./Alum. Metal Primer (GAPR00)
 - d. Coat 2: 100% Acrylic Enamel EVERSIELD, 100% Acrylic Semi-Gloss Enamel (EVSH50)
or EVERSIELD, 100% Acrylic Gloss Enamel (EVSH60)
 - e. Coat 3: 100% Acrylic Enamel EVERSIELD, 100% Acrylic Semi-Gloss Enamel (EVSH50)
or EVERSIELD, 100% Acrylic Gloss Enamel (EVSH60)
 - f. DFT: 5 mils.

END OF SECTION

**SECTION 10 14 00
IDENTIFYING DEVICES**

PART 1 - GENERAL

1.01 SUMMARY

- A. Section includes:
 - 1. Plastic signs and symbols.
 - 2. Metal signs.

1.02 QUALITY ASSURANCE

- A. Requirements of regulatory agencies, and Codes:
 - 1. State Fire Marshal, Title 19.
 - 2. 2019 California Building Code (CBC) and Standards.
 - 3. Federal Americans with Disabilities Act (ADA) and to State "Accessibility" Regulations.
- B. Text, numbering and message: The District will provide exact numbering and wording for signs.

1.03 SUBMITTALS

- A. Procedure: In accordance with Section 01 33 00.
- B. Samples: 2 for each type, including the following:
 - 1. Manufacturer's standard color range.
 - 2. One of each typical sign specified.
- C. Product data: Manufacturer's standard brochures describing all items and materials; specific items for this work shall be indicated/highlighted.
- D. Shop drawings: Signs, 4 copies, all work, including fastening devices and backing plates.

PART 2 - PRODUCTS

2.01 MANUFACTURERS/MATERIALS

- A. All other plastic and metal signs:
 - 1. Acceptable manufacturers/products: Mohawk Sign Systems (518.370. 3433) Series No. 200-A, or equal.
 - 2. Description of system: Text, letters, symbols and Braille must be integral.
 - 3. List of signs: Note that all signs specified below may not be required for the Project. Refer to the Drawings and provide all required signage for the Project.

B. Unframed plastic signs.

1. Plastic - ES plastic: 2-color sandwich with face color contrasting with core color; suitable for interior and exterior use.
2. Text/letters/symbols/Braille:
 - a. Raised in accordance with ADA requirements.
 - b. Color contrasting with their background color.
 - c. Created by sandblasting away the face color to expose the surrounding background (core) color.
 - d. Provide corresponding Grade 2 (Contracted) Braille under all lettering and numbers in accordance with ADA.
 - e. Gluing components of signs together is not acceptable.
3. Type style: "Helvetica Medium" all upper case, 3/4 in. high (72-point).
4. Arrangement: Standard spacing between letters, words, numbers and lines; centered typically; 2 in. minimum margins.
5. Edges and corners: Finish edges smooth; 1" in. rounded corners. Provide a screw mounting hole at each corner.
6. Colors: To be selected by Architect.
7. Sign face colors, and core colors: One face/core color combination for each site will be selected by Architect from manufacturer's standard color range (12 colors minimum).
8. Code required colors: Where colors are mandated by Codes or regulations, conform to those requirements; all other colors will be selected by Architect.
9. Color type: Integral to sign material; painting is not acceptable.
10. Mounting: Non-corrosive vandal-resistant screws and double-face, pressure-sensitive foam tape, full length and width of sign.
11. Braille shall comply with CBC 11B-703. See drawing for additional requirement.

C. Room number signs:

1. Size: as indicated on drawings.

D. Room name signs:

1. Wording: Varies from sign to sign, but signs will average 12 letters.
2. Arrange words in a single line of text where possible within the limitations imposed for number of characters for each line. Use additional lines where necessary to accommodate longer texts. Do not hyphenate words.

E. Typical sizes: Signs shall be modular. Use combinations of the following height and width dimensions as necessary to suit the wording for each particular type.

1. Heights:
 - a. For 1 line of text: 2-1/2 in.
 - b. For 2 lines of text: 4 in.

- c. For 3 lines of text: 5-1/2 in.
NOTE: With corresponding Braille.
Braille to be 3/8" minimum – 1/2" minimum below tactile.
- 2. Length - characters for each line of text:
 - a. 10 characters or less: 9 in.
 - b. 16 characters maximum: 13 in.
- F. Other sizes: for MEN, WOMEN, BOYS, GIRLS: 2-1/2 in. high by 6 in. long, or as indicated.
- G. Fire alarm signs:
 - 1. Wording: FIRE ALARM INSIDE.
 - 2. Sizes: 6 in. high by 6 in. long.
- H. Plastic "ISA" symbol signs:
 - 1. Figure/symbol style: Recognized standard "International Symbols of Accessibility" such as those developed by the American Institute of Graphics for the US Dept. of Transportation.
 - 2. Types:
 - a. Toilet room door symbols: Appropriate Man/Boy or Woman/Girl symbols.
 - (1) Finish: 70% min. contrast between symbols and background with a non-glare finish.
 - (2) Geometric symbols:
 - (a) For Men/Boys: Equilateral triangle, 12 in. on a side by 1/4 in. thick.
 - (b) For Women/Girls: 12 in. diameter circle by 1/4 in. thick.
 - (c) For All Gender: Equilateral triangle, 12 in. on a side, superimposed over a 12 in. diameter circle; 1/4 in. thick.
 - (3) Refer to the Drawings.
- I. Toilet room permanent wall signs:
 - 1. Size: 6" w x 8" h.
 - 2. Refer to the Drawings.
- J. Building entrance signs:
 - 1. Size: 6 in. by 6 in., typically.
 - 2. International "ISA" symbol.
 - 3. Refer to the Drawings.

- K. "Not an Exit" sign:
1. Type size: 3/4 in. high (72-point).
 2. Sign size: 2-1/2 in. high by 9 in. long, except as indicated - refer to Drawings.
 3. Location: Refer to Drawings.
 4. Wording: NOT AN EXIT.
- L. Metal signs - general:
1. Materials: Reflectorized sign, porcelain on steel with beaded text, two 1/4 in. diameter galvanized bolts mounted to galvanized steel post.
 - a. Type imagery:
 - (1) Type style: Helvetica Medium; all upper case.
 - (2) Arrangement: Use standard spacing between letters, words, numbers and lines; center typically.
 2. Colors:
 - a. Sign colors, and/or background paint colors: As selected by Architect from manufacturer's standard color range (12 colors minimum); one color maximum.
 - b. White or black, as selected by Architect to contrast with sign or background color; one color maximum.
 - c. Code required colors: Where colors are mandated by Codes or regulations, conform to those requirements; all other colors shall be as selected by Architect.
 3. Metal "ISA" symbol signs:
 - a. General: Conform to the State Accessibility Codes.
 - b. Symbol style: Recognized standard "International Symbol of Accessibility" such as that developed by the American Institute of Graphics for the US Department of Transportation.
 - c. Types:
 - (1) Accessible parking stall signs.
 - (2) Accessible path of travel/direction-to-building-entrance signs.
 - d. Refer to Drawings for size and configuration.
- M. Metal accessible parking entrance signs:
1. General: Conform to the State Accessibility Codes.
 2. Refer to Drawings for size, text and configuration.
- N. Metal fire lane:
1. General: Conform to Fire Code Sec. 10.207 (K, L).
 2. Location: To be determined by the Fire Department Inspector.
 3. Provide signs a minimum of one for every 100 lin. ft. of fire lane - refer to Drawings.

Coordinate exact quantity and locations with Fire Department Field Inspector.

4. Locate signs 2 ft. inside curb line or edge of pavement.
 - a. Where the entire roadway width is a designated fire lane, post signs on both sides of the street/drive, facing traffic.
 - b. Size: 12 in. wide by 18 in. long.
 - c. Color: White background with 2 in. wide red border all sides.
 - d. Wording: 1 in. high red letters in center of white area: NO PARKING FIRE LANE.
 - e. Construction: Mount sign on galvanized steel post with 6 ft.-8 in. clear from bottom of sign to top of adjacent concrete curb or any adjacent paving.

- O. Assistive Listening System sign:
 1. Size: 14" w x 6" h.
 2. Refer to the Drawings.

PART 3 - EXECUTION

3.01 PREPARATION

- A. Layout: Accurately layout work to maintain proper lines, levels and spacings.

3.02 INSTALLATION - PLASTIC SIGNS

- A. General: Press tape firmly to mounting surface, and secure each sign with 4 vandal-resistant screws, one screw at each corner, equidistant from the edges.

- B. Mounting location:
 1. General:
 - a. At heights and locations prescribed by Code.
 - b. As indicated on Drawings.
 - c. Multiple signs: Where more than one sign occurs in one area, group signs vertically, one above the other with 1/4 in. space between signs; field verify with Architect before installation.

 2. Mount the following signs on doors:
 - a. Toilet room: Figure/geometric symbol at 60 in. above finished floor to centerline of sign.
 - b. Fire alarm signs: As field-directed by Architect.
 - c. NOT AN EXIT signs: As indicated on drawings and as field-directed by Architect.

 3. Mount following signs on walls:

- a. Typical signs: Room name signs and room number signs at 60 in. above finished floor to centerline of sign and as indicated on drawings.
- b. Building entrance: "ISA" symbol building entrance signs as indicated on drawings.
- c. Toilet room wall: Combination "ISA" symbol and figure/geometric symbol signs as indicated on Drawings at 60 in. above finished floor to centerline of sign.
- d. Room capacity signs: Mount on wall in visible location as indicated on drawings.

3.03 INSTALLATION - METAL SIGNS

- A. Typical: Attach signs securely to posts and set posts in concrete.
- B. GATES TO REMAIN OPEN: Attach signs securely to gate frame just above gate opening, and centered from left to right.

3.04 SCHEDULE - REQUIRED PLASTIC AND METAL SIGNS

- A. General: Certain signs are listed below. This list is not complete. Other signs may be shown on Drawings and details. Provide all signs required.
- B. List of signs:
 - 1. Room name and number signs: One sign for each doorway including both existing and new rooms/doorways; either a name sign or a number sign as directed by District.
 - a. Approximately 70% will be name signs.
 - 2. Fire alarm signs: One for each room containing a fire alarm station; mount on the exterior face of an exterior door to that room.
 - 3. Plastic accessibility symbol signs:
 - a. Toilet room door signs: One for each accessible toilet room.
 - b. Toilet room wall signs: One for each accessible toilet room.
 - c. Building entrance signs: Locate where indicated on Drawings.
 - 4. NOT AN EXIT sign: Locate where indicated on drawings.
 - 5. Metal accessibility symbol signs:
 - a. Accessible parking stall signs: Locate where indicated on Drawings.
 - b. Accessible path of travel/direction-to-building-entrance signs: Locate where indicated on Drawings.
 - 6. Metal accessible parking entrance signs, fire lane signs and gate signs: Locate where indicated on Drawings.

END OF SECTION

**SECTION 10 21 13
TOILET COMPARTMENTS**

PART 1 - GENERAL

1.01 SUMMARY

A. Section includes:

1. Floor-mounted overhead-braced high density polyethylene (HDPE) toilet compartments.
1. Wall mounted HDPE urinal screens.
2. Supplementary parts and components, such as inserts, clips, fasteners, anchors, and other miscellaneous supports required for a complete installation.

A. Related work:

1. Toilet Accessories: Section 10810

1.02 SUBMITTALS

A. Procedure: In accordance with Section 01340.

B. Data: Manufacturer's data for partitions and screens. Supplement with shop drawings showing plan layout, attachment to adjacent construction.

C. Samples:

1. 6 in. square of each color of selected panel material.
2. Full size samples of hardware when requested by the Architect.

1.03 HANDLING

A. Procedure: In accordance with Section 01340.

B. Protection: Maintain manufacturer's protective covers on panels as long as possible to protect them from damage.

1.04 WARRANTY

A. Warrant materials against breakage, corrosion and delamination for 10 years after Substantial Completion. Repair defective materials, at no cost to District, within warranty period.

PART 2 - PRODUCTS

2.01 MANUFACTURER

A Poly-Mar HD by Santana Products Co. (800.368.5002).

2.02 MATERIALS

A. General:

1. Provide materials selected for surface flatness and smoothness.

2. Exposed surfaces which exhibit defects, discolorations, and other imperfections are not acceptable.
- B. Solid plastic: High density, solid polymer resin, either monolithic polyethylene or polymer resin, with homogenous color throughout, of color(s) selected by Architect.
1. Provide monolithic material not less than 1 in. thick. Ease edges uniformly.
- C. Pilaster shoes and caps: Formed one-piece plastic.
- C. Panel brackets: Manufacturer's full length standard design for attaching panels to walls and pilasters, extruded anodized aluminum.
- D. Hardware and accessories: Manufacturer's standard design, heavy duty operating hardware and accessories of chromium plated, non-ferrous cast alloy (Zamac).
- E. Anchorages and fasteners: Manufacturer's standard exposed fasteners of stainless steel, chromium-plated steel, or brass, finished to match hardware, with theft-resistant type heads and nuts.
1. Concealed anchors: Hot-dip galvanized, cadmium-plated or other rust-resistant protective coated steel.

2.03 FABRICATION

- A. Fabricate units with cutouts, drilled holes, and internal reinforcement to receive partition-mounted hardware, accessories, and grab bars, as indicated.
- F. Floor-supports: Furnish galvanized steel anchorage devices complete with threaded rods, lock washers, and leveling adjustment nuts at pilasters to permit structural connection at floor.
1. Provide shoe at each pilaster to conceal anchorage.
- C. Wall-hung screens: Furnish panels of same construction and finish as partition system panels.
- CBC 11B
- G. Hardware: Provide for each compartment complying with ~~ANSI A117.1~~ for disabled accessibility and as follows.
1. Hinges: Cutout inset type, adjustable to hold door open at any angle up to 90 deg. Provide gravity type, spring-action cam type, or concealed torsion rod type to suit manufacturer's standards.
 2. Latch and keeper: Manufacturer's standard surface mounted latch unit, designed for disabled accessibility, with combination rubber-faced door strike and keeper.
 3. Coat hook: Manufacturer's standard unit, combination hook and rubber-tipped bumper, sized to prevent door hitting mounted accessories. Mount on back side of door, at 48 in. height.
 4. Door pull: Manufacturer's standard unit for out-swinging doors. Provide pulls on both faces of disabled compartment doors.
- E. Disabled Access Law Compliance:
1. Layouts of enclosures designated as enclosures for the disabled and hardware provisions therefore shall comply with current disabled access requirements in the California Code of

Regulations, Title 24 and ADA Accessibility Guidelines for Buildings and Facilities.

2. Toilet compartments for the disabled shall be provided with the following, together with all other requirements:
 - a. Doors shall be not less than 36" wide.
 - b. Coat hooks shall be mounted at 48" high, maximum.
 - c. Door latches shall be flip-over style, sliding, or other hardware not requiring the user to grasp or twist.
 - d. Inside and outside of enclosure doors for the disabled shall be equipped with a loop or U-shaped handle immediately below the latch. The latch shall be flip-over style, sliding, or other hardware not requiring the user to grasp or twist. Model No. RP100S-P by MSI (805.375.6599).

PART 3 - EXECUTION

3.01 INSPECTION

- A.. Verify conditions and measurements affecting the work of this Section at site. Make sure that detrimental conditions are corrected before proceeding with installation.

3.02 INSTALLATION

- A. Set compartments and screens plumb, level, and space uniformly in compliance with their manufacturer's printed instructions and the following.
- B. Set pilasters with anchorages having not less than 2 in. penetration into structural floor, unless otherwise recommended by compartment manufacturer.
 1. Level, plumb, and tighten installation with devices furnished.
 2. Hang doors and adjust so that tops of doors are level with tops of pilasters when doors are in closed position.
- C. Secure panels to panels, and panels to walls with continuous extruded aluminum angles.
 1. Anchor panels to studs or backing plates only, with tamper-proof bolts or screws; fastening components to walls with toggle bolts will not be allowed.
- D. Install hardware as recommended by manufacturer. Conceal evidence of drilling in finished work.

3.03 ADJUSTING/CLEANING

- A. Adjust brackets and hardware to provide uniform clearances not exceeding the following dimensions:
 1. Pilasters and walls: 1 in.
 2. Panels and walls: 1 in.
 3. Pilasters and panels: 2 in.
 4. Pilasters and doors: 3/16 in.

- B. Adjust hardware for proper operation. Set hinges on in-swinging doors to hold open approximately 30 deg. from closed position when unlatched, except set hinges on out-swinging doors (and entrance swing doors) to return to fully closed position.
- C. After completion of installation, clean and polish exposed surfaces and touch-up minor scratches.

END OF SECTION

SECTION 10 26 23
FIBERGLASS REINFORCED PROTECTIVE WALL COVERING

PART 1 - GENERAL

1.01 SUMMARY

- A. Section Includes: Fiberglass reinforced plastic (FRP) paneling for wall surfaces, including trim accessories.

1.02 REFERENCES

- A. General: Standards listed by reference form a part of this specification section. Standards listed are identified by issuing authority, abbreviation, designation number, title or other designation. Standards subsequently referenced in this Section are referred to by issuing authority abbreviation and standard designation.
- B. ASTM International:
 - 1. ASTM D2583 - Standard Test Method for Indentation Hardness of Rigid Plastics by Means of a Barcol Impressor.
 - 2. ASTM D5319 – Standard Specification for Glass-Fiber Reinforced Polyester Wall and Ceiling Panels.
 - 3. ASTM D5420 - Standard Test Method for Impact Resistance of Flat, Rigid Plastic Specimen by Means of a Striker Impacted by a Falling Weight (Gardner Impact).
 - 4. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials.
- D. Crane Composites (Inspired by Kemlite):
 - 1. Installation Guide For FRP Panels #6876.

1.03 ADMINISTRATIVE REQUIREMENTS

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

1.04 ACTION SUBMITTALS

- A. Product Technical Data: For each type of product required.
- B. Shop Drawings: Showing layout, profiles and product components, including anchorage, accessories, finish colors, patterns and textures. Indicate location and dimension of joints and fastener attachment.
- C. Samples: Selection and verification samples for finishes, colors and textures. Submit two samples of each type of panel, trim and fastener.
- D. Certificates: Product certificates signed by manufacturer certifying materials comply with specified performance characteristics, criteria and physical requirements.

- E. Test and Evaluation Reports: Showing compliance with specified performance characteristics and physical properties.
- F. Manufacturer's Instructions: Manufacturer's Installation Guide for FRP #6876.
- G. Qualifications Statements: For manufacturer and installer.

1.05 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For installed products including maintenance methods and precautions against cleaning materials and methods detrimental to finishes and performance.
- B. Warranty: Warranty documents required in this section.

1.06 MAINTENANCE MATERIAL

- A. Extra Materials: Deliver to Owner extra materials from same production run as products installed. Package products with protective covering and identify with descriptive labels. Comply with Division 01 Closeout Submittals Section.
 - 1. Quantity: Furnish quantity of units equal to 5% percent of amount installed.
 - 2. Delivery, Storage and Protection: Comply with Owner's requirements for delivery, storage and protection of extra materials.

1.07 QUALITY ASSURANCE

- A. Manufacturer Qualifications:
 - 1. Provider of advanced installer training.
- B. Installer Qualifications:
 - 1. At least five years experience in the installation of fiberglass reinforced plastic panels.
 - 2. Experience on at least five projects of similar size, type and complexity as this Project.
 - 3. Employer of workers for this Project who are competent in techniques required by manufacturer for installation indicated.
- C. Surface-Burning Characteristics: Determined by testing identical products according to ASTM E84 by a testing agency acceptable to authorities having jurisdiction.
 - 1. Flame-Spread Index: **25 (Class A)]** or less.
 - 2. Smoke-Developed Index: **[450]** or less.

1.08 DELIVERY, STORAGE AND HANDLING

- A. Delivery: Deliver materials in manufacturer's original, unopened, undamaged containers with identification labels intact. Package sheets on skids or pallets for shipment to project site.

- B. Storage and Handling: Store materials protected from exposure to harmful weather conditions and at temperature and humidity conditions recommended by manufacturer. Store panels in a dry indoor location at Project site. Remove any foreign matter from face of panel by using a soft bristle brush, avoiding abrasive action.

1.09 PROJECT CONDITIONS

A. Ambient Conditions:

1. Do not begin installation until building is enclosed, permanent heating and cooling equipment is in operation, and residual moisture from plaster, concrete or terrazzo work has dissipated.
2. During installation, and within 48 hours prior to installation, maintain ambient temperature and relative humidity within limits required by type of panel adhesive used and recommendation of panel adhesive manufacturer.

1.10 WARRANTY

A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace FRP panels that fail within specified warranty period.

1. Failures shall include, but not be limited to substantial defects in material and workmanship, rotting, rusting, corrosion, development of structural surface cracks, or requiring painting or refinishing.
2. Warranty Period: Ten years from date of Substantial Completion.

B. Special Warranty: Installer's standard form in which installer agrees to repair or replace FRP panels that fail due to poor workmanship or faulty installation within the specified warranty period.

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

PART 2 - PRODUCTS

2.01 FIBERGLASS REINFORCED PLASTIC (FRP) PANELS

A. General: Fiberglass reinforced plastic panels complying with ASTM D5319.

1. Low-Emitting Materials: Comply with testing and product requirements of California Department of Health Services standards for Volatile Organic Emissions.

B. Basis of Design Product: Subject to compliance with requirements provide Crane Composites, Inc.; Glasbord Fiberglass Reinforced Plastic (FRP) Panels, **Glasbord FSI (FSI)** or approved equal.

C. Product Options:

1. Color: **85 White.**
2. Surface Finish: **Smooth.**
3. Nominal Thickness: **0.10 inch (2.5 mm).**

4. Wall Panel Size: **4 feet (1.2 m) by 8 feet (2.4 m)**

2.02 ACCESSORIES

- A. Moldings, Trim and Caps: One-piece extruded polypropylene or PVC, configured to cover panel edges and corners.
 1. Color: **85 White**.
- B. Panel Adhesive: As recommended by panel manufacturer for the required substrates.
 1. Adhesive shall have a VOC content of **50 g/L** or less.
- C. Panel Sealant: **As recommended by panel manufacturer**.
 1. Sealant shall have a VOC content of **250 g/L** or less.

2.03 SOURCE QUALITY CONTROL

- A. Obtain fiberglass reinforced panels, moldings and other accessories from a single manufacturer.

PART 3 - EXECUTION

3.01 EXAMINATION

- A. General: Comply with manufacturer's product data, including product technical bulletins, and installation instructions in product catalogs and product packaging.
- B. Verify that substrates previously installed under other sections are acceptable for product installation in accordance with FRP manufacturer's instructions.
 1. Examine substrate surfaces to determine that corners are plumb and straight, that surfaces are smooth, sound and uniform, that nails or screw fasteners are countersunk, and that joints and cracks are filled flush and smooth with adjoining surfaces.
 2. Do not begin panel installation until substrate surfaces are in satisfactory condition.

3.02 PREPARATION

- A. Clean substrates to remove substances that could impair bond of adhesive, including oil, grease, dirt, dust or other contamination.
- B. Condition panels by unpacking and placing in installation space no less than 24 hours before installation.
- C. Lay out paneling before beginning installation. Locate panel joints to provide equal panel widths at ends of walls and so that trimmed panels at corners are not less than 12 inches (300 mm) wide.

3.03 INSTALLATION

- A. General: Comply with panel manufacturer's Installation Guide #6876.

- B. Cut and drill panels with carbide tipped saw blades or drill bits, or cut with snips.
- C. Install panels with manufacturer's recommended gap for panel field and corner joints.
 - 1. Pre-drill fastener holes in panels, 1/8 inch (3.2 mm) greater in diameter than fastener.
 - 2. Install panels in a full spread of adhesive. For trowel type and application of adhesive, follow adhesive manufacturer's recommendations.
- D. Install trim accessories with adhesive and nails or staples. Do not fasten through panels.
- E. Sealant:
 - 1. Fill grooves in trim accessories with sealant before installing panels and bed inside corner trim in a bead of sealant.
 - 2. Remove excess sealant and smears as paneling is installed. Clean with solvent recommended by sealant manufacturer and then wipe with clean dry cloths.

3.04 CLEANING

- A. Remove temporary coverings and protection of adjacent work areas.
- B. Repair or replace any installed products that have been damaged.
- C. Clean installed panels in accordance with manufacturer's instructions prior to Owner's acceptance.
- D. Remove and lawfully dispose of construction debris from project site.

3.05 PROTECTION

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

END OF SECTION

**SECTION 10 28 16
TOILET ROOM ACCESSORIES**

PART 1 - GENERAL

1.01 SUMMARY

- A. Section includes:
 - 1. Toilet room accessories, including framed mirrors.
 - 2. Supplementary parts and components, such as inserts, clips, anchors, fasteners, and other miscellaneous supports required for a complete installation.
- B. Related work:
 - 1. Cut-outs, openings and recesses for installation of accessories.

1.02 SUBMITTALS

- A. Data: Manufacturer catalog cuts and data sheets, complete parts list, and installation requirements for each accessory specified.
- B. Schedule: Indicate types, quantities, sizes, and installation locations (by room) for each toilet accessory item to be provided for Project.
- C. Closeout: Furnish to the District operating instructions and keys for equipment and locks.

1.03 QUALITY ASSURANCE

- A. Compliance with ADA requirements for accessories and their attachments is the Contractor's responsibility.

1.04. HANDLING

- A. Protection: Keep protective covers on accessories until their installation is complete, then remove at final clean-up.

1.05. WARRANTY

- A. Provide the District the manufacturer warranty protecting mirrors against silver spoilage for 5 years after Substantial Completion.

PART 2 - PRODUCTS

2.01 MATERIALS

- A. Stainless steel: AISI Type 302/304 complying with ASTM A167.
- B. Sheet steel: Cold-rolled commercial quality, complying with ASTM A336, 20 gage minimum.
 - 1. Galvanized steel: ASTM A527, G60 zinc coating, 20 gage minimum.
- C. Mirrors: as noted on drawings.
- D. Mounting devices: Galvanized steel.

- E. Fasteners: Stainless steel where exposed; may be galvanized steel where concealed. Provide spanner head design where exposed.

2.02 FABRICATION

- A. Fabricate units with seamless one piece flanges on exposed faces.
 - 1. Miter corners, weld and grind smooth and flush with parent metal so that welds are invisible on exposed surfaces.
 - 2. Open joints (not fully welded) on exposed surfaces are not acceptable.
 - 3. Conceal anchoring devices.
- B. Hang doors or panels on continuous stainless steel piano hinges.
- C. Master-key locked dispensing units. Key coin boxes of coin-operated dispensing units separately from the lock on the unit.
- D. Grind smooth all edges, both inside and out.
- E. Finishing:
 - 1. Finish exposed surfaces with bright, directional polish, NAAMM No. 4 finish so grain direction is parallel with the length of the component (horizontal or vertical) for all accessories, except where a knurled surface is specified for grab bars.
 - 2. When polishing is completed, passivate and rinse surfaces. Remove embedded foreign matter and leave surfaces chemically clean.

PART 3 - EXECUTION

3.01 INSPECTION

- A. Inspect adjacent construction and supports.
- B. Make sure that openings are within allowable tolerances, plumb, level, clean, will provide a solid anchoring surface, and that other conditions detrimental to the proper or timely completion of this work are corrected before proceeding with installation.

3.02 INSTALLATION

- A. Drill holes to correct size and location. Install accessories plumb, level and equally spaced (when applicable).
- B. Attach accessories securely with screws or bolts to steel studs or backing plates. Do not use Molly or toggle bolts in gypsum board.
- C. Adjust accessories for proper operation. After completion of installation, clean and polish exposed surfaces after removal of protective coverings.

3.03 ACCESSORY SCHEDULE:

- A. As indicated on the drawings.

END OF SECTION

**SECTION 10 44 13
FIRE EXTINGUISHER CABINETS**

PART 1 - GENERAL

1.01. SUMMARY

- A. Section includes fire protection cabinets for fire extinguishers.

1.02. SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Shop Drawings: For fire protection cabinets. Include plans, elevations, sections, details, and attachments to other work.
- C. Samples: For each exposed product and for each color and texture specified.
- D. Maintenance data.

1.03 QUALITY ASSURANCE

- A. Fire-Rated, Fire Protection Cabinets: Listed and labeled to comply with requirements in ASTM E 814 for fire-resistance rating of walls where they are installed.
- B. Coordinate size of fire protection cabinets to ensure that type and capacity of fire extinguishers indicated are accommodated.
- C. Coordinate sizes and locations of fire protection cabinets with wall depths.

PART 2 - PRODUCTS

2.01. MATERIALS

- A. Stainless-Steel Sheet: ASTM A 666, Type 304.
- B. Tempered Float Glass: ASTM C 1048, Kind FT, Condition A, Type I, Quality q3, 3 mm thick, **Class 2 (tinted, heat absorbing, and light reducing), bronze tint.**

2.02. FIRE PROTECTION CABINET

- A. Cabinet Type: Suitable for fire extinguisher.
 - 1. Products: Subject to compliance with requirements, **available products that may be incorporated into the Work include, but are not limited to, the following:**
 - a. Fire End & Croker Corporation;

- b. J. L. Industries, Inc., a division of Activar Construction Products Group;.
- c. Kidde Residential and Commercial Division, Subsidiary of Kidde plc;.
- d. Larsen's Manufacturing Company;.
- e. Modern Metal Products, Division of Technico Inc.; .
- f. Moon-American; .
- g. Potter Roemer LLC; .
- h. Watrous Division, American Specialties, Inc.

B. Cabinet Construction: **Nonrated**.

C. Cabinet Material: **Stainless-steel** sheet.

- 1. Surface Mounted: At Gymnasium.
- 2. Semirecessed Cabinets: Cabinet box partially recessed in walls of sufficient depth to suit style of trim indicated; with one-piece combination trim and perimeter door frame overlapping surrounding wall surface with exposed trim face and wall return at outer edge (backbend). Provide where walls are of insufficient depth for recessed cabinets but are of sufficient depth to accommodate semirecessed cabinet installation.
 - a. Square-Edge Trim: **1-1/4- to 1-1/2-inch (32- to 38-mm)** backbend depth.
 - b. Rolled-Edge Trim: **2-1/2-inch (64-mm)** backbend depth.

D. Cabinet Trim Material: **Same material and finish as door**.

E. Door Material: **Stainless-steel sheet**.

F. Door Style: **FullCenter glass panel with frame**.

G. Door Glazing: **Tempered float glass (bronze tint)**.

H. Door Hardware: Manufacturer's standard door-operating hardware of proper type for cabinet type, trim style, and door material and style indicated.

I. Accessories:

- 1. Mounting Bracket: Manufacturer's standard steel, designed to secure fire extinguisher to fire protection cabinet, of sizes required for types and capacities of fire extinguishers indicated, with plated or baked-enamel finish.
- 2. Break-Glass Strike: Manufacturer's standard metal strike, complete with chain and mounting clip, secured to cabinet.
- 3. Door Lock: **Cam lock that allows door to be opened during emergency by pulling sharply on door handle**.
- 4. Identification: Lettering complying with authorities having jurisdiction for letter style, size, spacing, and location. Locate **as indicated**.
 - a. Identify fire extinguisher in fire protection cabinet with the words "**FIRE EXTINGUISHER**."
 - 1) Location: Applied to **cabinet door**.
 - 2) Application Process: **Engraved**.
 - 3) Lettering Color: **Red**.
 - 4) Orientation: **Horizontal**.

- J. Finishes:
 - 1. Stainless Steel: **No. 2B.**

2.03. FABRICATION

- A. Fire Protection Cabinets: Provide manufacturer's standard box (tub), with trim, frame, door, and hardware to suit cabinet type, trim style, and door style indicated. Miter and weld joints and grind smooth.

PART 3 - EXECUTION

3.01. INSTALLATION

- A. Examine walls and partitions for suitable framing depth and blocking where **semirecessed** cabinets will be installed and prepare recesses as required by type and size of cabinet and trim style.
- B. Install fire protection cabinets in locations and at mounting heights indicated **or, if not indicated, at heights acceptable to authorities having jurisdiction.**
- C. Fire Protection Cabinets: Fasten cabinets to structure, square and plumb.
- D. Adjust fire protection cabinet doors to operate easily without binding. Verify that integral locking devices operate properly.
- E. Replace fire protection cabinets that have been damaged or have deteriorated beyond successful repair by finish touchup or similar minor repair procedures.

END OF SECTION

**SECTION 10 44 16
FIRE EXTINGUISHERS**

PART 1 - GENERAL

1.01. SUMMARY

- A. Section includes portable, hand-carried fire extinguishers.

1.02. SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Operation and maintenance data.
- C. Warranty: Sample of special warranty.

1.03. QUALITY ASSURANCE

- A. NFPA Compliance: Fabricate and label fire extinguishers to comply with NFPA 10, "Portable Fire Extinguishers."
- B. Fire Extinguishers: Listed and labeled for type, rating, and classification by an independent testing agency acceptable to authorities having jurisdiction.
- C. Coordinate type and capacity of fire extinguishers with fire protection cabinets to ensure fit and function.

1.04. WARRANTY

- A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace fire extinguishers that fail in materials or workmanship within specified warranty period.
 - 1. Failures include, but are not limited to, the following:
 - a. Failure of hydrostatic test according to NFPA 10.
 - b. Faulty operation of valves or release levers.
 - 2. Warranty Period: **Six** years from date of Substantial Completion.

PART 2 - PRODUCTS

2.01. PORTABLE, HAND-CARRIED FIRE EXTINGUISHERS

- A. Fire Extinguishers: Type, size, and capacity for each fire protection cabinet indicated.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Amerex Corporation.
 - b. Ansul Incorporated; Tyco International Ltd.
 - c. Badger Fire Protection; a Kidde company.
 - d. Buckeye Fire Equipment Company.
 - e. Fire End & Croker Corporation.
 - f. J. L. Industries, Inc.; a division of Activar Construction Products Group.
 - g. Kidde Residential and Commercial Division; Subsidiary of Kidde plc.
 - h. Larsen's Manufacturing Company.
 - i. Moon-American.
 - j. Pem All Fire Extinguisher Corp.; a division of PEM Systems, Inc.
 - k. Potter Roemer LLC.
 - l. Pyro-Chem; Tyco Safety Products.
 2. Instruction Labels: Include pictorial marking system complying with NFPA 10, Appendix B.
- B. Clean-Agent Type in Steel Container: UL-rated 1-A:10-B:C, 10-lb (4.5-kg) nominal capacity, with HFC blend agent and inert material in enameled-steel container; with pressure-indicating gage.

PART 3 - EXECUTION

3.01. INSTALLATION

- A. Examine fire extinguishers for proper charging and tagging.
 1. Remove and replace damaged, defective, or undercharged fire extinguishers.

END OF SECTION

**SECTION 12 49 20
MANUAL ROLLER SHADES**

PART 1 – GENERAL

1.01 SCOPE

- A. SUPPLIER: Furnish and install Manual Roller Shades
- B. RELATED WORK SPECIFIED ELSEWHERE:
 - 1. Section 06 10 00: Rough Carpentry
 - 2. Section 08 51 13: Aluminum Windows

1.02 REFERENCES

- A. FLAME-RESISTANT MATERIALS SHALL PASS OR EXCEED ONE OR MORE OF THE FOLLOWING TESTS:
 - National Fire Protection Association (NFPA) 701 (small scale for horizontal applications)
 - Department of Transportation Motor Vehicle Safety Standard 302 Flammability of Interior Materials
 - California Administrative Code Title 19
 - Federal Standard 191 Method 5903 (used by Port Authority of New York and New Jersey for drapery, curtain, and upholstery material)
 - Boston Fire Department Teat BFD IX-1
 - New York State Uniform Fire Prevention and Building Code

1.03 SUBMITTALS

- A. PRODUCT DATA: Manufacturer's descriptive literature shall be submitted indicating materials, finishes, construction and installation instructions and verifying that product meets requirements specified. Manufacturers recommendations for maintenance and cleaning shall be included.
- B. DRAWINGS AND DIAGRAMS: Wiring diagrams of any motorized components or units, working and assembly drawings shall be supplied as requested.
- C. SAMPLE: Responsible contracting officer or agent shall supply one sample shade of each type specified in this contract for approval. Supplied units shall be furnished complete with all required components, mounting and associated hardware, instructions and warranty.

1.04 QUALITY ASSURANCE:

- A. Supplier: Manufacturer, subsidiary or licensed agent shall be approved to supply the products specified, and to honor any claims against product presented in accordance with warranty.

- B. **INSTALLER:** Installer or agent shall be qualified to install specified products by prior experience, demonstrated performance and acceptance of requirements of manufacturer, subsidiary, or licensed agent. Installer shall be responsible for an acceptable installation.
- C. **UNIFORMITY:** Provide Manual Roller Shades of only one manufacturer for entire project.

1.05 DELIVERY, STORAGE AND HANDLING:

- A. Product shall be delivered to site in manufacturer's original packaging.
- B. Product shall be handled and stored to prevent damage to materials, finishes and operating mechanisms.

1.06 JOB CONDITIONS:

- A. Prior to shade installation, building shall be enclosed.
- B. Interior temperature shall be maintained between 60° F. and 90° F. during and after installation; relative humidity shall not exceed 80%. Wet work shall be complete and dry.

1.07 WARRANTY:

- A. Lifetime Limited Warranty. Fabrics warranted for 5 years. Specific product warranties available from manufacturer or its authorized agent.

PART 2 – PRODUCTS

2.01 ACCEPTABLE MANUFACTURER

- A. Hunter Douglas Architectural/ 13915 Danielson St., Ste.100/ Poway, CA 92064/ Phone: 800-727-8953 Fax: 800-205-9819/ Website: www.HDarchitectural.com, or architect approved equivalent.
- B. Or approved equivalent product substitutions must be approved by architect prior to close of bid.

2.02 MANUAL ROLLER SHADES

A. **PRODUCT: Hunter Douglas “Manual Roller Shades”**

B. **MATERIALS:**

1. **FABRICS:** Inherently anti-static, flame retardant, fade and stain resistant, light filtering, room darkening, & blackout fabrics providing 0% - 15% openness factors. Fabric weights to range between 6.00 oz/sq.yd. – 20.70 oz/sq.yd. containing fiberglass, PVC, polyester, acrylic, vinyl laminates, cotton, & vinyl coatings. Finish selected by architect from manufacturer's available contract colors.
2. **CONTROL SYSTEM:** Adjustment-free continuous qualified #10 stainless steel ball chain ((90-lb. test)) and pulley clutch operating system allows precise control and ensures a uniform look. Clutch will develop no more than ½ pound drag for ease of lifting. Glass reinforced polyester thermopolymer (PBT) plastic components conform to military specification MIL M-24519 and designed for smooth, trouble-free operation.
3. **ROLLER:** Circular-shaped painted extruded aluminum tubes with thicker wall & ribs provide additional strength while locking into place the clutch & end plug. 3” outside diameter extruded tube to have a .090 wall thickness. 2” outside diameter extruded tube

to have a .072" wall thickness (1 ½" & 1 1/8" tubes have .055" wall thickness) providing strength & durability.

4. END PLUG: Heat stabilized fiber reinforced plastic outside sleeve and center shaft provide bearing surfaces on which the roller rides ensuring smooth, wear resistant operation.
5. BOTTOM ROD: Extruded aluminum weight in a Sealed Pocket Hem Bar, or Flat Bottom Bar for fabrics that are not seamable. Bottom rod is for tracking adjustments and provides uniform look.
6. MOUNTING HARDWARE: Manufacturer's standard .07" nickel-plated, C1008/1010 cold rolled steel universal brackets including end plug bracket with lock down retainer device.
7. OPTIONS: Fascia, Top & Bottom Covers.

2.03 FABRICATION

- A. Shade measurements shall be accurate to within $\pm 1/8$ " or as recommended in writing by manufacturer.

2.04 FABRICS

- A. FABRIC selection from the following: (0% Openness) Avila Twilight, Edessa Twilight, Geneva Twilight, Flocke, Morocco, Pima, Sheerweave 7000, Sheerweave 7100, Sheerweave 7300 (1% Openness) GlacierScreen HD2001, GreenScreen Revive 1%, E Screen 7501, Vizela, Sheerweave 7350, Sheerweave 2701, Sheerweave 4800 (3% Openness) GlacierScreen HD1003, GlacierScreen HD2003, GreenScreen Eco, GreenScreen Revive 3%, T Screen, E Screen 7503, E Screen 7703 KoolBlack, M Screen 8503, T Screen, Sheerweave 2410, Sheerweave 2410 Performance +, Infinity2, Sheerweave 2703, Sheerweave 4400, Sheerweave 4600, Sheerweave 4650, (4% Openness) Star 2115 (5% Openness) GlacierScreen HD1005, E Screen 7505, E Screen 7705 KoolBlack, Cortina, Satine, M Screen 8505, M Screen Deco, SilverScreen, Sheerweave 2000, Sheerweave 2390, Sheerweave 2390 Performance +, Sheerweave 2705, Sheerweave 4000, Sheerweave 4500, Sheerweave 4550, Sheerweave 4700, Sheerweave 5000, (7% Openness) Siena (10% Openness) GlacierScreen HD1010, E Screen 7510, Vienne, New Orleans, Sheerweave 2100, Sheerweave 2360, Sheerweave 2710, Sheerweave 4100 (12% Openness) Natte (14% Openness) A Screen, Sheerweave 3000.

PART 3 - EXECUTION

3.01 INSPECTION:

- A. SUBCONTRACTOR shall be responsible for inspection on site, approval of mounting surfaces, installation conditions and field measurement for this work.
- B. OTHER INTERACTING TRADES shall receive drawings of shade systems, dimensions, assembly and installation methods from subcontractor upon request.

3.02 INSTALLATION:

- A. INSTALLATION shall comply with manufacturer's specifications, standards and procedures as detailed on contract drawings.
- B. ADEQUATE CLEARANCE shall be provided to permit unencumbered operation of shade and hardware.

C. CLEAN finish installation of dirt and finger marks. Leave work area clean and free of debris.

3.03 DEMONSTRATION:

A. Demonstrate operation method and instruct owner's personnel in the proper operation and maintenance of the blinds.

3.04 SCHEDULE:

A. Provide at all new windows.

B. EXTERIOR WINDOWS: See drawings.

END OF SECTION

**SECTION 22 05 00
COMMON WORK RESULTS FOR PLUMBING**

PART 1 – GENERAL

1.01 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.

1.02 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 the County of Ventura, 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.

1.03 SUBMITTALS

- A. Provide submittals in accordance with Section 01 33 00: 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 31 13: Project Coordination and Section 01 33 00 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 31 13 and Section 01 33 00 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 31 13.
 - 2. Schedule and description of equipment, piping and fittings.

1.04 PROJECT RECORD DOCUMENTS

- A. Comply with provisions of Section 01 77 00: 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 77 00. 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) 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. Testing, Adjusting, and Balancing reports: Submit as specified in Section 23 05 93.
- 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. Ventura 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.

1.05 COORDINATION

- A. Contract Documents indicate extent and general arrangement of Work under Division 22. Contractor shall coordinate work in accordance with Section 01 31 13 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.

1.06 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.

1.07 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.

1.08 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.

1.09 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

2.01 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

3.01 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.

3.02 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.

3.03 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.

3.04 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:
Plastic 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	
Domestic water piping	200	Water

Gas piping (steel threaded, Propress or plastic)	60 (both tests)	Air
Gas piping (steel welded)	100 (both tests)	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 05 13: Basic Plumbing Materials and Methods.

3.05 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.

3.06 PROTECTION, CARE AND CLEANING

- A. In addition to storage criteria of the General Conditions, and provisions under Section 01 50 00: 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 05 13
BASIC PLUMBING MATERIALS AND METHODS**

PART 1 – GENERAL

1.01 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 26: Electrical.

1.02 SUBMITTALS

- A. Provide in accordance with Division 01, Section 22 05 00 and specific requirements of each section of Division 22.
- B. Types of welding rods to be used.

1.03 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. 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.

1.04 COORDINATION

- A. Coordinate related Work in accordance with provisions of Section 01 31 13: Project Coordination.

PART 2 – PRODUCTS

2.01 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 05 00, 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.

2.02 MANUFACTURERS AND MATERIALS

A. Ball Valves: Bronze, 2-inch and smaller:

BV-1: Class 150, 600 psi, CWP, 2 piece construction reinforced Teflon seats, full port, adjustable packing gland, stainless ball and stem, threaded ends.

Hammond UP-8303A/UP-8305/UP-8513, NIBCO T-685-80-LF/TS-685-66-LF, Milwaukee UPBA400S/450S, or equal.

BV-2: Class 150, 600 psi, CWP two piece construction with reinforced TFE seats, full port, adjustable packing gland, (no threaded stem designs allowed), threaded ends.

NIBCO T-685-80-LF, Hammond UP-8303A, Milwaukee UPBA-400 or equal.

NIBCO T585 S6R66 (Stainless Steel), Milwaukee BA-260 (Stainless Steel).

BV-3 Class 150, 600 psi CWP, 2-piece construction, bronze body, reinforced Teflon seats, adjustable packing gland, (no threaded stem designs allowed), threaded ends.

Hammond UP8301A, NIBCO T-585-70, Milwaukee BA-400, 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. 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.

NIBCO T-413-Y-LF, Milwaukee UP-509, Hammond UP-904 or equal.

CHV-2: Class 125 200 psi, swing check, bronze body, Teflon disc, soldered ends.

Stockham B-310TY, Crane 1340, NIBCO S-413-Y, Milwaukee 1509-T, Hammond IB-912 or equal.

CHV-3: 200 psi, CWP, bronze body, horizontal swing, Y pattern, renewable seat and disc, solder ends.

Nibco S-413-Y-LF, Milwaukee UP 1509-T, Hammond Up-946 or equal.

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. Valve shall be Koso California seismic valve, 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.

D. 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
Cold water, underground	All	P-5	PF-5
Domestic hot and cold water, in building and above ground	All	P-6	PF-6
Condensate drains and drains From HVAC Equipment, above grade inside of buildings.	All	P-6	PF-6
Condensate drains and drains From HVAC Equipment outside of buildings and below grade	All	P-2	PF-2
Gas Natural	Underground	P-8	PF-8 and PF-9
Gas Natural	Above Ground 3/4" to 2"	P-7	PF-7
Gas Natural	Above Ground 2-1/2" and larger	P-7	PF-10
Copper Drainage Tube (Above Ground)	Waste and Vent	P-4	PF-4
Vents	Above Ground	P-1	PF-1
Waste lines, Sanitary	Above Ground	P-1	PF-1
Waste lines, Sanitary	Below Ground	P-3	PF-3

E. 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 22 05 53: Plumbing Identification.
- P-1 Cast iron: Hubless, service weight, ASTM A888, CISPI 301, conforming to CISPI 310 and installed in accordance to IAPMO 1S 06. American Foundry, Tyler, or AB & I or equal.
- P-2 PVC, schedule 40, extruded from 100 percent virgin Polyvinyl Chloride (PVC) compound, meeting requirements of class 1254-13 of ASTM D1784.
- P-3 CPVC (Chlorinated polyvinyl Chloride) schedule 40 pipe, conforming to ASTM D1784 and complying with UL723 (ASTM E84). The joints shall be of solvent cement type conforming to ASTM F493. Installer shall be certified by the manufacturer for this type of joint installation. Spears, Corzan, Charlotte or equal.
- P-4 Copper drainage tube, inside structure and above grade. Type DWV hard temper, ASTM B 306, Mueller, Anaconda, Cerro Brass, Cambridge-Lee, Halstead or equal.
- P-5 PVC, thick wall, cast-iron OD sized, UL listed, AWWA listed, NSF listed, Class 200 with tracer wire, Blue Brute, or equal.
- P-6 Copper water tube, Type L hard, ASTM B88. Mueller, Cambridge-Lee, Halstead or equal. (when used above ground only)
- P-7 Black steel pipe, Schedule 40, ASTM A53, Type E, ERW by US Steel, or equal.
- P-8 Polyethylene plastic pipe, ASTM D 2513, standard dimension ratio. 11, rated at 80 psi working pressure at 73 degrees Fahrenheit (F). for 3-inch and smaller, SDR 11.5 rated at 76 psi at 73 degrees F. for 4-inch and above, butt or socket type fittings, joined by heat fusion, orange or yellow color.

CPCHEM (Chevron Phillips Chemical Company LP) PE 2406, or equal.

F. Pipe Fittings:

- PF-1 Cast iron, soil or waste no-hub coupling with neoprene gaskets, stainless steel corrugated shields and stainless steel clamps. 2 bands for size 1 ½-inch thru 4-inch, IAPMO, ASTM C 564 and CISPI 310.
- American Foundry, Mission, Tyler, or equal.
- PF-2 Plastic fittings, schedule 40 molded from PVC type I compound, conforming to the requirements of specification ASTM D2466.
- PF-3 CPVC fittings must conform to ASTM D2846 specification for chlorinated polyvinylchloride (CPVC) plastic for hot and cold water distribution system.
- PF-4 Cast brass drainage fittings ASA B 16.23, ASTM B 42. Provide with copper drainage tube.

Mueller Brass, Nibco, Stanley Flagg, Lee Brass Or equal.

- PF-5 Cast-iron OD sized,, bell and spigot gasket joints.
- PF-6 Wrought copper - solder type ANSI B 16.22
Mueller Brass, Nibco, Lee Brass or equal.
- PF-7 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, by Stockham or equal.
- PF-8 Polyethylene plastic fittings, ASTM D 3261 and D 2683, standard dimension ratio 11, rated at 80 psi working pressure at 73 degrees F. for 3 inches and smaller, SDR 11.5 rated at 76 psi at 73 degrees F. for 4 inches and above, butt or socket type fittings, joined by heat fusion, color orange or yellow.

CPCHEM, (Chevron Phillips Chemical Company LP) or equal.
- PF-9 Polyethylene transition risers, for PF-8 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.

Central Plastics Company or equal.
- PF-10 Steel butt weld type, ASTM A 234WPB.

G. Pipe Isolators:

- PLA-1 Absorption pad shall be not less than ½ inch thick, unloaded. Pad shall completely encompass pipe.

Holdrite, LSP, Stoneman, Potter-Roemer, Trisolator, PR-Isolator, or equal.

Hydra-Zorb Cushion Clamps, Acousto-Clamp, or equal.

H. 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; by 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. Walworth, Homestead, WKM, or equal.

I. 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
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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, 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>
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Cold water	1/16 inch thick neoprene
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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.

J. 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

3.01 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.

3.02 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 4000 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.
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.
- 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 treads 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.
 - b. 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.
- 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. 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, R. W. Lyall Co., 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 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 ¾ inch in size with one hose bib in the lunch pavilion 1 inch in size. Other hose bibs shall be ¾ inch lock shield type. Bibs shall be furnished with vacuum breaker protection.

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. 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. 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.
12. Turnbuckles, if furnished, shall provide a load carrying capacity equal to that of the pipe hanger with which they are being installed.
13. Pipe hangers shall be of same size, or nearest larger manufactured size available, as pipe or tubing on which they are being installed.
14. 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.
15. Where special pipe-supporting requirements in the Specifications conflict with any standard requirements specified herein, the Specification requirements shall govern.

16. 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 ½-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 ¼-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.
17. 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.
18. 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.
19. 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.

20. 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. 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.
 3. 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.
 4. 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.
 5. 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.
 6. 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 even if not indicated on Drawings.

END OF SECTION

**SECTION 22 05 53
PLUMBING IDENTIFICATION**

PART 1 – GENERAL

1.01 SUMMARY

- A. Section Includes: Marking and identification on mechanical piping systems, ducts, controls, valves, and apparatus.
- B. Related Requirements:
 - 1. Division 01: General Requirements
 - 3. Section 22 05 13: Basic Plumbing Materials and Methods.
 - 4. Section 22 10 00: Plumbing.
 - 5. Section 22 20 13: Plumbing Piping.

1.02 SUBMITTALS

- A. Submit in accordance with Division 01 and Section 22 05 00: Common Work Results for Plumbing.
- B. Submit product data and installation instructions for each item specified.
- C. Submit Samples of materials.

1.03 QUALITY ASSURANCE

- A. Comply with provisions of:
 - 1. Section 22 05 00: 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

2.01 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.

2.02 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.

2.03 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.

2.04 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.

2.05 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)
3/4 to 1 1/4	8	1/2
1 1/2 to 2	8	3/4
2 1/2 to 6	12	1 1/4
8 to 10	24	2 1/2
over 10	32	3 1/2

- 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
Indirect drain	Ind drain	Green	White
Gas	Gas	Yellow	White

- 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.

2.06 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: 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

3.01 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.

3.02 CLEANUP

- A. Remove rubbish, debris, and waste materials and legally dispose of off the Project site.

END OF SECTION

**SECTION 22 07 00
PLUMBING INSULATION**

PART 1 – GENERAL

1.01 SUMMARY

A. Section Includes:

1. Insulation for plumbing piping.

B. Related Requirements:

1. Division 01: General Requirements.
2. Section 22 05 00: Common Work Results for Plumbing.
3. Section 22 0513: Basic Plumbing Materials and Methods.
4. Section 22 05 53: Plumbing Identification.
5. Section 22 10 00: Plumbing.

1.02 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.

1.03 SUBMITTALS

- A. Submit in accordance with Division 01 and Section 22 05 00: 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.

1.04 QUALITY ASSURANCE

- A. Qualifications of Manufacturer and Installer, Materials, Fabrication, Execution, and Standard of Quality: Comply with provisions stated under Section 22 05 00: Common Work Results for Plumbing and Section 22 05 13: 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 05 00 and 22 05 13 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.

1.05 PRODUCT HANDLING

- A. Protection, Replacement, Delivery and Storage: Comply with provisions stated under Sections 22 05 00: Common Work Results for Plumbing and 22 0513: Basic Plumbing Materials and Methods.

PART 2 – PRODUCTS

2.01 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.

PART 3 – EXECUTION

3.01 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 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.

3.02 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 05 13: 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 1/2-inch wide stainless steel strapping and wing seals. Aluminum jacket shall be mitered to fit fittings.

3.03 CLEANUP

- A. Remove rubbish, debris, and waste materials and legally dispose of off the Project site.

3.04 PROTECTION

- A. Protect the Work of this Section until Substantial Completion.

END OF SECTION

**SECTION 22 10 00
PLUMBING**

PART 1 - GENERAL

1.01 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 05 00: Common Work Results for Plumbing.
 - 3. Section 22 05 13: Basic Plumbing Materials and Methods.
 - 4. Section 22 05 53: Identification for Plumbing piping and Equipment.
 - 5. Section 22 07 00: Plumbing Insulation.

1.02 SUBMITTALS

- A. Provide in accordance with Division 01 and Section 22 05 00: Common Work Results for Plumbing.
- B. Provide necessary documentation to Owner for processing rebates for water efficient fixtures.

1.03 QUALITY ASSURANCE

- A. Unless otherwise noted, the California Plumbing Code is hereby made part of this section.
- B. Conform to provisions of Section 22 05 00: 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.

1.04 PRODUCT HANDLING

- A. Conform to provisions of Section 22 05 13: Basic Plumbing Materials and Methods.

PART 2 - PRODUCTS

2.01 PIPING SYSTEMS

- A. Materials: Refer to Section 22 05 13: Basic Mechanical Materials and Methods.
- B. Insulation for Piping: Refer to Section 22 07 00: Plumbing Insulation.

END OF SECTION

**SECTION 22 42 00
PLUMBING FIXTURES**

PART 1 - GENERAL

1.01 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 equipment, 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 cast brass, chromium-plated and polished. (No tubular traps). Exceptions as follows:
 - a. Traps that are an integral part of a fixture.
 - b. Traps concealed in floors, walls and furring.
 - c. Traps standard for service sinks and Industrial Shop equipment.
 - d. Laboratory traps and tailpieces shall be as specified in section 22 07 00.
 "Basic Plumbing Materials and Methods"
 2. Concealed traps and 17 gage tailpieces may be rough brass finish, except as otherwise specified. Laboratory traps and tailpieces shall be as specified in Section 22 07 00: Basic Plumbing Materials and Methods. Furnish chromium-plated and polished cast brass wall flanges with setscrews and chromium-plated and polished brass casing on discharge side of each trap.
 3. Tailpieces shall be not lighter than 17 gage, brass, chromium-plated, and polished. Furnish and install chromium brass plated wall flanges with set screws and chromium-plated 20 gage brass casing on discharge side of each chrome-plated all cast trap.

PART 2 - GENERAL

2.01 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

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. (To be specified for painted walls, screwed into cleanout plug.)

SMITH	ZURN	JOSAM	WADE	WATTS	MIFAB
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. (To be specified for tile walls.)

SMITH	ZURN	WADE	WATTS	MIFAB	JOSAM
4735U	Z-1460-VP	58630	CO-300-S- 6	C1400-S- 3-6	58640-VP

2.02 DIELECTRIC UNIONS

A. Schedule Numbers:

- Dielectric style Unions using ferrous and no-ferrous metals are prohibited. Dielectric flanges are admitted for use – see DU-2.

DU-1: Lead Free Brass union with 6-inch Lead Free Brass nipple.

DU-2: Lead Free Brass union or Lead Free Brass flanged fittings are to be used in between pipes made of dissimilar metals to prevent accelerated corrosion and deterioration in the piping systems due to galvanic and stray current.

WATTS	WILKINS	ZURN	NIBCO
LF3100M3			733-LF

2.03 FLEXIBLE HOSES

A. Schedule Numbers:

FLH-1: Braided stainless steel metal hose (for gas use). US Flex, Metraflex, Nelson Dunn or equal.

FLH-2: Braided bronze metal hose (for non-pressure condensate connection use). US Flex, Metraflex, Nelson Dunn or equal.

2.04 HOSE BIBBS

A. Schedule Numbers:

HB-1: For plaster or stucco wall, furnished with box and stop, exposed trim chrome-plated, with or without door and with vacuum breaker.

(To be specified for use at exterior building walls.)

ACORN	WOODFORD	PRIER
8141, 8151	B75	C-633NFC

HB-2: For brick, CMU and poured in place concrete walls, furnished with box and stop, exposed trim chrome-plated, with or without door and with vacuum breaker.

(To be specified for use around exterior building wall.)

ACORN	WOODFORD	PRIER
8141, 8104, 8151	B75	C-633NFC

HB-3: ASTM B 62 bronze body, rubber composition disc or renewable seat, straight nose with brass die cast or enamel iron hand wheel and with vacuum breaker.

(To be specified for use for Lath House.)

ACORN	ZURN	WOODFORD	PRIER
8131-RBVB	Z-1343-VB	Y24	C-155

HB-4: Same as HB-3 except furnish with bent nose.

(To be specified for use at roof top AC Unit. Mechanical Equipment Room, Boiler Rooms, etc.)

ACORN	ZURN	CHAMPION	PRIER
8126-LK-RBVB	Z-1343-VB-LK	B-401 LK	C-255NP

2.05 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
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2.06 P-TRAPS

A. Schedule Numbers:

PT-1: Cast brass complete, chrome-plated.

AB&A
107

2.07 PRESSURE REGULATING VALVE ASSEMBLIES

A. Schedule Numbers:

PRV-1: Furnish for gas service, spring-loaded model, Buna N rubber composition or leather valve seat disc and diaphragm, inlet pressure 125 pound maximum.

REPLANCE	FISHER	SENSUS
1813C	S-100, 166-1, S-201, 166-2	121

PRV-2: Furnish for gas service for (unit heaters, boilers, and similar installations). Spring-loaded model, Buna N rubber composition, or leather valve seat and diaphragm suitable for temperatures to 150 degrees F.; maximum inlet pressure one pound. Outlet pressure 4 inches to 10 inches adjustable; orifice to suit. For pilot lines and main burners.

REPLIANCE	MAXITROL	HONEYWELL
A3000 Series	RV	V5172 Series

2.08 SINKS and TRIM

A. For access compliant sinks: Insulate cold water, hot water and drain pipes under sinks with district approved type insulation.

PLUMEREX	LAV GUARD
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2.09 SERVICE STOP GAS VALVES

A. Schedule Numbers:

SGV-1: Bronze/Brass gas cock valve with double stake packing nut, ½ inch to 2-inch, with IPS, inclusive, with flat or square head. CSA approved.

(To be specified for oven ranges, convection ovens, skillets.)

AMERICAN	Mc DONALD	NIBCO
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85 CBK or 86C	10596, flat 10604, square	GB2A
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SGV-2: Bronze/Brass, ¾-inches to 2-inch IPS (WOG) water, oil, or gas – full port ball valve. CSA approved.

(To be specified for larger water heaters, small boilers, pool heaters, and A/C units on roofs.)

WATTS	NIBCO	WILKINS	OR EQUAL
LFFBV-4	F-510-CS-R-66-FS	Model 850	

SGV-3: Cast iron, 2-inch to 4-inch flanged ball valves (WOG) water, oil, or gas. CSA approved.

(To be specified for larger heating equipment.)

WILKINS	NIBCO	WATTS	OR EQUAL
Model 850	F-510-CS-R-66-FS	G4000M1	

SGV-4: Lubricated plug gas valve, ¾-inch to 2-inch IPS valve.

To be specified for use after gas meter headers, gas regulators, and isolation valves for building isolation, individual floor level isolation, and boiler rooms.)

NORDSTROM	WALWORTH	RESUN	OR EQUAL
142	1786	1430	

SGV-5: Lubricated plug gas valve flanged type 2 ½-inch and larger valve.

(To be specified for use after gas meter headers, gas regulators, isolation valves for buildings isolation, individual floor level isolation and boiler rooms.)

NORDSTROM	WALWORTH	RESUN	OR EQUAL
142	1786-F	1431	

SGV-6: Bronze/Brass ½ inch to 2-inch IPS X Flare Appliance ball valves with Tee handle. Flares to be used in conjunction with corrugated flex lines.

(To be specified for clothes dryer, water heaters, unit heaters, and wall heaters up to 100,000 BTU.)

RED and WHITE	BRASSCRAFT	NIBCO	OR EQUAL
RW 5210 RW 5211 RW 5221	TBV 10-12 TBV 8-8 TBV 6-8	GBV 12 GBV 1516	

2.10 STOP VALVES

- A. Stops shall be loose key type, ½-inches IPS inlet and outlet chrome-plated brass casting, except as noted.

B. Schedule Numbers:

STV-1: Angle:

CHICAGO,	BRASSCRAFT	NIBCO	OR EQUAL
442-LKABCP		77	

STV-2: Partition:

CHICAGO	T& S BRASS	OR EQUAL
1771-ABCP	B-1028	

STV-3: Straight Type, with Loose Key:

CHICAGO	BRASSCRAFT	T&S BRASS	OR EQUAL
45-LKABCP (1/2 inch)		B-O418	

2.11 YARD BOXES

A. Schedule Numbers:

YB-1 Yard Boxes: 14 3/4-inch by 20-inch by 12-inch, cast concrete, with cast iron hinged locking traffic cover marked "GAS"

(For use over gas stops for portable buildings only, on addition to accessible emergency shutoff valve on building.)

BROOKS No. 36-HFL Assembly with cast iron hinged locking cover	OR EQUAL
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YB-2: Same as YB-1, marked "WATER" (For use over water valves).

BROOKS No. 36-HFL Assembly with cast iron hinged locking cover	OR EQUAL
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YB-3: Same as YB-1, marked "SEWER"

BROOKS No. 36-HFL Assembly with cast iron hinged locking cover	OR EQUAL
--	----------

2.12 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 1/4 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 **(To be specified for finished floors inside buildings, in covered areas, and in concrete paving.)**

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	

2.13 FLUSH VALVE ASSEMBLY

- A. Valves shall be furnished so that flush remains constant and will not require any adjustment.
1. Each flush valve shall be provided with a loose key, square shank, lock shield angle service stop connected to flush valve with a union connection.
 2. Provide 17 gage pressed brass escutcheons for wall and fixture. Escutcheons shall be fastened to not turn or rattle.
 3. Each flush valve shall be furnished with a vacuum breaker providing one inch opening to atmosphere, which will not leak under any degree of back pressure and will not restrict rate of flow more than 10% at 10 PSI, and will operate noiselessly.
 4. Tailpiece shall not be lighter than 17 gage and shall be part of flush valve assembly.
 5. Exposed metal parts of flush valve assembly shall be nickel or chromium-plated on a brass or copper base.
 6. Refer to 2.02.E for fixture supplies.
 7. Controls for water closet flush valves shall be mounted on the wide side of toilet areas.
- B. Schedule Numbers:

FLV-1:Automatic Flush Valve for Water Closets: Battery-powered, sensor-operated, 17 gage chrome-plated brass or heavier with cover and with metal cover manual override button. Shall deliver 1.28 gallon of water at each operation.

SLOAN	ZURN	OR EQUAL
Royal 111 SMO-1.28	ZER600 0AV-HET-CPM	

FLV-1a: Manual Flush Valve for Water Closet: Shall deliver 1.28 gallon of water at each operation.

SLOAN	ZURN	OR EQUAL
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2.14 WATER CLOSETS

A. General: Water closets shall be vitreous china with Polyvinyl chloride bolt caps. Fixtures with auto-flush valves shall be provided with manual override button.

B. Schedule Numbers:

WC-4: Floor mounted, access compliant, 17 to 19 inches height to top of seat with flush valve at 1.28 gallons per flush and open front, fire retardant seat.

(To be specified for access compliant use in Secondary schools for students and adults use.)

a. Bowl:

AMERICAN STANDARD	KOHLER	SLOAN	ZURN	OR EQUAL
3461.001	K-96057	ST-2029	Z5665-BWL-1	

b. Auto-flush valve (battery): FLV-1.

c. Manual-flush valve: FLV-1a.

d. Seat: White, ring thickness including bumpers shall be one inch.

OLSONITE	BEMIS	CENTOCO	OR EQUAL
10SSCTFR	1955 SSFR	AMFR500STSCCSS	

2.15 HEIGHT OF FIXTURES

A. Heights for standard fixtures.

Fixture	Adults and Students Ages 12 and Over	Elementary Ages 6 to 11 (Inches)	Kindergarten and Younger Ages 3 to 5 (Inches)
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	(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		

PART 3 - EXECUTION

3.01 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.

3.02 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. 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.

5. 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.
 6. Piping materials for trap arms shall be Brass, Cast Iron or DWV copper
- 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. Where indicated on Drawings.

3.03 EXCAVATION, TRENCHING AND BACKFILLING

- A. Perform trenching, excavation, and backfilling required for Work of this section as specified herein and in Section 31 2323: Excavating, Backfilling, and Compacting for Utilities.

3.04 SERVICE CONNECTIONS

- A. Determine exact location of required water, drain, and sewer connections and provide proper connections.
- B. Potable water lines shall be purged completely before connecting to sources of water for the Project. Determine quality of water supply before connection.

3.05 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.

3.06 CONDENSATE DRAINS - FROM WINDOW TYPE HEAT PUMP AND EXTERIOR WALL MOUNT HEAT PUMP UNITS

- A. Whether indicated on Drawings or not, window units and wall mount units without built in bottom drain pan for evaporator and condenser coils shall be provided with galvanized steel condensate pan at bottom of unit with drain line that drains into approved drywell. Install copper 1/2 inch diameter pipe for window type air conditioners and 3/4 inch diameter pipe for exterior wall-mounted heat pump units.

3.07 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".
1. 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.
 2. Plastic pipe shall be installed not less than 30 inches below grade.
 3. 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".

4. 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.
5. 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.
6. Piping shall not support weight of valves, metal fittings or other items. Pipe shall be installed strain free.
7. 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.
8. 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
9. 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.
10. 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 the building.

3.08 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.

3.09 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 device 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.

3.10 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.
- 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. 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.
 2. Install gate or ball valve at each location where a water line is connected to a piece of equipment other than items mentioned above.

3.11 VALVES - GAS SERVICE

- A. A gas readily accessible shut-off stop shall be installed on each gas line entering a building immediately prior to the point it enters the building. Unless otherwise specified or indicated, shut-off valves for lines entering a permanent structure, buildings or portable buildings, shall be installed in a vertical riser above grade.
 1. Gas shut off valve for portable buildings – In addition to the gas readily accessible shut-off stop specified above, a dedicated Gas shut off valve shall be provided in a marked Yard Box, for each portable building to facilitate relocation/removal of building without the need to shut off gas to entire school.

- B. Gas Shut off valve within a building – A gas shut off valve with handles shall be accessible and serviceable within an access panel. Install valve minimum 3 feet above floor but less than 7 feet above floor.
- C. In addition to locations specified, gas shut off valve shall be installed at following locations:
1. Install a lubricated plug gas shut off valve on any line connected to gas main or header at master assembly.
 2. Install a lubricated plug gas shut off valve before entering any building or structure.
 3. Install a gas valve on each outlet, in addition to any gas stop furnished with equipment.
 4. Service to laboratory gas cocks shall be furnished with a special precision check valve, located downstream from gas stop servicing room outlet at each laboratory cock. Unless otherwise specified, 1/8-inches bore shall be provided for each outlet cock.
 5. Install a gas shut-off valve on each gas line serving 2 or more gas outlets in same room. Service stop shall be installed not more than 7 feet above floor, and shall be in the room it serves.
 6. Install a gas shut-off valve on inlet side of each gas pressure regulating valve.
 7. Gas shut-off valves to be furnished with equipment.
 8. Install gas shut-off valve at not more than 1,000 foot intervals on each gas main.
 9. At multi-story buildings, provide gas-shut off valve(s) to isolate and control each floor or level. Install valves in a concealed manner in walls with access panels.
 10. Gas shut-off valves in classrooms and locations subject to tampering shall be protected while remaining accessible.
- D. When a gas-shut off valve adjacent to gas-fired equipment is indicated in Contract Documents it shall be furnished and installed as part of Work of this section.
- E. When electrical wall switches with emergency push button are specified for controlling gas outlets at Laboratory Classrooms, provide main shut-off gas valve with normally closed electric solenoid valve within an accessible access panel.

3.12 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. Underground dielectric connections shall be furnished in accessible yard boxes.
4. Above ground dielectric connections shall be exposed; or if in finished rooms shall be located in accessible access boxes.

3.13 UNDERGROUND PIPE MARKERS

- A. Pipe markers shall be furnished according to Section 22 0553: "Plumbing Identification"
- B. Underground Caution Tape shall be placed 12 to 18 inches above the utility line. The Caution Tape shall be a designated color and marked with the appropriate name for the specific type of utility pipe as follows:
 1. Yellow – with the words: CAUTION GAS LINE BELOW
 2. Blue – with the words: CAUTION WATER LINE BELOW

3.14 CLEANUP

- A. Remove rubbish, debris, and waste materials and legally dispose off Project site.
- B.

3.15 PROTECTION

- A. Protect Work of this section until Substantial Completion.

END OF SECTION

**SECTION 23 05 00
COMMON WORK RESULTS FOR HVAC**

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SUMMARY

- A. This Section includes the following:

1. Piping materials and installation instructions common to most piping systems.
2. Transition fittings.
3. Dielectric fittings.
4. Sleeves.
5. Escutcheons.
6. Grout.
7. HVAC demolition.
8. Equipment installation requirements common to equipment sections.
9. Painting and finishing.
10. Supports and anchorages.

1.03 DEFINITIONS

- A. Finished Spaces: Spaces other than mechanical and electrical equipment rooms, furred spaces, pipe and duct chases, unheated spaces immediately below roof, spaces above ceilings, unexcavated spaces, crawlspaces, and tunnels.
- B. Exposed, Interior Installations: Exposed to view indoors. Examples include finished occupied spaces and mechanical equipment rooms.
- C. Exposed, Exterior Installations: Exposed to view outdoors or subject to outdoor ambient temperatures and weather conditions. Examples include rooftop locations.
- D. Concealed, Interior Installations: Concealed from view and protected from physical contact by building occupants. Examples include above ceilings and chases.
- E. Concealed, Exterior Installations: Concealed from view and protected from weather conditions and physical contact by building occupants but subject to outdoor ambient temperatures. Examples include installations within unheated shelters.

F. The following are industry abbreviations for plastic materials:

1. CPVC: Chlorinated polyvinyl chloride plastic.
2. PE: Polyethylene plastic.
3. PVC: Polyvinyl chloride plastic.

G. The following are industry abbreviations for rubber materials:

1. EPDM: Ethylene-propylene-diene terpolymer rubber.
2. NBR: Acrylonitrile-butadiene rubber.

1.04 SUBMITTALS

A. Product Data: For the following:

1. Transition fittings.
2. Dielectric fittings.
3. Mechanical sleeve seals.
4. Escutcheons.

B. Welding certificates.

1.05 QUALITY ASSURANCE

A. Steel Support Welding: Qualify processes and operators according to AWS D1.1, "Structural Welding Code--Steel."

B. Electrical Characteristics for HVAC Equipment: Equipment of higher electrical characteristics may be furnished provided such proposed equipment is approved in writing and connecting electrical services, circuit breakers, and conduit sizes are appropriately modified. If minimum energy ratings or efficiencies are specified, equipment shall comply with requirements.

1.06 DELIVERY, STORAGE, AND HANDLING

A. Deliver pipes and tubes with factory-applied end caps. Maintain end caps through shipping, storage, and handling to prevent pipe end damage and to prevent entrance of dirt, debris, and moisture.

1.07 COORDINATION

A. Arrange for pipe spaces, chases, slots, and openings in building structure during progress of construction, to allow for HVAC installations.

B. Coordinate installation of required supporting devices and set sleeves in poured-in-place concrete and other structural components as they are constructed.

- C. Coordinate requirements for access panels and doors for HVAC items requiring access that are concealed behind finished surfaces. Access panels and doors are specified in Division 08 Section "Access Doors and Frames."

PART 2 - PRODUCTS

2.01 MANUFACTURERS

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

2.02 PIPE, TUBE, AND FITTINGS

- A. Refer to individual Division 23 piping Sections for pipe, tube, and fitting materials and joining methods.
- B. Pipe Threads: ASME B1.20.1 for factory-threaded pipe and pipe fittings.

2.03 JOINING MATERIALS

- A. Refer to individual Division 23 piping Sections for special joining materials not listed below.
- B. Solder Filler Metals: ASTM B 32, lead-free alloys. Include water-flushable flux according to ASTM B 813.
- C. Brazing Filler Metals: AWS A5.8, BCuP Series, copper-phosphorus alloys for general-duty brazing, unless otherwise indicated; and AWS A5.8, BAg1, silver alloy for refrigerant piping, unless otherwise indicated.

2.04 DIELECTRIC FITTINGS

- A. Description: Combination fitting of copper alloy and ferrous materials with threaded, solder-joint, plain, or weld-neck end connections that match piping system materials.
- B. Insulating Material: Suitable for system fluid, pressure, and temperature.
- C. Dielectric Unions: Factory-fabricated, union assembly, for 250-psig minimum working pressure at 180 deg F.
 - 1. Manufacturers:
 - a. Capitol Manufacturing Co.
 - b. Central Plastics Company.
 - c. Eclipse, Inc.

- d. Epco Sales, Inc.
 - e. Hart Industries, International, Inc.
 - f. Watts Industries, Inc.; Water Products Div.
 - g. Zurn Industries, Inc.; Wilkins Div.
2. Separate companion flanges and steel bolts and nuts shall have 150- or 300-psig minimum working pressure where required to suit system pressures.
- D. Dielectric Couplings: Galvanized-steel coupling with inert and noncorrosive, thermoplastic lining; threaded ends; and 300-psig minimum working pressure at 225 deg F.
- 1. Manufacturers:
 - a. Calpico, Inc.
 - b. Lochinvar Corp.
- E. Dielectric Nipples: Electroplated steel nipple with inert and noncorrosive, thermoplastic lining; plain, threaded, or grooved ends; and 300-psig minimum working pressure at 225 deg F.
- 1. Manufacturers:
 - a. Perfection Corp.
 - b. Precision Plumbing Products, Inc.
 - c. Sioux Chief Manufacturing Co., Inc.
 - d. Victaulic Co. of America.

2.05 ESCUTCHEONS

- A. Description: Manufactured wall and ceiling escutcheons and floor plates, with an ID to closely fit around pipe, tube, and insulation of insulated piping and an OD that completely covers opening.
- B. One-Piece, Deep-Pattern Type: Deep-drawn, box-shaped brass with polished chrome-plated finish.
- C. One-Piece, Cast-Brass Type: With set screw.
 - 1. Finish: Polished chrome-plated.
- D. Split-Casting, Cast-Brass Type: With concealed hinge and set screw.
 - 1. Finish: Polished chrome-plated.
- E. One-Piece, Stamped-Steel Type: With set screw or spring clips and chrome-plated finish.

- F. Split-Plate, Stamped-Steel Type: With concealed hinge, set screw, and chrome-plated finish.
- G. One-Piece, Floor-Plate Type: Cast-iron floor plate.
- H. Split-Casting, Floor-Plate Type: Cast brass with concealed hinge and set screw.

PART 3 - EXECUTION

3.01 HVAC DEMOLITION

- A. Refer to Division 01 Section "Cutting and Patching" and Division 02 Section "Selective Structure Demolition" for general demolition requirements and procedures.
- B. Disconnect, demolish, and remove HVAC systems, equipment, and components indicated to be removed.
 1. Piping to Be Removed: Remove portion of piping indicated to be removed and cap or plug remaining piping with same or compatible piping material.
 2. Piping to Be Abandoned in Place: Drain piping and cap or plug piping with same or compatible piping material.
 3. Ducts to Be Removed: Remove portion of ducts indicated to be removed and plug remaining ducts with same or compatible ductwork material.
 4. Ducts to Be Abandoned in Place: Cap or plug ducts with same or compatible ductwork material.
 5. Equipment to Be Removed: Disconnect and cap services and remove equipment.
 6. Equipment to Be Removed and Reinstalled: Disconnect and cap services and remove, clean, and store equipment; when appropriate, reinstall, reconnect, and make equipment operational.
 7. Equipment to Be Removed and Salvaged: Disconnect and cap services and remove equipment and deliver to Owner.
- C. If pipe, insulation, or equipment to remain is damaged in appearance or is unserviceable, remove damaged or unserviceable portions and replace with new products of equal capacity and quality.

3.02 PIPING SYSTEMS - COMMON REQUIREMENTS

- A. Install piping according to the following requirements and Division 23 Sections specifying piping systems.
- B. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems. Install piping as indicated unless deviations to layout are approved on Coordination Drawings.

- C. Install piping in concealed locations, unless otherwise indicated and except in equipment rooms and service areas.
- D. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.
- E. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal.
- F. Install piping to permit valve servicing.
- G. Install piping at indicated slopes.
- H. Install piping free of sags and bends.
- I. Install fittings for changes in direction and branch connections.
- J. Install piping to allow application of insulation.
- K. Select system components with pressure rating equal to or greater than system operating pressure.
- L. Install escutcheons for penetrations of walls, ceilings, and floors according to the following:
 - 1. New Piping:
 - a. Piping with Fitting or Sleeve Protruding from Wall: One-piece, deep-pattern type.
 - b. Chrome-Plated Piping: One-piece, cast-brass type with polished chrome-plated finish.
 - c. Insulated Piping: One-piece, stamped-steel type with spring clips.
 - d. Bare Piping at Wall and Floor Penetrations in Finished Spaces: One-piece, cast-brass type with polished chrome-plated finish.
 - e. Bare Piping at Ceiling Penetrations in Finished Spaces: One-piece, cast-brass type with polished chrome-plated finish.
 - f. Bare Piping in Unfinished Service Spaces: One-piece, stamped-steel type with concealed hinge and set screw or spring clips.
- M. Permanent sleeves are not required for holes formed by removable PE sleeves.
- N. Install sleeves for pipes passing through concrete and masonry walls, gypsum-board partitions, and concrete floor and roof slabs.
- O. Cut sleeves to length for mounting flush with both surfaces.
 - 1. Exception: Extend sleeves installed in floors of mechanical equipment areas or other wet areas 2 inches above finished floor level. Extend cast-iron

sleeve fittings below floor slab as required to secure clamping ring if ring is specified.

- P. Install sleeves in new walls and slabs as new walls and slabs are constructed.
- Q. Install sleeves that are large enough to provide 1/4-inch annular clear space between sleeve and pipe or pipe insulation. Use the following sleeve materials:
- R. PVC Pipe Sleeves: For pipes smaller than NPS 6.
- S. Steel Sheet Sleeves: For pipes NPS 6 and larger, penetrating gypsum-board partitions.
- T. Stack Sleeve Fittings: For pipes penetrating floors with membrane waterproofing. Secure flashing between clamping flanges. Install section of cast-iron soil pipe to extend sleeve to 2 inches above finished floor level. Refer to Division 07 Section "Sheet Metal Flashing and Trim" for flashing.
- U. Above ground, Exterior-Wall Pipe Penetrations: Seal penetrations using sleeves and mechanical sleeve seals. Select sleeve size to allow for 1-inch annular clear space between pipe and sleeve for installing mechanical sleeve seals.
- V. Install steel pipe for sleeves smaller than 6 inches in diameter.
- W. Mechanical Sleeve Seal Installation: Select type and number of sealing elements required for pipe material and size. Position pipe in center of sleeve. Assemble mechanical sleeve seals and install in annular space between pipe and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.
- X. Fire-Barrier Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at pipe penetrations. Seal pipe penetrations with firestop materials. Refer to Division 07 Section "Penetration Firestopping" for materials.
- Y. Verify final equipment locations for roughing-in.
- Z. Refer to equipment specifications in other Sections of these Specifications for roughing-in requirements.

3.03 PIPING JOINT CONSTRUCTION

- A. Join pipe and fittings according to the following requirements and Division 23 Sections specifying piping systems.
- B. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.
- C. Remove scale, slag, dirt, and debris from inside and outside of pipe and fittings before assembly.
- D. Soldered Joints: Apply ASTM B 813, water-flushable flux, unless otherwise indicated, to tube end. Construct joints according to ASTM B 828 or CDA's "Copper Tube Handbook," using lead-free solder alloy complying with ASTM B 32.

- E. Brazed Joints: Construct joints according to AWS's "Brazing Handbook," "Pipe and Tube" Chapter, using copper-phosphorus brazing filler metal complying with AWS A5.8.

3.04 PIPING CONNECTIONS

- A. Make connections according to the following, unless otherwise indicated:
- B. Install unions, in piping NPS 2 and smaller, adjacent to each valve and at final connection to each piece of equipment.
- C. Dry Piping Systems: Install dielectric unions and flanges to connect piping materials of dissimilar metals.
- D. Wet Piping Systems: Install dielectric coupling and nipple fittings to connect piping materials of dissimilar metals.

3.05 EQUIPMENT INSTALLATION - COMMON REQUIREMENTS

- A. Install equipment to allow maximum possible headroom unless specific mounting heights are not indicated.
- B. Install equipment level and plumb, parallel and perpendicular to other building systems and components in exposed interior spaces, unless otherwise indicated.
- C. Install HVAC equipment to facilitate service, maintenance, and repair or replacement of components. Connect equipment for ease of disconnecting, with minimum interference to other installations. Extend grease fittings to accessible locations.
- D. Install equipment to allow right of way for piping installed at required slope.

3.06 PAINTING

- A. Painting of HVAC systems, equipment, and components is specified in Division 09 Sections "Interior Painting" and "Exterior Painting."
- B. Damage and Touchup: Repair marred and damaged factory-painted finishes with materials and procedures to match original factory finish.

3.07 ERECTION OF WOOD SUPPORTS AND ANCHORAGES

- A. Cut, fit, and place wood grounds, nailers, blocking, and anchorages to support, and anchor HVAC materials and equipment.
- B. Select fastener sizes that will not penetrate members if opposite side will be exposed to view or will receive finish materials. Tighten connections between members. Install fasteners without splitting wood members.
- C. Attach to substrates as required to support applied loads.

END OF SECTION

SECTION 23 05 13
COMMON MOTOR REQUIREMENTS FOR HVAC EQUIPMENT

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SUMMARY

A. Section includes general requirements for single-phase and polyphase, general-purpose, horizontal, small and medium, squirrel-cage induction motors for use on ac power systems up to 600 V and installed at equipment manufacturer's factory or shipped separately by equipment manufacturer for field installation.

1.03 COORDINATION

- A. Coordinate features of motors, installed units, and accessory devices to be compatible with the following:
- B. Motor controllers.
- C. Torque, speed, and horsepower requirements of the load.
- D. Ratings and characteristics of supply circuit and required control sequence.
- E. Ambient and environmental conditions of installation location.

PART 2 - PRODUCTS

2.01 GENERAL MOTOR REQUIREMENTS

- A. Comply with requirements in this Section except when stricter requirements are specified in HVAC equipment schedules or Sections.
- B. Comply with NEMA MG 1 unless otherwise indicated.
- C. Comply with IEEE 841 for severe-duty motors.

2.02 MOTOR CHARACTERISTICS

- A. Duty: Continuous duty at ambient temperature of 40 deg C and at altitude of 3300 feet above sea level.
- B. Capacity and Torque Characteristics: Sufficient to start, accelerate, and operate connected loads at designated speeds, at installed altitude and environment, with indicated operating sequence, and without exceeding nameplate ratings or considering service factor.

2.03 SINGLE-PHASE MOTORS

- A. Motors larger than 1/20 hp shall be one of the following, to suit starting torque and requirements of specific motor application:
- B. Permanent-split capacitor.
 - 1. Split phase.
 - 2. Capacitor start, inductor run.
 - 3. Capacitor start, capacitor run.
- C. Multispeed Motors: Variable-torque, permanent-split-capacitor type.
- D. Bearings: Pre lubricated, antifriction ball bearings or sleeve bearings suitable for radial and thrust loading.
- E. Motors: Motors for fans that are less than 1 hp and 1/12 hp or greater shall be electronically-commutated motors or shall have a minimum motor efficiency of 70 percent when rated in accordance with NEMA Standard MG 1-2006 at full load rating conditions. These motors shall also have the means to adjust motor speed for either balancing or remote control. Belt-driven fans may use sheave adjustments for airflow balancing in lieu of a varying motor speed.
- F. Thermal Protection: Internal protection to automatically open power supply circuit to motor when winding temperature exceeds a safe value calibrated to temperature rating of motor insulation. Thermal-protection device shall automatically reset when motor temperature returns to normal range.

PART 3 - EXECUTION (Not Applicable)

END OF SECTION

SECTION 23 05 29
HANGERS AND SUPPORTS FOR HVAC PIPING AND EQUIPMENT

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.02 SUMMARY

A. This Section includes the following hangers and supports for HVAC system piping and equipment:

1. Steel pipe hangers and supports.
2. Trapeze pipe hangers.
3. Metal framing systems.
4. Thermal-hanger shield inserts.
5. Fastener systems.
6. Pipe stands.
7. Equipment supports.

B. Related Sections include the following:

1. Division 05 Section "Metal Fabrications" for structural-steel shapes and plates for trapeze hangers for pipe and equipment supports.
2. Division 23 Section "Vibration and Seismic Controls for HVAC Piping and Equipment" for vibration isolation devices.
3. Division 23 Section(s) "Metal Ducts" for duct hangers and supports.

1.03 DEFINITIONS

A. MSS: Manufacturers Standardization Society for The Valve and Fittings Industry Inc.

B. Terminology: As defined in MSS SP-90, "Guidelines on Terminology for Pipe Hangers and Supports."

1.04 PERFORMANCE REQUIREMENTS

A. Design supports for multiple pipes, including pipe stands, capable of supporting combined weight of supported systems, system contents, and test water.

B. Design equipment supports capable of supporting combined operating weight of supported equipment and connected systems and components.

C. Design seismic-restraint hangers and supports for piping and equipment and obtain approval from authorities having jurisdiction.

1.05 SUBMITTALS

- A. Product Data: For the following:
 - 1. Steel pipe hangers and supports.
 - 2. Thermal-hanger shield inserts.
 - 3. Powder-actuated fastener systems.
- B. Shop Drawings: Signed and sealed by a qualified professional engineer. Show fabrication and installation details and include calculations for the following:
 - 1. Trapeze pipe hangers. Include Product Data for components.
 - 2. Metal framing systems. Include Product Data for components.
 - 3. Pipe stands. Include Product Data for components.
 - 4. Equipment supports.
- C. Welding certificates.

1.06 QUALITY ASSURANCE

- A. Welding: Qualify procedures and personnel according to the following:
 - 1. AWS D1.1, "Structural Welding Code--Steel."
 - 2. AWS D1.3, "Structural Welding Code--Sheet Steel."
 - 3. AWS D1.4, "Structural Welding Code--Reinforcing Steel."
 - 4. ASME Boiler and Pressure Vessel Code: Section IX.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

- A. In other Part 2 articles where titles below introduce lists, the following requirements apply to product selection:
- B. Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers specified.

2.02 PIPE HANGERS AND SUPPORTS

- A. Description: MSS SP-58, Types 1 through 58, factory-fabricated components. Refer to Part 3 "Hanger and Support Applications" Article for where to use specific hanger and support types.
- B. Manufacturers:
 - 1. AAA Technology & Specialties Co., Inc.
 - 2. Bergen-Power Pipe Supports.

3. B-Line Systems, Inc.; a division of Cooper Industries.
4. Carpenter & Paterson, Inc.
5. Empire Industries, Inc.
6. ERICO/Michigan Hanger Co.
7. Globe Pipe Hanger Products, Inc.
8. Grinnell Corp.
9. GS Metals Corp.
10. National Pipe Hanger Corporation.
11. PHD Manufacturing, Inc.
12. PHS Industries, Inc.
13. Piping Technology & Products, Inc.
14. Tolco Inc.
 - a. Galvanized, Metallic Coatings: Pregalvanized or hot dipped.
 - b. Nonmetallic Coatings: Plastic coating, jacket, or liner.
 - c. Padded Hangers: Hanger with fiberglass or other pipe insulation pad or cushion for support of bearing surface of piping.

2.03 TRAPEZE PIPE HANGERS

- A. Description: MSS SP-69, Type 59, shop- or field-fabricated pipe-support assembly made from structural-steel shapes with MSS SP-58 hanger rods, nuts, saddles, and U-bolts.

2.04 METAL FRAMING SYSTEMS

- A. Description: MFMA-3, shop- or field-fabricated pipe-support assembly made of steel channels and other components.
- B. Manufacturers:
 1. B-Line Systems, Inc.; a division of Cooper Industries.
 2. ERICO/Michigan Hanger Co.; ERISTRUT Div.
 3. GS Metals Corp.
 4. Power-Strut Div.; Tyco International, Ltd.
 5. Thomas & Betts Corporation.
 6. Tolco Inc.

7. Unistrut Corp.; Tyco International, Ltd.
- C. Coatings: Manufacturer's standard finish, unless bare metal surfaces are indicated.
- D. Nonmetallic Coatings: Plastic coating, jacket, or liner.

2.05 THERMAL-HANGER SHIELD INSERTS

- A. Description: 100-psig- minimum, compressive-strength insulation insert encased in sheet metal shield.
- B. Manufacturers:
 1. Carpenter & Paterson, Inc.
 2. ERICO/Michigan Hanger Co.
 3. PHS Industries, Inc.
 4. Pipe Shields, Inc.
 5. Rilco Manufacturing Company, Inc.
 6. Value Engineered Products, Inc.
- C. Insulation-Insert Material for Hot Piping: Water-repellent treated, ASTM C 533, Type I calcium silicate or ASTM C 552, Type II cellular glass.
- D. For Trapeze or Clamped Systems: Insert and shield shall cover entire circumference of pipe.
- E. For Clevis or Band Hangers: Insert and shield shall cover lower 180 degrees of pipe.
- F. Insert Length: Extend 2 inches beyond sheet metal shield for piping operating below ambient air temperature.

2.06 FASTENER SYSTEMS

- A. Powder-Actuated Fasteners: Threaded-steel stud, for use in hardened portland cement concrete with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.
 1. Manufacturers:
 - a. Hilti, Inc.
 - b. ITW Ramset/Red Head.
 - c. Masterset Fastening Systems, Inc.
 - d. MKT Fastening, LLC.
 - e. Powers Fasteners.

B. Mechanical-Expansion Anchors: Insert-wedge-type stainless steel, for use in hardened portland cement concrete with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.

1. Manufacturers:
 - a. B-Line Systems, Inc.; a division of Cooper Industries.
 - b. Empire Industries, Inc.
 - c. Hilti, Inc.
 - d. ITW Ramset/Red Head.
 - e. MKT Fastening, LLC.
 - f. Powers Fasteners.

2.07 MISCELLANEOUS MATERIALS

- A. Structural Steel: ASTM A 36/A 36M, steel plates, shapes, and bars; black and galvanized.
- B. Grout: ASTM C 1107, factory-mixed and -packaged, dry, hydraulic-cement, nonshrink and nonmetallic grout; suitable for interior and exterior applications.
 1. Properties: Nonstaining, noncorrosive, and nongaseous.
 2. Design Mix: 5000-psi, 28-day compressive strength.

PART 3 - EXECUTION

3.01 HANGER AND SUPPORT APPLICATIONS

- A. Specific hanger and support requirements are specified in Sections specifying piping systems and equipment.
- B. Comply with MSS SP-69 for pipe hanger selections and applications that are not specified in piping system Sections.
- C. Use hangers and supports with galvanized, metallic coatings for piping and equipment that will not have field-applied finish.
- D. Use nonmetallic coatings on attachments for electrolytic protection where attachments are in direct contact with copper tubing.
- E. Use padded hangers for piping that is subject to scratching.
- F. Horizontal-Piping Hangers and Supports: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
 1. Adjustable, Steel Clevis Hangers (MSS Type 1): For suspension of noninsulated or insulated stationary pipes, NPS 1/2 to NPS 30.

2. Carbon- or Alloy-Steel, Double-Bolt Pipe Clamps (MSS Type 3): For suspension of pipes, NPS 3/4 to NPS 24, requiring clamp flexibility and up to 4 inches of insulation.
 3. Steel Pipe Clamps (MSS Type 4): For suspension of cold and hot pipes, NPS 1/2 to NPS 24, if little or no insulation is required.
 4. Pipe Hangers (MSS Type 5): For suspension of pipes, NPS 1/2 to NPS 4, to allow off-center closure for hanger installation before pipe erection.
 5. Adjustable, Swivel Split- or Solid-Ring Hangers (MSS Type 6): For suspension of noninsulated stationary pipes, NPS 3/4 to NPS 8.
 6. Adjustable, Steel Band Hangers (MSS Type 7): For suspension of noninsulated stationary pipes, NPS 1/2 to NPS 8.
 7. Adjustable Band Hangers (MSS Type 9): For suspension of noninsulated stationary pipes, NPS 1/2 to NPS 8.
 8. Adjustable, Swivel-Ring Band Hangers (MSS Type 10): For suspension of noninsulated stationary pipes, NPS 1/2 to NPS 2.
 9. Split Pipe-Ring with or without Turnbuckle-Adjustment Hangers (MSS Type 11): For suspension of noninsulated stationary pipes, NPS 3/8 to NPS 8.
 10. Extension Hinged or 2-Bolt Split Pipe Clamps (MSS Type 12): For suspension of noninsulated stationary pipes, NPS 3/8 to NPS 3.
 11. U-Bolts (MSS Type 24): For support of heavy pipes, NPS 1/2 to NPS 30.
 12. Clips (MSS Type 26): For support of insulated pipes not subject to expansion or contraction.
 13. Single Pipe Rolls (MSS Type 41): For suspension of pipes, NPS 1 to NPS 30, from 2 rods if longitudinal movement caused by expansion and contraction might occur.
 14. Adjustable Roller Hangers (MSS Type 43): For suspension of pipes, NPS 2-1/2 to NPS 20, from single rod if horizontal movement caused by expansion and contraction might occur.
 15. Adjustable Pipe Roll and Base Units (MSS Type 46): For support of pipes, NPS 2 to NPS 30, if vertical and lateral adjustment during installation might be required in addition to expansion and contraction.
- G. Hanger-Rod Attachments: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
1. Swivel Turnbuckles (MSS Type 15): For use with MSS Type 11, split pipe rings.
 2. Malleable-Iron Sockets (MSS Type 16): For attaching hanger rods to various types of building attachments.
- H. Building Attachments: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
1. Steel or Malleable Concrete Inserts (MSS Type 18): For upper attachment to suspend pipe hangers from concrete ceiling.

2. Top-Beam C-Clamps (MSS Type 19): For use under roof installations with bar-joist construction to attach to top flange of structural shape.
 3. Side-Beam or Channel Clamps (MSS Type 20): For attaching to bottom flange of beams, channels, or angles.
 4. Center-Beam Clamps (MSS Type 21): For attaching to center of bottom flange of beams.
 5. Welded Beam Attachments (MSS Type 22): For attaching to bottom of beams if loads are considerable and rod sizes are large.
 6. C-Clamps (MSS Type 23): For structural shapes.
 7. Top-Beam Clamps (MSS Type 25): For top of beams if hanger rod is required tangent to flange edge.
 8. Side-Beam Clamps (MSS Type 27): For bottom of steel I-beams.
 9. Steel-Beam Clamps with Eye Nuts (MSS Type 28): For attaching to bottom of steel I-beams for heavy loads.
 10. Linked-Steel Clamps with Eye Nuts (MSS Type 29): For attaching to bottom of steel I-beams for heavy loads, with link extensions.
 11. Malleable Beam Clamps with Extension Pieces (MSS Type 30): For attaching to structural steel.
 12. Welded-Steel Brackets: For support of pipes from below, or for suspending from above by using clip and rod. Use one of the following for indicated loads:
 - a. Light (MSS Type 31): 750 lb.
 - b. Medium (MSS Type 32): 1500 lb.
 - c. Heavy (MSS Type 33): 3000 lb.
 13. Side-Beam Brackets (MSS Type 34): For sides of steel or wooden beams.
 14. Plate Lugs (MSS Type 57): For attaching to steel beams if flexibility at beam is required.
 15. Horizontal Travelers (MSS Type 58): For supporting piping systems subject to linear horizontal movement where headroom is limited.
- I. Saddles and Shields: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
1. Steel Pipe-Covering Protection Saddles (MSS Type 39): To fill interior voids with insulation that matches adjoining insulation.
 2. Protection Shields (MSS Type 40): Of length recommended in writing by manufacturer to prevent crushing insulation.
 3. Thermal-Hanger Shield Inserts: For supporting insulated pipe.

J. Spring Hangers and Supports: Unless otherwise indicated and except as specified in piping system Sections, install the following types:

1. Restraint-Control Devices (MSS Type 47): Where indicated to control piping movement.
2. Spring Cushions (MSS Type 48): For light loads if vertical movement does not exceed 1-1/4 inches.
3. Spring-Cushion Roll Hangers (MSS Type 49): For equipping Type 41 roll hanger with springs.
4. Spring Sway Braces (MSS Type 50): To retard sway, shock, vibration, or thermal expansion in piping systems.
5. Variable-Spring Hangers (MSS Type 51): Preset to indicated load and limit variability factor to 25 percent to absorb expansion and contraction of piping system from hanger.
6. Variable-Spring Trapeze Hangers (MSS Type 53): Preset to indicated load and limit variability factor to 25 percent to absorb expansion and contraction of piping system from trapeze support.

K. Comply with MSS SP-69 for trapeze pipe hanger selections and applications that are not specified in piping system Sections.

3.02 HANGER AND SUPPORT INSTALLATION

A. Steel Pipe Hanger Installation: Comply with MSS SP-69 and MSS SP-89. Install hangers, supports, clamps, and attachments as required to properly support piping from building structure.

B. Trapeze Pipe Hanger Installation: Comply with MSS SP-69 and MSS SP-89. Arrange for grouping of parallel runs of horizontal piping and support together on field-fabricated trapeze pipe hangers.

1. Pipes of Various Sizes: Support together and space trapezes for smallest pipe size or install intermediate supports for smaller diameter pipes as specified above for individual pipe hangers.
2. Field fabricate from ASTM A 36/A 36M, steel shapes selected for loads being supported. Weld steel according to AWS D1.1.

C. Thermal-Hanger Shield Installation: Install in pipe hanger or shield for insulated piping.

D. Fastener System Installation:

1. Install powder-actuated fasteners for use in lightweight concrete or concrete slabs less than 4 inches thick in concrete after concrete is placed and completely cured. Use operators that are licensed by powder-actuated tool manufacturer. Install fasteners according to powder-actuated tool manufacturer's operating manual.
2. Install mechanical-expansion anchors in concrete after concrete is placed and completely cured. Install fasteners according to manufacturer's written instructions.

E. Pipe Stand Installation:

1. Pipe Stand Types except Curb-Mounting Type: Assemble components and mount on smooth roof surface. Do not penetrate roof membrane.
 2. Curb-Mounting-Type Pipe Stands: Assemble components or fabricate pipe stand and mount on permanent, stationary roof curb. Refer to Division 07 Section "Roof Accessories" for curbs.
- F. Install hangers and supports complete with necessary inserts, bolts, rods, nuts, washers, and other accessories.
- G. Install hangers and supports to allow controlled thermal and seismic movement of piping systems, to permit freedom of movement between pipe anchors, and to facilitate action of expansion joints, expansion loops, expansion bends, and similar units.
- H. Install lateral bracing with pipe hangers and supports to prevent swaying.
- I. Install building attachments within concrete slabs or attach to structural steel. Install additional attachments at concentrated loads, including valves, flanges, and strainers, NPS 2-1/2 and larger and at changes in direction of piping. Install concrete inserts before concrete is placed; fasten inserts to forms and install reinforcing bars through openings at top of inserts.
- J. Load Distribution: Install hangers and supports so piping live and dead loads and stresses from movement will not be transmitted to connected equipment.
- K. Pipe Slopes: Install hangers and supports to provide indicated pipe slopes and so maximum pipe deflections allowed by ASME B31.1 (for power piping) and ASME B31.9 (for building services piping) are not exceeded.
- L. Insulated Piping: Comply with the following:
1. Attach clamps and spacers to piping.
 - a. Piping Operating above Ambient Air Temperature: Clamp may project through insulation.
 - b. Piping Operating below Ambient Air Temperature: Use thermal-hanger shield insert with clamp sized to match OD of insert.
 - c. Do not exceed pipe stress limits according to ASME B31.1 for power piping and ASME B31.9 for building services piping.
 2. Install MSS SP-58, Type 39, protection saddles if insulation without vapor barrier is indicated. Fill interior voids with insulation that matches adjoining insulation.
 - a. Option: Thermal-hanger shield inserts may be used. Include steel weight-distribution plate for pipe NPS 4 and larger if pipe is installed on rollers.
 3. Install MSS SP-58, Type 40, protective shields on cold piping with vapor barrier. Shields shall span an arc of 180 degrees.
 - a. Option: Thermal-hanger shield inserts may be used. Include steel weight-distribution plate for pipe NPS 4 and larger if pipe is installed on rollers.
 4. Shield Dimensions for Pipe: Not less than the following:
 - a. NPS 1/4 to NPS 3-1/2: 12 inches long and 0.048 inch thick.

5. Insert Material: Length at least as long as protective shield.

6. Thermal-Hanger Shields: Install with insulation same thickness as piping insulation.

3.03 EQUIPMENT SUPPORTS

A. Factory fabricated roof curbs.

3.04 METAL FABRICATIONS

A. Cut, drill, and fit miscellaneous metal fabrications for trapeze pipe hangers and equipment supports.

B. Fit exposed connections together to form hairline joints. Field weld connections that cannot be shop welded because of shipping size limitations.

C. Field Welding: Comply with AWS D1.1 procedures for shielded metal arc welding, appearance and quality of welds, and methods used in correcting welding work, and with the following:

1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.

2. Obtain fusion without undercut or overlap.

3. Remove welding flux immediately.

4. Finish welds at exposed connections so no roughness shows after finishing and contours of welded surfaces match adjacent contours.

3.05 ADJUSTING

A. Hanger Adjustments: Adjust hangers to distribute loads equally on attachments and to achieve indicated slope of pipe.

B. Trim excess length of continuous-thread hanger and support rods to 1-1/2 inches

3.06 PAINTING

A. Touch Up: Clean field welds and abraded areas of shop paint. Paint exposed areas immediately after erecting hangers and supports. Use same materials as used for shop painting. Comply with SSPC-PA 1 requirements for touching up field-painted surfaces.

1. Apply paint by brush or spray to provide minimum dry film thickness of 2.0 mils.

B. Touch Up: Cleaning and touchup painting of field welds, bolted connections, and abraded areas of shop paint on miscellaneous metal are specified in Division 09 painting Sections.

C. Galvanized Surfaces: Clean welds, bolted connections, and abraded areas and apply galvanizing-repair paint to comply with ASTM A 780.

END OF SECTION

SECTION 23 05 48
VIBRATION AND SEISMIC CONTROLS FOR HVAC PIPING AND EQUIPMENT

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SUMMARY

A. This Section includes the following:

1. Isolation mounts.
2. Restrained elastomeric isolation mounts.
3. Freestanding and restrained spring isolators.
4. Housed spring mounts.
5. Elastomeric hangers.
6. Spring hangers.
7. Spring hangers with vertical-limit stops.
8. Pipe riser resilient supports.
9. Resilient pipe guides.
10. Restraining braces and cables.

1.03 DEFINITIONS

- A. IBC: International Building Code.
- B. ICC-ES: ICC-Evaluation Service.
- C. OSHPD: Office of Statewide Health Planning and Development for the State of California.

1.04 PERFORMANCE REQUIREMENTS

- A. Seismic-Restraint Loading:
 1. Site Class as Defined in the CBC.

1.05 SUBMITTALS

- A. Product Data: For the following:
 1. Include rated load, rated deflection, and overload capacity for each vibration isolation device.

2. Illustrate and indicate style, material, strength, fastening provision, and finish for each type and size of seismic-restraint component used.
 - a. Tabulate types and sizes of seismic restraints, complete with report numbers and rated strength in tension and shear as evaluated by an agency acceptable to authorities having jurisdiction.
 - b. Annotate to indicate application of each product submitted and compliance with requirements.
 3. Interlocking Snubbers: Include ratings for horizontal, vertical, and combined loads.
- B. Delegated-Design Submittal: For vibration isolation and seismic-restraint details indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.
1. Design Calculations: Calculate static and dynamic loading due to equipment weight and operation, seismic forces required to select vibration isolators, seismic restraints, and for designing vibration isolation bases.
 - a. Coordinate design calculations with wind load calculations required for equipment mounted outdoors.
 2. Seismic-Restraint Details:
 - a. Design Analysis: To support selection and arrangement of seismic restraints. Include calculations of combined tensile and shear loads.
 - b. Details: Indicate fabrication and arrangement. Detail attachments of restraints to the restrained items and to the structure. Show attachment locations, methods, and spacings. Identify components, list their strengths, and indicate directions and values of forces transmitted to the structure during seismic events. Indicate association with vibration isolation devices.
 - c. Preapproval and Evaluation Documentation: By an agency acceptable to authorities having jurisdiction, showing maximum ratings of restraint items and the basis for approval (tests or calculations).
- C. Coordination Drawings: Show coordination of seismic bracing for HVAC piping and equipment with other systems and equipment in the vicinity, including other supports and seismic restraints.
- D. Welding certificates.
- E. Qualification Data: For testing agency.
- F. Field quality-control test reports.
- G. Operation and Maintenance Data: For air-mounting systems to include in operation and maintenance manuals.

1.06 QUALITY ASSURANCE

- A. Testing Agency Qualifications: An independent agency, with the experience and capability to conduct the testing indicated, that is a nationally recognized testing

laboratory (NRTL) as defined by OSHA in 29 CFR 1910.7, and that is acceptable to authorities having jurisdiction.

- B. Comply with seismic-restraint requirements in the IBC unless requirements in this Section are more stringent.
- C. Welding: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."
- D. Seismic-restraint devices shall have horizontal and vertical load testing and analysis and shall bear anchorage preapproval OPA number from OSHPD, preapproval by ICC-ES, or preapproval by another agency acceptable to authorities having jurisdiction, showing maximum seismic-restraint ratings. Ratings based on independent testing are preferred to ratings based on calculations. If preapproved ratings are not available, submittals based on independent testing are preferred. Calculations (including combining shear and tensile loads) to support seismic-restraint designs must be signed and sealed by a qualified professional engineer.

PART 2 - PRODUCTS

2.01 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.

2.02 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-damped 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.

2.03 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.

2.04 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.

2.05 VIBRATION ISOLATORS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. M.W. Sausse & Co., Inc.
 - 2. CaldynMason Industries.
- B. Pads: Arranged in single or multiple layers of sufficient stiffness for uniform loading over pad area, molded with a nonslip pattern and galvanized-steel baseplates, and factory cut to sizes that match requirements of supported equipment.
 - 1. Resilient Material: Oil- and water-resistant neoprene.
- C. Mounts: Double-deflection type, with molded, oil-resistant rubber, hermetically sealed compressed fiberglass, or neoprene isolator elements with factory-drilled, encapsulated top plate for bolting to equipment and with baseplate for bolting to structure. Color-code or otherwise identify to indicate capacity range.
 - 1. Materials: Cast-ductile-iron or welded steel housing containing two separate and opposing, oil-resistant rubber or neoprene elements that prevent central threaded element and attachment hardware from contacting the housing during normal operation.
 - 2. Neoprene: Shock-absorbing materials compounded according to the standard for bridge-bearing neoprene as defined by AASHTO.
- D. Restrained: All-directional mountings with seismic restraint.
 - 1. Materials: Cast-ductile-iron or welded steel housing containing two separate and opposing, oil-resistant rubber or neoprene elements that prevent central threaded element and attachment hardware from contacting the housing during normal operation.
 - 2. Neoprene: Shock-absorbing materials compounded according to the standard for bridge-bearing neoprene as defined by AASHTO.
- E. Restrained Spring Isolators: Freestanding, steel, open-spring isolators with seismic or limit-stop restraint.

1. Housing: Steel with resilient vertical-limit stops to prevent spring extension due to weight being removed; factory-drilled baseplate bonded to 1/4-inch- thick, neoprene or rubber isolator pad attached to baseplate underside; and adjustable equipment mounting and leveling bolt that acts as blocking during installation.
 2. Restraint: Seismic or limit stop as required for equipment and authorities having jurisdiction.
 3. Outside Spring Diameter: Not less than 80 percent of the compressed height of the spring at rated load.
 4. Minimum Additional Travel: 50 percent of the required deflection at rated load.
 5. Lateral Stiffness: More than 80 percent of rated vertical stiffness.
 6. Overload Capacity: Support 200 percent of rated load, fully compressed, without deformation or failure.
- F. Housed Spring Mounts: Housed spring isolator with integral seismic snubbers.
1. Housing: Ductile-iron or steel housing to provide all-directional seismic restraint.
 2. Base: Factory drilled for bolting to structure.
 3. Snubbers: Vertically adjustable to allow a maximum of 1/4-inch travel up or down before contacting a resilient collar.

2.06 SEISMIC-RESTRAINT DEVICES

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Cooper B-Line, Inc.; a division of Cooper Industries.
 2. Hilti, Inc.
 3. Mason Industries.
 4. TOLCO Incorporated; a brand of NIBCO INC.
 5. Unistrut; Tyco International, Ltd.
 6. M.W. Sausse & Co., Inc.
- B. General Requirements for Restraint Components: Rated strengths, features, and applications shall be as defined in reports by an agency acceptable to authorities having jurisdiction.
1. Structural Safety Factor: Allowable strength in tension, shear, and pullout force of components shall be at least four times the maximum seismic forces to which they will be subjected.
- C. Snubbers: Factory fabricated using welded structural-steel shapes and plates, anchor bolts, and replaceable resilient isolation washers and bushings.

1. Anchor bolts for attaching to concrete shall be seismic-rated, drill-in, and stud-wedge or female-wedge type.
 2. Resilient Isolation Washers and Bushings: Oil- and water-resistant neoprene.
 3. Maximum 1/4-inch air gap, and minimum 1/4-inch- thick resilient cushion.
- D. Channel Support System: MFMA-3, shop- or field-fabricated support assembly made of slotted steel channels with accessories for attachment to braced component at one end and to building structure at the other end and other matching components and with corrosion-resistant coating; and rated in tension, compression, and torsion forces.
- E. Restraint Cables: ASTM A 492 stainless-steel cables with end connections made of steel assemblies with thimbles, brackets, swivel, and bolts designed for restraining cable service; and with a minimum of two clamping bolts for cable engagement.
- F. Hanger Rod Stiffener: Steel tube or steel slotted-support-system sleeve with internally bolted connections to hanger rod.
- G. Bushings for Floor-Mounted Equipment Anchor Bolts: Neoprene bushings designed for rigid equipment mountings, and matched to type and size of anchor bolts and studs.
- H. Bushing Assemblies for Wall-Mounted Equipment Anchorage: Assemblies of neoprene elements and steel sleeves designed for rigid equipment mountings, and matched to type and size of attachment devices used.
- I. Resilient Isolation Washers and Bushings: One-piece, molded, oil- and water-resistant neoprene, with a flat washer face.
- J. Mechanical Anchor Bolts: Drilled-in and stud-wedge or female-wedge type in zinc-coated steel for interior applications and stainless steel for exterior applications. Select anchor bolts with strength required for anchor and as tested according to ASTM E 488. Minimum length of eight times diameter.
- K. Adhesive Anchor Bolts: Drilled-in and capsule anchor system containing polyvinyl or urethane methacrylate-based resin and accelerator, or injected polymer or hybrid mortar adhesive. Provide anchor bolts and hardware with zinc-coated steel for interior applications and stainless steel for exterior applications. Select anchor bolts with strength required for anchor and as tested according to ASTM E 488.

2.07 FACTORY FINISHES

- A. Finish: Manufacturer's standard paint applied to factory-assembled and -tested equipment before shipping.
1. Powder coating on springs and housings.
 2. All hardware shall be galvanized. Hot-dip galvanize metal components for exterior use.
 3. Baked enamel or powder coat for metal components on isolators for interior use.
 4. Color-code or otherwise mark vibration isolation and seismic-control devices to indicate capacity range.

PART 3 - EXECUTION

3.01 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 Conditioning Units, : 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 1/2 inches.
- L. 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.

3.02 EXAMINATION

- A. Examine areas and equipment to receive vibration isolation and seismic-control devices for compliance with requirements for installation tolerances and other conditions affecting performance.
- B. Examine roughing-in of reinforcement and cast-in-place anchors to verify actual locations before installation.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.03 APPLICATIONS

- A. Multiple Pipe Supports: Secure pipes to trapeze member with clamps approved for application by an agency acceptable to authorities having jurisdiction.
- B. Hanger Rod Stiffeners: Install hanger rod stiffeners where indicated or scheduled on Drawings to receive them and where required to prevent buckling of hanger rods due to seismic forces.
- C. Strength of Support and Seismic-Restraint Assemblies: Where not indicated, select sizes of components so strength will be adequate to carry present and future static and seismic loads within specified loading limits.

3.04 VIBRATION-CONTROL AND SEISMIC-RESTRAINT DEVICE INSTALLATION

- A. Comply with requirements in Division 07 Section "Roof Accessories" for installation of roof curbs, equipment supports, and roof penetrations.
- B. Equipment Restraints:

1. Install seismic snubbers on HVAC equipment mounted on vibration isolators. Locate snubbers as close as possible to vibration isolators and bolt to equipment base and supporting structure.
 2. Install resilient bolt isolation washers on equipment anchor bolts where clearance between anchor and adjacent surface exceeds 0.125 inch.
 3. Install seismic-restraint devices using methods approved by an agency acceptable to authorities having jurisdiction providing required submittals for component.
- C. Piping Restraints:
1. Comply with requirements in MSS SP-127.
 2. Space lateral supports a maximum of 40 feet o.c., and longitudinal supports a maximum of 80 feet o.c.
 3. Brace a change of direction longer than 12 feet.
- D. Install cables so they do not bend across edges of adjacent equipment or building structure.
- E. Install seismic-restraint devices using methods approved by an agency acceptable to authorities having jurisdiction providing required submittals for component.
- F. Install bushing assemblies for anchor bolts for floor-mounted equipment, arranged to provide resilient media between anchor bolt and mounting hole in concrete base.
- G. Install bushing assemblies for mounting bolts for wall-mounted equipment, arranged to provide resilient media where equipment or equipment-mounting channels are attached to wall.
- H. Attachment to Structure: If specific attachment is not indicated, anchor bracing to structure at flanges of beams, at upper truss chords of bar joists, or at concrete members.
- I. Drilled-in Anchors:
1. Identify position of reinforcing steel and other embedded items prior to drilling holes for anchors. Do not damage existing reinforcing or embedded items during coring or drilling. Notify the structural engineer if reinforcing steel or other embedded items are encountered during drilling. Locate and avoid prestressed tendons, electrical and telecommunications conduit, and gas lines.
 2. Do not drill holes in concrete or masonry until concrete, mortar, or grout has achieved full design strength.
 3. Wedge Anchors: Protect threads from damage during anchor installation. Heavy-duty sleeve anchors shall be installed with sleeve fully engaged in the structural element to which anchor is to be fastened.
 4. Adhesive Anchors: Clean holes to remove loose material and drilling dust prior to installation of adhesive. Place adhesive in holes proceeding from the bottom of the hole and progressing toward the surface in such a manner as to avoid introduction of air pockets in the adhesive.

5. Set anchors to manufacturer's recommended torque, using a torque wrench.
6. Install zinc-coated steel anchors for interior and stainless-steel anchors for exterior applications.

3.05 ACCOMMODATION OF DIFFERENTIAL SEISMIC MOTION

- A. Install flexible connections in piping where they cross seismic joints, where adjacent sections or branches are supported by different structural elements, and where the connections terminate with connection to equipment that is anchored to a different structural element from the one supporting the connections as they approach equipment.

3.06 FIELD QUALITY CONTROL

- A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.
- B. Tests and Inspections:
 1. Provide evidence of recent calibration of test equipment by a testing agency acceptable to authorities having jurisdiction.
 2. Schedule test with Owner, through Architect, before connecting anchorage device to restrained component (unless post connection testing has been approved), and with at least seven days' advance notice.
 3. Obtain Architect's approval before transmitting test loads to structure. Provide temporary load-spreading members.
 4. Test at least four of each type and size of installed anchors and fasteners selected by Architect.
 5. Test to 90 percent of rated proof load of device.
 6. Measure isolator restraint clearance.
 7. Measure isolator deflection.
 8. Verify snubber minimum clearances.
 9. Test and adjust air-mounting system controls and safeties.
 10. If a device fails test, modify all installations of same type and retest until satisfactory results are achieved.
- C. Remove and replace malfunctioning units and retest as specified above.
- D. Prepare test and inspection reports.

3.07 ADJUSTING

- A. Adjust limit stops on restrained spring isolators to mount equipment at normal operating height. After equipment installation is complete, adjust limit stops so they are out of contact during normal operation.
- B. Adjust active height of spring isolators.

- C. Adjust restraints to permit free movement of equipment within normal mode of operation.

3.08 DEMONSTRATION

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain air-mounting systems. Refer to Division 01 Section "Demonstration And Training."

END OF SECTION

**SECTION 23 05 53
IDENTIFICATION FOR HVAC PIPING AND EQUIPMENT**

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SUMMARY

- A. Section Includes:

- 1. Equipment labels.
- 2. Warning signs and labels.
- 3. Pipe labels.
- 4. Duct labels.
- 5. Stencils.
- 6. Warning tags.

1.03 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Samples: For color, letter style, and graphic representation required for each identification material and device.
- C. Equipment Label Schedule: Include a listing of all equipment to be labeled with the proposed content for each label.

1.04 COORDINATION

- A. Coordinate installation of identifying devices with completion of covering and painting of surfaces where devices are to be applied.
- B. Coordinate installation of identifying devices with locations of access panels and doors.
- C. Install identifying devices before installing acoustical ceilings and similar concealment.

PART 2 - PRODUCTS

2.01 EQUIPMENT LABELS

- A. Metal Labels for Equipment:

1. Material and Thickness: Brass, 0.032-inch minimum thickness, and having predrilled or stamped holes for attachment hardware.
2. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch.
3. Minimum Letter Size: 1/4 inch for name of units if viewing distance is less than 24 inches, 1/2 inch for viewing distances up to 72 inches, and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-fourths the size of principal lettering.
4. Fasteners: Stainless-steel rivets or self-tapping screws.
5. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.
6. Each piece of HVAC equipment should have a physical equipment tag 2" high, Arial font, black background with white engraved letters.
7. HVAC equipment shall be adhered to the ceiling access panel, or onto the t-bar.
8. Filter locations should be noted on the ceiling (t-bar or access panel in hard lid) with a label stating "Filter Access".

B. Plastic Labels for Equipment:

1. Material and Thickness: Multilayer, multicolor, plastic labels for mechanical engraving, 1/8 inch thick, and having predrilled holes for attachment hardware.
2. Letter Color: Black.
3. Background Color: Yellow.
4. Maximum Temperature: Able to withstand temperatures up to 160 deg F.
5. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch.
6. Minimum Letter Size: 1/4 inch for name of units if viewing distance is less than 24 inches, 1/2 inch for viewing distances up to 72 inches, and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-fourths the size of principal lettering.
7. Fasteners: Stainless-steel rivets or self-tapping screws.
8. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.
9. Each piece of HVAC equipment should have a physical tag 2" high, Arial font, black background with white engraved letters.
10. HVAC equipment tag shall be adhered to the ceiling access panel, or onto the t-bar.

11. Filter locations should be noted on the ceiling (t-bar or access panel in hard lid) with a label stating "Filter Access".

- C. Label Content: Include equipment's Drawing designation or unique equipment number, Drawing numbers where equipment is indicated (plans, details, and schedules), plus the Specification Section number and title where equipment is specified.
- D. Equipment Label Schedule: For each item of equipment to be labeled, on 8-1/2-by-11-inch bond paper. Tabulate equipment identification number and identify Drawing numbers where equipment is indicated (plans, details, and schedules), plus the Specification Section number and title where equipment is specified. Equipment schedule shall be included in operation and maintenance data.

2.02 WARNING SIGNS AND LABELS

- A. Material and Thickness: Multilayer, multicolor, plastic labels for mechanical engraving, 1/8 inch thick, and having predrilled holes for attachment hardware.
- B. Letter Color: White.
- C. Background Color: Red.
- D. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch.
- E. Minimum Letter Size: 1/4 inch for name of units if viewing distance is less than 24 inches, 1/2 inch for viewing distances up to 72 inches, and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-fourths the size of principal lettering.
- F. Fasteners: Stainless-steel rivets or self-tapping screws.
- G. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.
- H. Label Content: Include caution and warning information, plus emergency notification instructions.

2.03 PIPE LABELS

- A. General Requirements for Manufactured Pipe Labels: Preprinted, color-coded, with lettering indicating service, and showing flow direction.
- B. Pretensioned Pipe Labels: Precoiled, semirigid plastic formed to cover full circumference of pipe and to attach to pipe without fasteners or adhesive.
- C. Self-Adhesive Pipe Labels: Printed plastic with contact-type, permanent-adhesive backing.
- D. Pipe Label Contents: Include identification of piping service using same designations or abbreviations as used on Drawings, pipe size, and an arrow indicating flow direction.

1. Flow-Direction Arrows: Integral with piping system service lettering to accommodate both directions, or as separate unit on each pipe label to indicate flow direction.
2. Lettering Size: At least 1-1/2 inches high.

2.04 DUCT LABELS

- A. Material and Thickness: Multilayer, multicolor, plastic labels for mechanical engraving, 1/8 inch thick, and having predrilled holes for attachment hardware.
- B. Letter Color: White.
- C. Background Color: Blue.
- D. Maximum Temperature: Able to withstand temperatures up to 160 deg F.
- E. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch.
- F. Minimum Letter Size: 1/4 inch for name of units if viewing distance is less than 24 inches, 1/2 inch for viewing distances up to 72 inches, and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-fourths the size of principal lettering.
- G. Fasteners: Stainless-steel rivets or self-tapping screws.
- H. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.
- I. Duct Label Contents: Include identification of duct service using same designations or abbreviations as used on Drawings, duct size, and an arrow indicating flow direction.
 1. Flow-Direction Arrows: Integral with duct system service lettering to accommodate both directions, or as separate unit on each duct label to indicate flow direction.
 2. Lettering Size: At least 1-1/2 inches high.

2.05 STENCILS

- A. Stencils: Prepared with letter sizes according to ASME A13.1 for piping; minimum letter height of 1-1/4 inches for ducts; and minimum letter height of 3/4 inch for access panel and door labels, equipment labels, and similar operational instructions.
 1. Stencil Material: Brass.
 2. Stencil Paint: Exterior, gloss, alkyd enamel black unless otherwise indicated. Paint may be in pressurized spray-can form.
 3. Identification Paint: Exterior, alkyd enamel in colors according to ASME A13.1 unless otherwise indicated.

2.06 WARNING TAGS

- A. Warning Tags: Preprinted or partially preprinted, accident-prevention tags, of plasticized card stock with matte finish suitable for writing.
 - 1. Size: Approximately 4 by 7 inches.
 - 2. Fasteners: Brass grommet and wire.
 - 3. Nomenclature: Large-size primary caption such as "DANGER," "CAUTION," or "DO NOT OPERATE."
 - 4. Color: Yellow background with black lettering.

PART 3 - EXECUTION

3.01 PREPARATION

- A. Clean piping and equipment surfaces of substances that could impair bond of identification devices, including dirt, oil, grease, release agents, and incompatible primers, paints, and encapsulants.

3.02 EQUIPMENT LABEL INSTALLATION

- A. Install or permanently fasten labels on each major item of mechanical equipment.
- B. Locate equipment labels where accessible and visible.

3.03 PIPE LABEL INSTALLATION

- A. Piping Color-Coding: Painting of piping is specified in Division 09 Section "Interior Painting."
- B. Stenciled Pipe Label Option: Stenciled labels may be provided instead of manufactured pipe labels, at Installer's option. Install stenciled pipe labels, complying with ASME A13.1, on each piping system.
 - 1. Identification Paint: Use for contrasting background.
 - 2. Stencil Paint: Use for pipe marking.
- C. Locate pipe labels where piping is exposed or above accessible ceilings in finished spaces; machine rooms; accessible maintenance spaces such as shafts, tunnels, and plenums; and exterior exposed locations as follows:
 - 1. Near each valve and control device.
 - 2. Near each branch connection, excluding short takeoffs for fixtures and terminal units. Where flow pattern is not obvious, mark each pipe at branch.
 - 3. Near penetrations through walls, floors, ceilings, and inaccessible enclosures.
 - 4. At access doors, manholes, and similar access points that permit view of concealed piping.
 - 5. Near major equipment items and other points of origination and termination.

6. Spaced at maximum intervals of 50 feet along each run. Reduce intervals to 25 feet in areas of congested piping and equipment.
7. On piping above removable acoustical ceilings. Omit intermediately spaced labels.

3.04 DUCT LABEL INSTALLATION

- A. Install plastic-laminated duct labels with permanent adhesive on air ducts in the following color codes:
 1. Green: For exhaust-, outside-, relief-, return-, and mixed-air ducts.
- B. Stenciled Duct Label Option: Stenciled labels, showing service and flow direction, may be provided instead of plastic-laminated duct labels, at Installer's option, if lettering larger than 1 inch high is needed for proper identification because of distance from normal location of required identification.
- C. Locate labels near points where ducts enter into concealed spaces and at maximum intervals of 50 feet in each space where ducts are exposed or concealed by removable ceiling system.

3.05 WARNING-TAG INSTALLATION

- A. Write required message on, and attach warning tags to, equipment and other items where required.

END OF SECTION

SECTION 23 05 93
TESTING, ADJUSTING, AND BALANCING FOR HVAC

PART 1 – GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SUMMARY

A. This Section includes TAB to produce design objectives for the following:

1. Vibration measuring.
2. Verifying that automatic control devices are functioning properly.
3. Reporting results of activities and procedures specified in this Section.

1.03 DEFINITIONS

- A. Adjust: To regulate air patterns at the terminal equipment, such as to reduce fan speed or adjust a damper.
- B. Balance: To proportion flows within the distribution system, including submains, branches, and terminals, according to indicated quantities.
- C. Barrier or Boundary: Construction, either vertical or horizontal, such as walls, floors, and ceilings that are designed and constructed to restrict the movement of airflow, smoke, odors, and other pollutants.
- D. Draft: A current of air, when referring to localized effect caused by one or more factors of high air velocity, low ambient temperature, or direction of airflow, whereby more heat is withdrawn from a person's skin than is normally dissipated.
- E. NC: Noise criteria.
- F. Procedure: An approach to and execution of a sequence of work operations to yield repeatable results.
- G. RC: Room criteria.
- H. Report Forms: Test data sheets for recording test data in logical order.
- I. System Effect: A phenomenon that can create undesired or unpredicted conditions that cause reduced capacities in all or part of a system.
- J. System Effect Factors: Allowances used to calculate a reduction of the performance ratings of a fan when installed under conditions different from those presented when the fan was performance tested.
- K. TAB: Testing, adjusting, and balancing.
- L. Terminal: A point where the controlled medium, such as air, fluid or energy, enters or leaves the distribution system.

- M. Test: A procedure to determine quantitative performance of systems or equipment.
- N. Testing, Adjusting, and Balancing (TAB) Firm: The entity responsible for performing and reporting TAB procedures.

1.04 SUBMITTALS

- A. Qualification Data: Within 30 days from Contractor's Notice to Proceed, submit 4 copies of evidence that TAB firm and this Project's TAB team members meet the qualifications specified in "Quality Assurance" Article.
- B. Contract Documents Examination Report: Within 30 days from Contractor's Notice to Proceed, submit 4 copies of the Contract Documents review report as specified in Part 3.
- C. Strategies and Procedures Plan: Within 60 days from Contractor's Notice to Proceed, submit 4 copies of TAB strategies and step-by-step procedures as specified in Part 3 "Preparation" Article. Include a complete set of report forms intended for use on this Project.
- D. Certified TAB Reports: Submit two copies of reports prepared, as specified in this Section, on approved forms certified by TAB firm.
- E. Sample Report Forms: Submit two sets of sample TAB report forms.
- F. Warranties specified in this Section.

1.05 QUALITY ASSURANCE

- A. TAB Firm Qualifications: Engage a TAB firm certified by AABC.
- B. TAB Conference: Meet with Owner's and Architect's representatives on approval of TAB strategies and procedures plan to develop a mutual understanding of the details. Ensure the participation of TAB team members, equipment manufacturers' authorized service representatives, HVAC controls installers, and other support personnel. Provide seven days' advance notice of scheduled meeting time and location.
 - 1. Agenda Items: Include at least the following:
 - a. Submittal distribution requirements.
 - b. The Contract Documents examination report.
 - c. TAB plan.
 - d. Work schedule and Project-site access requirements.
 - e. Coordination and cooperation of trades and subcontractors.
 - f. Coordination of documentation and communication flow.
- C. Certification of TAB Reports: Certify TAB field data reports. This certification includes the following:
 - 1. Review field data reports to validate accuracy of data and to prepare certified TAB reports.

2. Certify that TAB team complied with approved TAB plan and the procedures specified and referenced in this Specification.
- D. TAB Report Forms: Use standard forms from AABC's "National Standards for Testing and Balancing Heating, Ventilating, and Air Conditioning Systems."
 - E. Instrumentation Type, Quantity, and Accuracy: As described in AABC's "National Standards for Testing and Balancing Heating, Ventilating, and Air Conditioning Systems."
 - F. Instrumentation Calibration: Calibrate instruments at least every six months or more frequently if required by instrument manufacturer.
1. Keep an updated record of instrument calibration that indicates date of calibration and the name of party performing instrument calibration.

1.06 PROJECT CONDITIONS

- A. Full Owner Occupancy: Owner will occupy the site and existing building during entire TAB period. Cooperate with Owner during TAB operations to minimize conflicts with Owner's operations.

1.07 COORDINATION

- A. Coordinate the efforts of factory-authorized service representatives for systems and equipment, HVAC controls installers, and other mechanics to operate HVAC systems and equipment to support and assist TAB activities.
- B. Notice: Provide seven days' advance notice for each test. Include scheduled test dates and times.
- C. Perform TAB after leakage and pressure tests on air and water distribution systems have been satisfactorily completed.

1.08 WARRANTY

- A. National Project Performance Guarantee: Provide a guarantee on AABC's "National Standards for Testing and Balancing Heating, Ventilating, and Air Conditioning Systems" forms stating that AABC will assist in completing requirements of the Contract Documents if TAB firm fails to comply with the Contract Documents. Guarantee includes the following provisions:
 1. The certified TAB firm has tested and balanced systems according to the Contract Documents.
 2. Systems are balanced to optimum performance capabilities within design and installation limits.

PART 2 - PRODUCTS (Not Applicable)

PART 3 - EXECUTION

3.01 EXAMINATION

- A. Examine the Contract Documents to become familiar with Project requirements and to discover conditions in systems' designs that may preclude proper TAB of systems and equipment.

1. Contract Documents are defined in the General and Supplementary Conditions of Contract.
 2. Verify that balancing devices, such as test ports, gage cocks, thermometer wells, flow-control devices, and manual volume dampers, are required by the Contract Documents. Verify that quantities and locations of these balancing devices are accessible and appropriate for effective balancing and for efficient system and equipment operation.
- B. Examine approved submittal data of HVAC systems and equipment.
 - C. Examine Project Record Documents described in Division 01 Section "Project Record Documents."
 - D. Examine design data, including HVAC system descriptions, statements of design assumptions for environmental conditions and systems' output, and statements of philosophies and assumptions about HVAC system and equipment controls.
 - E. Examine equipment performance data including fan and pump curves. Relate performance data to Project conditions and requirements, including system effects that can create undesired or unpredicted conditions that cause reduced capacities in all or part of a system. Calculate system effect factors to reduce performance ratings of HVAC equipment when installed under conditions different from those presented when the equipment was performance tested at the factory. To calculate system effects for air systems, use tables and charts found in AMCA 201, "Fans and Systems," Sections 7 through 10; or in SMACNA's "HVAC Systems--Duct Design," Sections 5 and 6. Compare this data with the design data and installed conditions.
 - F. Examine system and equipment installations to verify that they are complete and that testing, cleaning, adjusting, and commissioning specified in individual Sections have been performed.
 - G. Examine system and equipment test reports.
 - H. Examine HVAC system and equipment installations to verify that indicated balancing devices, such as test ports, gage cocks, thermometer wells, and manual volume dampers, are properly installed, and that their locations are accessible and appropriate for effective balancing and for efficient system and equipment operation.
 - I. Examine systems for functional deficiencies that cannot be corrected by adjusting and balancing.
 - J. Examine HVAC equipment to ensure that clean filters have been installed, bearings are greased, belts are aligned and tight, and equipment with functioning controls is ready for operation.
 - K. Examine heat-transfer coils for correct piping connections and for clean and straight fins.
 - L. Examine equipment for installation and for properly operating safety interlocks and controls.
 - M. Examine automatic temperature system components to verify the following:
 1. Dampers, and other controlled devices are operated by the intended controller.

2. Dampers are in the position indicated by the controller.
 3. Integrity of dampers for free and full operation and for tightness of fully closed and fully open positions.
 4. Thermostats are located to avoid adverse effects of sunlight, drafts, and cold walls.
 5. Sensors are located to sense only the intended conditions.
 6. Sequence of operation for control modes is according to the Contract Documents.
 7. Controller set points are set at indicated values.
 8. Interlocked systems are operating.
 9. Changeover from heating to cooling mode occurs according to indicated values.
- A. Report deficiencies discovered before and during performance of TAB procedures. Observe and record system reactions to changes in conditions. Record default set points if different from indicated values.

3.02 PREPARATION

- A. Prepare a TAB plan that includes strategies and step-by-step procedures.
- B. Complete system readiness checks and prepare system readiness reports. Verify the following:
1. Permanent electrical power wiring is complete.
 2. Automatic temperature-control systems are operational.
 3. Equipment and duct access doors are securely closed.
 4. Balance, smoke, and fire dampers are open.
 5. Ceilings are installed in critical areas where air-pattern adjustments are required and access to balancing devices is provided.
 6. Windows and doors can be closed so indicated conditions for system operations can be met.

3.03 GENERAL PROCEDURES FOR TESTING AND BALANCING

- A. Perform testing and balancing procedures on each system according to the procedures contained in AABC's "National Standards for Testing and Balancing Heating, Ventilating, and Air Conditioning Systems" and this Section.
- B. Cut insulation, ducts, and equipment cabinets for installation of test probes to the minimum extent necessary to allow adequate performance of procedures. After testing and balancing, close probe holes and patch insulation with new materials identical to those removed. Restore vapor barrier and finish according to insulation Specifications for this Project.

- C. Mark equipment and balancing device settings with paint or other suitable, permanent identification material, including damper-control positions, valve position indicators, fan-speed-control levers, and similar controls and devices, to show final settings.
- D. Take and report testing and balancing measurements in inch-pound (IP) units.

3.04 PROCEDURES FOR MOTORS

- A. Motors, 1/2 HP and Larger: Test at final balanced conditions and record the following data:
 - 1. Manufacturer, model, and serial numbers.
 - 2. Motor horsepower rating.
 - 3. Motor rpm.
 - 4. Efficiency rating.
 - 5. Nameplate and measured voltage, each phase.
 - 6. Nameplate and measured amperage, each phase.
 - 7. Starter thermal-protection-element rating.
- B. Motors Driven by Variable-Frequency Controllers: Test for proper operation at speeds varying from minimum to maximum. Test the manual bypass for the controller to prove proper operation. Record observations, including controller manufacturer, model and serial numbers, and nameplate data.

3.05 PROCEDURES FOR TEMPERATURE MEASUREMENTS

- A. During TAB, report the need for adjustment in temperature regulation within the automatic temperature-control system.
- B. Measure indoor wet- and dry-bulb temperatures every other hour for a period of two successive eight-hour days, in each separately controlled zone, to prove correctness of final temperature settings. Measure when the building or zone is occupied.
- C. Measure outside-air, wet- and dry-bulb temperatures.

3.06 PROCEDURES FOR VIBRATION MEASUREMENTS

- A. Use a vibration meter meeting the following criteria:
 - 1. Solid-state circuitry with a piezoelectric accelerometer.
 - 2. Velocity range of 0.1 to 10 inches per second.
 - 3. Displacement range of 1 to 100 mils.
 - 4. Frequency range of at least 0 to 1000 Hz.
 - 5. Capable of filtering unwanted frequencies.

- B. Calibrate the vibration meter before each day of testing.
 - 1. Use a calibrator provided with the vibration meter.
 - 2. Follow vibration meter and calibrator manufacturer's calibration procedures.
- C. Perform vibration measurements when other building and outdoor vibration sources are at a minimum level and will not influence measurements of equipment being tested.
 - 1. Turn off equipment in the building that might interfere with testing.
 - 2. Clear the space of people.
- D. Perform vibration measurements after air and water balancing and equipment testing is complete.
- E. Clean equipment surfaces in contact with the vibration transducer.
- F. Position the vibration transducer according to manufacturer's written instructions and to avoid interference with the operation of the equipment being tested.
- G. Measure and record vibration on rotating equipment over 3 hp.
- H. For equipment with vibration isolation, take floor measurements with the vibration isolation blocked solid to the floor and with the vibration isolation floating. Calculate and report the differences.
- I. Inspect, measure, and record vibration isolation.
 - 1. Verify that vibration isolation is installed in the required locations.
 - 2. Verify that installation is level and plumb.
 - 3. Verify that isolators are properly anchored.
 - 4. For spring isolators, measure the compressed spring height, the spring OD, and the travel-to-solid distance.

3.07 TEMPERATURE-CONTROL VERIFICATION

- A. Verify that controllers are calibrated and commissioned.
- B. Check transmitter and controller locations and note conditions that would adversely affect control functions.
- C. Record controller settings and note variances between set points and actual measurements.
- D. Check the operation of limiting controllers (i.e., high- and low-temperature controllers).
- E. Check free travel and proper operation of control devices such as damper and valve operators.

- F. Check the sequence of operation of control devices. Note air pressures and device positions and correlate with airflow and water flow measurements. Note the speed of response to input changes.
- G. Check the interaction of electrically operated switch transducers.
- H. Check the interaction of interlock and lockout systems.
- I. Check main control supply-air pressure and observe compressor and dryer operations.
- J. Record voltages of power supply and controller output. Determine whether the system operates on a grounded or non-grounded power supply.
- K. Note operation of electric actuators using spring return for proper fail-safe operations.

3.08 TOLERANCES

- A. Set HVAC system airflow and water flow rates within the following tolerances:
 - 1. Supply, Return, and Exhaust Fans and Equipment with Fans: Minus 5 to plus 10 percent.
 - 2. Air Outlets and Inlets: 0 to minus 10 percent.

3.09 REPORTING

- A. Initial Construction-Phase Report: Based on examination of the Contract Documents as specified in "Examination" Article, prepare a report on the adequacy of design for systems' balancing devices. Recommend changes and additions to systems' balancing devices to facilitate proper performance measuring and balancing. Recommend changes and additions to HVAC systems and general construction to allow access for performance measuring and balancing devices.
- B. Status Reports: As Work progresses, prepare reports to describe completed procedures, procedures in progress, and scheduled procedures. Include a list of deficiencies and problems found in systems being tested and balanced. Prepare a separate report for each system and each building floor for systems serving multiple floors.

3.10 FINAL REPORT

- A. General: Typewritten, or computer printout in letter-quality font, on standard bond paper, in three-ring binder, tabulated and divided into sections by tested and balanced systems.
- B. Include a certification sheet in front of binder signed and sealed by the certified testing and balancing engineer.
 - 1. Include a list of instruments used for procedures, along with proof of calibration.
- C. Final Report Contents: In addition to certified field report data, include the following:
 - 1. Manufacturers' test data.
 - 2. Field test reports prepared by system and equipment installers.

3. Other information relative to equipment performance, but do not include Shop Drawings and Product Data.
- D. General Report Data: In addition to form titles and entries, include the following data in the final report, as applicable:
1. Title page.
 2. Name and address of TAB firm.
 3. Project name.
 4. Project location.
 5. Architect's name and address.
 6. Engineer's name and address.
 7. Contractor's name and address.
 8. Report date.
 9. Signature of TAB firm who certifies the report.
 10. Table of Contents with the total number of pages defined for each section of the report. Number each page in the report.
 11. Summary of contents including the following:
 - a. Indicated versus final performance.
 - b. Notable characteristics of systems.
 - c. Description of system operation sequence if it varies from the Contract Documents.
 12. Nomenclature sheets for each item of equipment.
 13. Notes to explain why certain final data in the body of reports varies from indicated values.
 14. Test conditions for fans and pump performance forms including the following:
 - a. Settings for outside-, return-, and relief-air dampers.
 - b. Conditions of filters.
 - c. Cooling coil, wet- and dry-bulb conditions.
 - d. Fan drive settings including settings and percentage of maximum pitch diameter.
 - e. Settings for supply-air, static-pressure controller.

- f. Other system operating conditions that affect performance.
- E. Vibration Measurement Reports:
1. Date and time of test.
 2. Vibration meter manufacturer, model number, and serial number.
 3. Equipment designation, location, equipment, speed, motor speed, and motor horsepower.
 4. Diagram of equipment showing the vibration measurement locations.
 5. Measurement readings for each measurement location.
 6. Calculate isolator efficiency using measurements taken.
 7. Description of predominant vibration source.
- F. Instrument Calibration Reports:
1. Report Data:
 - a. Instrument type and make.
 - b. Serial number.
 - c. Application.
 - d. Dates of use.
 - e. Dates of calibration.

3.11 INSPECTIONS

- A. Initial Inspection:
1. After testing and balancing are complete, operate each system and randomly check measurements to verify that the system is operating according to the final test and balance readings documented in the Final Report.
 2. Randomly check the following for each system:
 - a. Measure airflow of at least 10 percent of air outlets.
 - b. Measure room temperature at each thermostat/temperature sensor. Compare the reading to the set point.
 - c. Measure sound levels at two locations.
 - d. Measure space pressure of at least 10 percent of locations.
 - e. Verify that balancing devices are marked with final balance position.
 - f. Note deviations to the Contract Documents in the Final Report.

B. Final Inspection:

1. After initial inspection is complete and evidence by random checks verifies that testing and balancing are complete and accurately documented in the final report, request that a final inspection be made by Owner.
2. TAB firm test and balance engineer shall conduct the inspection in the presence of Owner.
3. Owner shall randomly select measurements documented in the final report to be rechecked. The rechecking shall be limited to either 10 percent of the total measurements recorded, or the extent of measurements that can be accomplished in a normal 8-hour business day.
4. If the rechecks yield measurements that differ from the measurements documented in the final report by more than the tolerances allowed, the measurements shall be noted as "FAILED."
5. If the number of "FAILED" measurements is greater than 10 percent of the total measurements checked during the final inspection, the testing and balancing shall be considered incomplete and shall be rejected.
6. TAB firm shall recheck all measurements and make adjustments. Revise the final report and balancing device settings to include all changes and resubmit the final report.
7. Request a second final inspection. If the second final inspection also fails, Owner shall contract the services of another TAB firm to complete the testing and balancing in accordance with the Contract Documents and deduct the cost of the services from the final payment.

END OF SECTION

**SECTION 23 07 00
HVAC INSULATION**

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SUMMARY

A. Section Includes:

1. Insulation Materials:
 - a. Flexible elastomeric.
 - b. Mineral fiber.
2. Insulating cements.
3. Adhesives.
4. Mastics.
5. Lagging adhesives.
6. Sealants.
7. Factory-applied jackets.
8. Field-applied jackets.
9. Tapes.
10. Securements.
11. Corner angles.

B. Related Sections:

1. Division 21 Section "Fire-Suppression Systems Insulation."
2. Division 22 Section "Plumbing Insulation."

1.03 SUBMITTALS

A. Product Data: For each type of product indicated. Include thermal conductivity, thickness, and jackets (both factory and field applied, if any).

B. Shop Drawings:

1. Detail application of protective shields, saddles, and inserts at hangers for each type of insulation and hanger.

2. Detail attachment and covering of heat tracing inside insulation.
 3. Detail insulation application at pipe expansion joints for each type of insulation.
 4. Detail insulation application at elbows, fittings, flanges, valves, and specialties for each type of insulation.
 5. Detail removable insulation at piping specialties, equipment connections, and access panels.
 6. Detail application of field-applied jackets.
 7. Detail application at linkages of control devices.
 8. Detail field application for each equipment type.
- C. Samples: For each type of insulation and jacket indicated. Identify each Sample, describing product and intended use.
1. Sample Sizes:
 - a. Preformed Pipe Insulation Materials: 12 inches long by NPS 2.
 - b. Sheet Form Insulation Materials: 12 inches square.
 - c. Jacket Materials for Pipe: 12 inches long by NPS 2.
 - d. Sheet Jacket Materials: 12 inches square.
 - e. Manufacturer's Color Charts: For products where color is specified, show the full range of colors available for each type of finish material.
- D. Qualification Data: For qualified Installer.
- E. Material Test Reports: From a qualified testing agency acceptable to authorities having jurisdiction indicating, interpreting, and certifying test results for compliance of insulation materials, sealers, attachments, cements, and jackets, with requirements indicated. Include dates of tests and test methods employed.
- F. Field quality-control reports.

1.04 QUALITY ASSURANCE

- A. Installer Qualifications: Skilled mechanics who have successfully completed an apprenticeship program or another craft training program certified by the Department of Labor, Bureau of Apprenticeship and Training.
- B. Fire-Test-Response Characteristics: Insulation and related materials shall have fire-test-response characteristics indicated, as determined by testing identical products per ASTM E 84, by a testing and inspecting agency acceptable to authorities having jurisdiction. Factory label insulation and jacket materials and adhesive, mastic, tapes, and cement material containers, with appropriate markings of applicable testing and inspecting agency.

1. Insulation Installed Indoors: Flame-spread index of 25 or less, and smoke-developed index of 50 or less.
2. Insulation Installed Outdoors: Flame-spread index of 75 or less, and smoke-developed index of 150 or less.

1.05 DELIVERY, STORAGE, AND HANDLING

- A. Packaging: Insulation material containers shall be marked by manufacturer with appropriate ASTM standard designation, type and grade, and maximum use temperature.

1.06 COORDINATION

- A. Coordinate size and location of supports, hangers, and insulation shields specified in Division 23 Section "Hangers and Supports for HVAC Piping and Equipment."
- B. Coordinate clearance requirements with piping Installer for piping insulation application, duct Installer for duct insulation application, and equipment Installer for equipment insulation application. Before preparing piping and ductwork Shop Drawings, establish and maintain clearance requirements for installation of insulation and field-applied jackets and finishes and for space required for maintenance.
- C. Coordinate installation and testing of heat tracing.

1.07 SCHEDULING

- A. Schedule insulation application after pressure testing systems and, where required, after installing and testing heat tracing. Insulation application may begin on segments that have satisfactory test results.
- B. Complete installation and concealment of plastic materials as rapidly as possible in each area of construction.

PART 2 - PRODUCTS

2.01 INSULATION MATERIALS

- A. Comply with requirements in Part 3 schedule articles for where insulating materials shall be applied.
- B. Products shall not contain asbestos, lead, mercury, or mercury compounds.
- C. Products that come in contact with stainless steel shall have a leachable chloride content of less than 50 ppm when tested according to ASTM C 871.
- D. Insulation materials for use on austenitic stainless steel shall be qualified as acceptable according to ASTM C 795.
- E. Foam insulation materials shall not use CFC or HCFC blowing agents in the manufacturing process.
- F. Mineral-Fiber, Preformed Pipe Insulation:
 1. Products: Subject to compliance with requirements, provide one of the following:

- a. Fibrex Insulations Inc.; Coreplus 1200.
 - b. Johns Manville; Micro-Lok.
 - c. Knauf Insulation; 1000 Pipe Insulation.
 - d. Manson Insulation Inc.; Alley-K.
 - e. Owens Corning; Fiberglas Pipe Insulation.
2. Type I, 850 deg F Materials: Mineral or glass fibers bonded with a thermosetting resin. Comply with ASTM C 547, Type I, Grade A, with factory-applied ASJ-SSL. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.

2.02 ADHESIVES

- A. Materials shall be compatible with insulation materials, jackets, and substrates and for bonding insulation to itself and to surfaces to be insulated, unless otherwise indicated.
- B. Mineral-Fiber Adhesive: Comply with MIL-A-3316C, Class 2, Grade A.
- 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Childers Products, Division of ITW; CP-82.
 - b. Foster Products Corporation, H. B. Fuller Company; 85-20.
 - c. ITW TACC, Division of Illinois Tool Works; S-90/80.
 - d. Marathon Industries, Inc.; 225.
 - e. Mon-Eco Industries, Inc.; 22-25.
- C. Polystyrene Adhesive: Solvent- or water-based, synthetic resin adhesive with a service temperature range of minus 20 to plus 140 deg F.
- 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Childers Products, Division of ITW; CP-96.
 - b. Foster Products Corporation, H. B. Fuller Company; 97-13.
- D. ASJ Adhesive, and FSK and PVDC Jacket Adhesive: Comply with MIL-A-3316C, Class 2, Grade A for bonding insulation jacket lap seams and joints.
- 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Childers Products, Division of ITW; CP-82.
 - b. Foster Products Corporation, H. B. Fuller Company; 85-20.
 - c. ITW TACC, Division of Illinois Tool Works; S-90/80.

- d. Marathon Industries, Inc.; 225.
- e. Mon-Eco Industries, Inc.; 22-25.

E. PVC Jacket Adhesive: Compatible with PVC jacket.

- 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Dow Chemical Company (The); 739, Dow Silicone.
 - b. Johns-Manville; Zeston Perma-Weld, CEEL-TITE Solvent Welding Adhesive.
 - c. P.I.C. Plastics, Inc.; Welding Adhesive.
 - d. Red Devil, Inc.; Celulon Ultra Clear.
 - e. Speedline Corporation; Speedline Vinyl Adhesive.

2.03 MASTICS

A. Materials shall be compatible with insulation materials, jackets, and substrates; comply with MIL-C-19565C, Type II.

B. Breather Mastic: Water based; suitable for indoor and outdoor use on above ambient services.

- 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Childers Products, Division of ITW; CP-10.
 - b. Foster Products Corporation, H. B. Fuller Company; 35-00.
 - c. ITW TACC, Division of Illinois Tool Works; CB-05/15.
 - d. Marathon Industries, Inc.; 550.
 - e. Mon-Eco Industries, Inc.; 55-50.
 - f. Vimasco Corporation; WC-1/WC-5.
- 2. Water-Vapor Permeance: ASTM F 1249, 3 perms at 0.0625-inch dry film thickness.
- 3. Service Temperature Range: Minus 20 to plus 200 deg F.
- 4. Solids Content: 63 percent by volume and 73 percent by weight.
- 5. Color: White.

2.04 LAGGING ADHESIVES

A. Description: Comply with MIL-A-3316C Class I, Grade A and shall be compatible with insulation materials, jackets, and substrates.

1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Childers Products, Division of ITW; CP-52.
 - b. Foster Products Corporation, H. B. Fuller Company; 81-42.
 - c. Marathon Industries, Inc.; 130.
 - d. Mon-Eco Industries, Inc.; 11-30.
 - e. Vimasco Corporation; 136.
2. Fire-resistant, water-based lagging adhesive and coating for use indoors to adhere fire-resistant lagging cloths over duct, equipment, and pipe insulation.
3. Service Temperature Range: Minus 50 to plus 180 deg F.
4. Color: White.

2.05 SEALANTS

A. ASJ Flashing Sealants, and Vinyl, PVDC, and PVC Jacket Flashing Sealants:

1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Childers Products, Division of ITW; CP-76.
2. Materials shall be compatible with insulation materials, jackets, and substrates.
3. Fire- and water-resistant, flexible, elastomeric sealant.
4. Service Temperature Range: Minus 40 to plus 250 deg F.
5. Color: White.

2.06 FACTORY-APPLIED JACKETS

A. Insulation system schedules indicate factory-applied jackets on various applications. When factory-applied jackets are indicated, comply with the following:

1. ASJ: White, kraft-paper, fiberglass-reinforced scrim with aluminum-foil backing; complying with ASTM C 1136, Type I.
2. ASJ-SSL: ASJ with self-sealing, pressure-sensitive, acrylic-based adhesive covered by a removable protective strip; complying with ASTM C 1136, Type I.
3. FSK Jacket: Aluminum-foil, fiberglass-reinforced scrim with kraft-paper backing; complying with ASTM C 1136, Type II.
4. FSP Jacket: Aluminum-foil, fiberglass-reinforced scrim with polyethylene backing; complying with ASTM C 1136, Type II.

5. PVDC Jacket for Outdoor Applications: 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.

6-mil- thick, white PVDC biaxially oriented barrier film with a permeance at 0.01 perms when tested according to ASTM E 96 and with a flame-spread index of 5 and a smoke-developed index of 25 when tested according to ASTM E 84.

- a. Products: Subject to compliance with requirements, provide one of the following:

1. Dow Chemical Company (The); Saran 540 Vapor Retarder Film and Saran 560 Vapor Retarder Film.

6. PVDC-SSL Jacket: PVDC jacket with a self-sealing, pressure-sensitive, acrylic-based adhesive covered by a removable protective strip.

- a. Products: Subject to compliance with requirements, provide one of the following:

1. Dow Chemical Company (The); Saran 540 Vapor Retarder Film and Saran 560 Vapor Retarder Film.

2.07 FIELD-APPLIED JACKETS

- A. Field-applied jackets shall comply with ASTM C 921, Type I, unless otherwise indicated.
- B. FSK Jacket: Aluminum-foil-face, fiberglass-reinforced scrim with kraft-paper backing for all outdoor piping.
- C. PVC Jacket: High-impact-resistant, UV-resistant PVC complying with ASTM D 1784, Class 16354-C; thickness as scheduled; roll stock ready for shop or field cutting and forming. Thickness is indicated in field-applied jacket schedules.

1. Products: Subject to compliance with requirements, provide one of the following:

- a. Johns Manville; Zeston.
- b. P.I.C. Plastics, Inc.; FG Series.
- c. Proto PVC Corporation; LoSmoke.
- d. Speedline Corporation; SmokeSafe.

2. Adhesive: As recommended by jacket material manufacturer.

3. Color: White.
4. Factory-fabricated fitting covers to match jacket if available; otherwise, field fabricate.
 - a. Shapes: 45- and 90-degree, short- and long-radius elbows, tees, valves, flanges, unions, reducers, end caps, soil-pipe hubs, traps, mechanical joints, and P-trap and supply covers for lavatories.

2.08 TAPES

A. ASJ Tape: White vapor-retarder tape matching factory-applied jacket with acrylic adhesive, complying with ASTM C 1136.

1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Avery Dennison Corporation, Specialty Tapes Division; Fasson 0835.
 - b. Compac Corp.; 104 and 105.
 - c. Ideal Tape Co., Inc., an American Biltrite Company; 428 AWF ASJ.
 - d. Venture Tape; 1540 CW Plus, 1542 CW Plus, and 1542 CW Plus/SQ.
2. Width: 3 inches.
3. Thickness: 11.5 mils.
4. Adhesion: 90 ounces force/inch in width.
5. Elongation: 2 percent.
6. Tensile Strength: 40 lbf/inch in width.
7. ASJ Tape Disks and Squares: Precut disks or squares of ASJ tape.

B. FSK Tape: Foil-face, vapor-retarder tape matching factory-applied jacket with acrylic adhesive; complying with ASTM C 1136.

1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Avery Dennison Corporation, Specialty Tapes Division; Fasson 0827.
 - b. Compac Corp.; 110 and 111.
 - c. Ideal Tape Co., Inc., an American Biltrite Company; 491 AWF FSK.
 - d. Venture Tape; 1525 CW, 1528 CW, and 1528 CW/SQ.

2. Width: 3 inches.
3. Thickness: 6.5 mils.
4. Adhesion: 90 ounces force/inch in width.
5. Elongation: 2 percent.
6. Tensile Strength: 40 lbf/inch in width.
7. FSK Tape Disks and Squares: Precut disks or squares of FSK tape.

C. PVC Tape: White vapor-retarder tape matching field-applied PVC jacket with acrylic adhesive. Suitable for indoor and outdoor applications.

1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Avery Dennison Corporation, Specialty Tapes Division; Fasson 0555.
 - b. Compac Corp.; 130.
 - c. Ideal Tape Co., Inc., an American Biltrite Company; 370 White PVC tape.
 - d. Venture Tape; 1506 CW NS.
2. Width: 2 inches.
3. Thickness: 6 mils.
4. Adhesion: 64 ounces force/inch in width.
5. Elongation: 500 percent.
6. Tensile Strength: 18 lbf/inch in width.

2.09 SECUREMENTS

A. Bands:

1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Childers Products; Bands.
 - b. PABCO Metals Corporation; Bands.
 - c. RPR Products, Inc.; Bands.
2. Stainless Steel: ASTM A 167 or ASTM A 240/A 240M, Type 304 or Type 316; 0.015 inch thick, 1/2 inch.
3. Aluminum: ASTM B 209, Alloy 3003, 3005, 3105, or 5005; Temper H-14, 0.020 inch thick, 1/2 inch wide with wing or closed seal.

4. Springs: Twin spring set constructed of stainless steel with ends flat and slotted to accept metal bands. Spring size determined by manufacturer for application.

B. Insulation Pins and Hangers:

1. Capacitor-Discharge-Weld Pins: Copper- or zinc-coated steel pin, fully annealed for capacitor-discharge welding, **[0.106-inch-]** **[0.135-inch-]** diameter shank, length to suit depth of insulation indicated.
 - a. Products: Subject to compliance with requirements, provide one of the following:
 1. AGM Industries, Inc.; CWP-1.
 2. GEMCO; CD.
 3. Midwest Fasteners, Inc.; CD.
 4. Nelson Stud Welding; TPA, TPC, and TPS.
2. Cupped-Head, Capacitor-Discharge-Weld Pins: Copper- or zinc-coated steel pin, fully annealed for capacitor-discharge welding, 0.106-inch- diameter shank, length to suit depth of insulation indicated with integral 1-1/2-inch galvanized carbon-steel washer.
 - a. Products: Subject to compliance with requirements, provide one of the following:
 1. AGM Industries, Inc.; CWP-1.
 2. GEMCO; Cupped Head Weld Pin.
 3. Midwest Fasteners, Inc.; Cupped Head.
 4. Nelson Stud Welding; CHP.
3. Metal, Adhesively Attached, Perforated-Base Insulation Hangers: Baseplate welded to projecting spindle that is capable of holding insulation, of thickness indicated, securely in position indicated when self-locking washer is in place. Comply with the following requirements:
 - a. Products: Subject to compliance with requirements, provide one of the following:
 1. AGM Industries, Inc.; Tactoo Insul-Hangers, Series T.
 2. GEMCO; Perforated Base.
 3. Midwest Fasteners, Inc.; Spindle.
 - b. Baseplate: Perforated, galvanized carbon-steel sheet, 0.030 inch thick by 2 inches square.

- c. Spindle: Copper- or zinc-coated, low carbon steel, fully annealed, 0.106-inch- diameter shank, length to suit depth of insulation indicated.
 - d. Adhesive: Recommended by hanger manufacturer. Product with demonstrated capability to bond insulation hanger securely to substrates indicated without damaging insulation, hangers, and substrates.
4. Nonmetal, Adhesively Attached, Perforated-Base Insulation Hangers: Baseplate fastened to projecting spindle that is capable of holding insulation, of thickness indicated, securely in position indicated when self-locking washer is in place. Comply with the following requirements:
- a. Products: Subject to compliance with requirements, provide one of the following:
 - 1. GEMCO; Nylon Hangers.
 - 2. Midwest Fasteners, Inc.; Nylon Insulation Hangers.
 - b. Baseplate: Perforated, nylon sheet, 0.030 inch thick by 1-1/2 inches in diameter.
 - c. Spindle: Nylon, 0.106-inch- diameter shank, length to suit depth of insulation indicated, up to 2-1/2 inches.
 - d. Adhesive: Recommended by hanger manufacturer. Product with demonstrated capability to bond insulation hanger securely to substrates indicated without damaging insulation, hangers, and substrates.
5. Self-Sticking-Base Insulation Hangers: Baseplate welded to projecting spindle that is capable of holding insulation, of thickness indicated, securely in position indicated when self-locking washer is in place. Comply with the following requirements:
- a. Products: Subject to compliance with requirements, provide one of the following:
 - 1. AGM Industries, Inc.; Tactoo Insul-Hangers, Series TSA.
 - 2. GEMCO; Press and Peel.
 - 3. Midwest Fasteners, Inc.; Self Stick.
 - b. Baseplate: Galvanized carbon-steel sheet, 0.030 inch thick by 2 inches square.
 - c. Spindle: Copper- or zinc-coated, low carbon steel, fully annealed, 0.106-inch- diameter shank, length to suit depth of insulation indicated.
 - d. Adhesive-backed base with a peel-off protective cover.

6. Insulation-Retaining Washers: Self-locking washers formed from 0.016-inch- thick, aluminum sheet, with beveled edge sized as required to hold insulation securely in place but not less than 1-1/2 inches in diameter.
 - a. Products: Subject to compliance with requirements, provide one of the following:
 1. AGM Industries, Inc.; RC-150.
 2. GEMCO; R-150.
 3. Midwest Fasteners, Inc.; WA-150.
 4. Nelson Stud Welding; Speed Clips.
 - b. Protect ends with capped self-locking washers incorporating a spring steel insert to ensure permanent retention of cap in exposed locations.
 7. Nonmetal Insulation-Retaining Washers: Self-locking washers formed from 0.016-inch- thick nylon sheet, with beveled edge sized as required to hold insulation securely in place but not less than 1-1/2 inches in diameter.
 - a. Products: Subject to compliance with requirements, provide one of the following:
 1. GEMCO.
 2. Midwest Fasteners, Inc.
- C. Staples: Outward-clinching insulation staples, nominal 3/4-inch- wide, stainless steel or Monel.
- D. Wire: 0.062-inch soft-annealed, stainless steel.
 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. C & F Wire.
 - b. Childers Products.
 - c. PABCO Metals Corporation.
 - d. RPR Products, Inc.

2.10 CORNER ANGLES

- A. PVC Corner Angles: 30 mils thick, minimum 1 by 1 inch, PVC according to ASTM D 1784, Class 16354-C. White or color-coded to match adjacent surface.
- B. Aluminum Corner Angles: 0.040 inch thick, minimum 1 by 1 inch, aluminum according to ASTM B 209, Alloy 3003, 3005, 3105 or 5005; Temper H-14.

- C. Stainless-Steel Corner Angles: 0.024 inch thick, minimum 1 by 1 inch, stainless steel according to ASTM A 167 or ASTM A 240/A 240M, Type 304.

PART 3 - EXECUTION

3.01 EXAMINATION

- A. Examine substrates and conditions for compliance with requirements for installation and other conditions affecting performance of insulation application.
 - 1. Verify that systems and equipment to be insulated have been tested and are free of defects.
 - 2. Verify that surfaces to be insulated are clean and dry.
 - 3. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 PREPARATION

- A. Surface Preparation: Clean and prepare surfaces to be insulated. Before insulating, apply a corrosion coating to insulated surfaces as follows:
 - 1. Stainless Steel: Coat 300 series stainless steel with an epoxy primer 5 mils thick and an epoxy finish 5 mils thick if operating in a temperature range between 140 and 300 deg F. Consult coating manufacturer for appropriate coating materials and application methods for operating temperature range.
 - 2. Carbon Steel: Coat carbon steel operating at a service temperature between 32 and 300 deg F with an epoxy coating. Consult coating manufacturer for appropriate coating materials and application methods for operating temperature range.
- B. Coordinate insulation installation with the trade installing heat tracing. Comply with requirements for heat tracing that apply to insulation.
- C. Mix insulating cements with clean potable water; if insulating cements are to be in contact with stainless-steel surfaces, use demineralized water.

3.03 GENERAL INSTALLATION REQUIREMENTS

- A. Install insulation materials, accessories, and finishes with smooth, straight, and even surfaces; free of voids throughout the length of equipment, ducts and fittings, and piping including fittings, valves, and specialties.
- B. Install insulation materials, forms, vapor barriers or retarders, jackets, and thicknesses required for each item of equipment, duct system, and pipe system as specified in insulation system schedules.
- C. Install accessories compatible with insulation materials and suitable for the service. Install accessories that do not corrode, soften, or otherwise attack insulation or jacket in either wet or dry state.
- D. Install insulation with longitudinal seams at top and bottom of horizontal runs.
- E. Install multiple layers of insulation with longitudinal and end seams staggered.

- F. Do not weld brackets, clips, or other attachment devices to piping, fittings, and specialties.
- G. Keep insulation materials dry during application and finishing.
- H. Install insulation with tight longitudinal seams and end joints. Bond seams and joints with adhesive recommended by insulation material manufacturer.
- I. Install insulation with least number of joints practical.
- J. Where vapor barrier is indicated, seal joints, seams, and penetrations in insulation at hangers, supports, anchors, and other projections with vapor-barrier mastic.
 - 1. Install insulation continuously through hangers and around anchor attachments.
 - 2. For insulation application where vapor barriers are indicated, extend insulation on anchor legs from point of attachment to supported item to point of attachment to structure. Taper and seal ends at attachment to structure with vapor-barrier mastic.
 - 3. Install insert materials and install insulation to tightly join the insert. Seal insulation to insulation inserts with adhesive or sealing compound recommended by insulation material manufacturer.
 - 4. Cover inserts with jacket material matching adjacent pipe insulation. Install shields over jacket, arranged to protect jacket from tear or puncture by hanger, support, and shield.
- K. Apply adhesives, mastics, and sealants at manufacturer's recommended coverage rate and wet and dry film thicknesses.
- L. Install insulation with factory-applied jackets as follows:
 - 1. Draw jacket tight and smooth.
 - 2. Cover circumferential joints with 3-inch- wide strips, of same material as insulation jacket. Secure strips with adhesive and outward clinching staples along both edges of strip, spaced 4 inches o.c.
 - 3. Overlap jacket longitudinal seams at least 1-1/2 inches. Install insulation with longitudinal seams at bottom of pipe. Clean and dry surface to receive self-sealing lap. Staple laps with outward clinching staples along edge at 4 inches o.c.
 - a. For below ambient services, apply vapor-barrier mastic over staples.
 - 4. Cover joints and seams with tape as recommended by insulation material manufacturer to maintain vapor seal.
 - 5. Where vapor barriers are indicated, apply vapor-barrier mastic on seams and joints and at ends adjacent to duct and pipe flanges and fittings.
- M. Cut insulation in a manner to avoid compressing insulation more than 75 percent of its nominal thickness.
- N. Finish installation with systems at operating conditions. Repair joint separations and cracking due to thermal movement.

- O. Repair damaged insulation facings by applying same facing material over damaged areas. Extend patches at least 4 inches beyond damaged areas. Adhere, staple, and seal patches similar to butt joints.
- P. For above ambient services, do not install insulation to the following:
 - 1. Vibration-control devices.
 - 2. Testing agency labels and stamps.
 - 3. Nameplates and data plates.
 - 4. Manholes.
 - 5. Handholes.
 - 6. Cleanouts.

3.04 PENETRATIONS

- A. Insulation Installation at Roof Penetrations: Install insulation continuously through roof penetrations.
 - 1. Seal penetrations with flashing sealant.
 - 2. For applications requiring only indoor insulation, terminate insulation above roof surface and seal with joint sealant. For applications requiring indoor and outdoor insulation, install insulation for outdoor applications tightly joined to indoor insulation ends. Seal joint with joint sealant.
 - 3. Extend jacket of outdoor insulation outside roof flashing at least 2 inches below top of roof flashing.
 - 4. Seal jacket to roof flashing with flashing sealant.
- B. Insulation Installation at Underground Exterior Wall Penetrations: Terminate insulation flush with sleeve seal. Seal terminations with flashing sealant.
- C. (That Are Not Fire Rated): Install insulation continuously through walls and partitions.
- D. Insulation Installation at Fire-Rated Wall and Partition Penetrations: Install insulation continuously through penetrations of fire-rated walls and partitions. Terminate insulation at fire damper sleeves for fire-rated wall and partition penetrations. Externally insulate damper sleeves to match adjacent insulation and overlap duct insulation at least 2 inches.
 - 1. Comply with requirements in Division 07 Section "Penetration Firestopping" firestopping and fire-resistive joint sealers.

3.05 FINISHES

- A. Duct, Equipment, and Pipe Insulation with ASJ, Glass-Cloth, or Other Paintable Jacket Material: Paint jacket with paint system identified below and as specified in Division 09 painting Sections.

1. Flat Acrylic Finish: Two finish coats over a primer that is compatible with jacket material and finish coat paint. Add fungicidal agent to render fabric mildew proof.
 - a. Finish Coat Material: Interior, flat, latex-emulsion size.
- B. Flexible Elastomeric Thermal Insulation: After adhesive has fully cured, apply two coats of insulation manufacturer's recommended protective coating.
- C. Color: Final color as selected by Architect. Vary first and second coats to allow visual inspection of the completed Work.
- D. Do not field paint aluminum or stainless-steel jackets.

3.06 FIELD QUALITY CONTROL

- A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.
- B. Perform tests and inspections.
- C. Tests and Inspections:
 1. Inspect ductwork, randomly selected by Architect, by removing field-applied jacket and insulation in layers in reverse order of their installation. Extent of inspection shall be limited to one location(s) for each duct system defined in the "Duct Insulation Schedule, General" Article.
 2. Inspect field-insulated equipment, randomly selected by Architect, by removing field-applied jacket and insulation in layers in reverse order of their installation. Extent of inspection shall be limited to one location(s) for each type of equipment defined in the "Equipment Insulation Schedule" Article. For large equipment, remove only a portion adequate to determine compliance.
 3. Inspect pipe, fittings, strainers, and valves, randomly selected by Architect, by removing field-applied jacket and insulation in layers in reverse order of their installation. Extent of inspection shall be limited to three locations of straight pipe, three locations of threaded fittings, three locations of welded fittings, two locations of threaded strainers, two locations of welded strainers, three locations of threaded valves, and three locations of flanged valves for each pipe service defined in the "Piping Insulation Schedule, General" Article.
- D. All insulation applications will be considered defective Work if sample inspection reveals noncompliance with requirements.

END OF SECTION

SECTION 23 08 13
ENVIRONMENTAL CONTROLS AND ENERGY MANAGEMENT SYSTEMS COMMISSIONING

PART 1 - GENERAL

1.01 SUMMARY

A. Section Includes:

1. General requirements for the Commissioning (Cx) of the Environmental Controls and Energy Management System (ECEMS), and interfacing with other systems such as, lighting controls and HVAC systems interconnection, 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 01, Section 01 91 13: General Commissioning Requirements. Coordinate work with the Commissioning Agent (CxA).

B. Related Requirements:

1. Division 01: General Requirements.
2. Division 01: Testing and Inspection.
3. Division 01: Contract Closeout.
4. Division 01: Maintenance and Operations Staff Demonstration and Training.
5. Division 01: General Commissioning Requirements.
6. Section 23 05 00: Common Work Results for HVAC.
7. Section 23 05 13: Basic HVAC Materials and Methods.
8. Section 23 09 23: Environmental Controls and Energy Management Systems.
9. Section 23 80 00: Heating, Ventilating and Air Conditioning Equipment.
10. Section 26 05 00: Common Work Results for Electrical.
11. Section 26 05 13: Basic Electrical Materials and Methods.
12. Section 26 05 19: Low Voltage Wires (600 Volt AC).
13. Section 26 05 26: Grounding and Bonding.
14. Project Commissioning Plan.

1.02 REFERENCES

- A. The latest version of applicable codes, standards, and references: Inspections and tests shall be in accordance with the following applicable codes and standards, except as provided otherwise herein:
1. National Electrical Manufacturers Association – NEMA.
 2. American Society for Testing and Materials – ASTM.
 3. American National Standards Institute – ANSI.
 4. California Electrical Code – CEC.
 5. Occupational Safety and Health Administration – OSHA.
 6. National Institute of Standards and Technology – NIST.
 7. American Society of Heating, Refrigerating and Air-Conditioning Engineers (ASHRAE). – Building Management and Energy Management Systems Commissioning, ASHRAE Guideline.
 8. California Building Code – CBC.
 9. California Mechanical Code – CMC.
 10. InterNational Electrical Testing Association (NETA) Acceptance Testing.

1.03 SUBMITTALS

- A. Submittals shall include the following:
1. Required Cx submittals in accordance with Division 01 Specifications.
 2. Copy of the Architect's reviewed and accepted submittals to the CxA via the OWNER.
 3. List of team members who will represent the Contractor in the Pre-functional 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 Functional Performance Tests, at least four weeks prior to the start of Pre-functional Performance Tests.
 6. System logic documentation and sequence of operations for review and approval.
 7. Provide Level 1 passwords.

8. 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.

1.04 MEETINGS, SEQUENCING AND SCHEDULING

- A. Meetings: Attend Cx meetings as required under Section 01 91 13, any other related Sections and the CxP.
- B. Sequencing and Scheduling: The work described in this Section shall begin only after work required in related Division 23 and 26 Sections have been successfully completed, and tests, inspection reports and Operation & Maintenance manuals required have been submitted and reviewed. The start-up and Pre-functional Equipment Checklists shall be completed and submitted to the Owner's Authorized Representative (OWNER) prior to the Functional Performance Tests.
 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 Section 01 91 13 and Cx plan.

1.05 QUALITY CONTROL

- A. Comply with Owner's Quality Control Specifications.
- B. Incorporate manufacturer's recommended Cx procedures for the systems and equipment to be commissioned under this Section.
- C. Typical quality control procedures include but are not limited to the following:
 1. Attend CxA progress and coordination meetings.
 2. Establish trend logs of system schedules as required in Section 23 09 23.
 3. Demonstrate system operation and compliance with contract documents.
 4. Manipulate systems and equipment to facilitate testing.
 5. Provide instrumentation necessary for verification and performance testing.
- D. Provide ECEMS technician(s) to work at the direction of the CxA for software optimization assistance for a minimum of 8 hours. Refer to Part 3 for a description of the software optimization.
- E. Compensation for Retesting: Compensate Owner for site time necessitated by incompleteness of systems or equipment at time of Functional Performance Testing

(FPT). Testing failures, which require on-site time for retesting, will be considered actual damages to the Owner. Parties under contract with the Owner who are affected by the retesting shall be included in the contract modification.

- F. Allow sufficient time before final commissioning dates to complete electrical testing, inspection, and calibration to avoid delays in the commissioning process.
- G. During the commissioning activities, provide labor and materials to make corrections when required, without undue delay.

1.06 COORDINATION

- A. Coordinate the completion of electrical testing, inspection, programming and calibration prior to start of commissioning activities.
- B. Coordinate factory field-testing per the requirements of this Section.
- C. Coordinate commissioning efforts with CxA prior to commencing any activities.

PART 2 - PRODUCTS

2.01 TEST EQUIPMENT

- A. Equipment to be used in the commissioning process shall meet the following requirements.
 - 1. Provide test equipment as necessary for start-up and commissioning of the EMS system.
 - 2. Provide testing equipment and accessories that are free of defects and are certified for use.
 - 3. Provide testing equipment with current calibration labels as per NIST Standards; Equipment shall be calibrated on the manufacturer's recommended intervals with calibration tags affixed to the instrument. In the absence of calibration tags, calibration documentation shall be submitted to the CxA at least thirty days prior to use; this documentation shall include description and serial number of instrument and calibration date and time.
 - 4. Testing equipment shall be maintained in good operating condition for the duration of the project.
 - 5. Testing equipment shall be UL Listed.
- B. Instrumentation required to verify readings and test the system and equipment performance shall be provided by the Contractor and made available to CxA. Generally, no testing equipment will be required beyond that required to perform Contractor's work under contract documents.

2.02 TESTING AND AIR BALANCING AND COMMISSIONING

- A. Provide a portable operator's terminal or hand-held device to facilitate testing, adjusting, and calibration of controls. This device shall support functions and allow querying and editing of parameters required for proper calibration and start up.
- B. Connections shall be provided local to the device being calibrated. For instance, for VAV boxes, connection of the operator's terminal shall be either at the sensor or at the terminal box. Otherwise, a wireless system shall be provided to facilitate this local functionality.

PART 3 - EXECUTION

3.01 COMMISSIONING PROCESS REQUIREMENTS

- A. Work prior to commissioning:
 - 1. Complete phases of the work so the system(s) can be started, tested, adjusted, balanced, and otherwise commissioned.
 - 2. If contractual modifications are required to bring the system(s) to acceptance levels, such modifications shall be made at no additional cost to the owner.
 - 3. Normal start-up services required to bring each system into full operational state:
 - a. Testing, motor rotation check, control sequences of operation, full and part load performance.
 - b. Commissioning will not start until each system is complete and start-up has been performed.
- B. Pre-Commissioning responsibilities:
 - 1. Inspection, calibration and testing of the equipment required to commission the following systems:
 - a. Environmental Controls and Energy Management Systems.
 - b. Interface and connections of EMS system with lighting controls, electric utility meter, gas meter, photo voltaic system, or as otherwise indicated in contract documents.
- C. Commissioning Process Requirements:
 - 1. Refer to Section 01 91 13: General Commissioning Requirements and related Sections for information on meetings, start-up plans, Functional Performance Testing (FPT), operations and maintenance data, training requirements, and other Commissioning activities.

3.02 PREPARATION

- A. Provide certified EMS technicians as required, with tools and equipment necessary to perform Cx activities specified.
- B. Provide certified testing agency personnel and equipment factory representatives as required in the Cx plan and other related Sections.
- C. Verify that work required in this Section and in Section 01 91 13 is complete prior to starting of FPT.
- D. Verify that complete operational manuals have been reviewed and accepted by the CxA as specified before starting FPT.

3.03 START-UP, TESTING, ADJUSTING, AND CALIBRATION

- A. Work or systems installed shall be fully functioning prior to Demonstration and Acceptance Phase. Start, test, adjust, and calibrate work as described below:
 - 1. Inspect the installation of devices. Review the manufacturer's installation instructions and validate that the device is installed in accordance with them.
 - 2. Verify proper electrical voltages and amperages, and verify that circuits are free from faults.
 - 3. Verify integrity/safety of electrical connections.
 - 4. For AHUs that use a throttled outside air damper position when minimum outside air is required, mark the minimum outside air damper position.
 - 5. Coordinate with testing and air balance (TAB) subcontractor to obtain, Cx and fine-tune control settings that are determined from balancing procedures. Record the following control settings as obtained from TAB Contractor, and note any TAB deficiencies in the ECEMS Start-up report:
 - a. Optimum duct static pressure setpoints for VAV air handling units.
 - b. Minimum outside air damper settings for air handling units.
 - c. Optimum differential pressure setpoints for variable speed pumping systems.
 - d. Calibration parameters for flow control devices such as VAV boxes and flow measuring stations.
 - 6. Test, calibrate, and set digital and analog sensing and actuating devices. Test equipment shall be 50 percent more accurate than the field device over the same range. Calibrate each instrumentation device by making a comparison between the ECEMS display and the reading at the device. (e.g., if field device is plus or minus 0.5 percent accurate, test equipment shall be plus or minus 0.25 percent accurate over the same range). Record the measured value and displayed value for each device in the ECEMS start-up report.
 - 7. Check and set zero and span adjustments for transducers and transmitters.
 - 8. Dampers and Valves:

- a. Check for adequate installation including free travel throughout range and adequate seal.
 - b. Where loops are sequenced, check for proper control with overlap.
9. Actuators:
- a. Check to insure that device seals tightly when the appropriate signal is applied to the operator.
 - b. Check for appropriate fail position, and that the stroke and range is as required.
10. Check each digital control point by making a comparison between the control command at the central command unit and the status of the controlled device. Check each digital input point by making a comparison of the state of the sensing device and the ECEMS display. Record the results for each device in the ECEMS start-up report.
11. For outputs to reset other manufacturer's devices (for example, VSDs) and for feedback from them, calibrate ranges to establish proper parameters. Coordinate with representative of the respective manufacturer and obtain their approval of the installation.
12. Verify proper sequences by using the checklists to record results and submit with ECEMS start-up report. Verify proper sequence and operation of specified functions.
13. Verify that safety devices trip at appropriate conditions. Adjust setpoints accordingly.
14. Tune control loops to obtain the fastest stable response without hunting, offset or overshoot. Record tuning parameters and response test results for each control loop in the ECEMS start-up report. Except from a startup, maximum allowable variance from setpoint for controlled variables under normal load fluctuations shall be as follows. Within 3 minutes of any upset (for which the system has the capability to respond) in the control loop, tolerances shall be maintained (exceptions noted):
- a. Duct air temperature: plus or minus 1 degree F.
 - b. Space temperature: plus or minus 2 degrees F.
 - c. Hot water temperature: plus or minus 3 degrees F
 - d. Duct pressure: plus or minus 0.25 inches w.g.
 - e. Water pressure: plus or minus 1 psid.
 - f. Air flow control: plus or minus 5 percent of setpoint velocity.
 - g. Space pressurization: plus or minus 0.05 inches w.g.

15. For interface and DDC control panels:
 - a. Ensure devices are properly installed with adequate clearance for maintenance and with clear labels in accordance with the record drawings.
 - b. Ensure that terminations are safe, secure and labeled in accordance with the record drawings.
 - c. Check power supplies for proper voltage ranges and loading.
 - d. Ensure that wiring and tubing are run in a neat and workman-like manner, either bound or enclosed in trough.
 - e. Check for adequate signal strength on communication networks.
 - f. Check for standalone performance of controllers by disconnecting the controller from the LAN. Verify that the controlling LAN reconfigures as specified in the event of a LAN disconnection.
 - g. Ensure that outputs and devices fail to their proper positions/states.
 - h. Ensure that buffered or volatile information is held through power outage.
 - i. With system and communications operating normally, sample and record update/annunciation times for critical alarms fed from the panel to the Operator Interface.
 - j. Check for adequate grounding of DDC panels and devices.

16. Operator Interfaces:
 - a. Verify that elements on the graphics are functional and are properly bound to physical devices or virtual points, and that hot links or page jumps are functional and logical.
 - b. Output specified ECEMS reports for review and approval.
 - c. Verify that the alarm printing and logging is functional and per requirements.
 - d. Verify that trends are archiving to disk and provide a sample to the CxA and owner for review.
 - e. Verify that e-mail alarm annunciation is functional.
 - f. Verify that functionality of remote operator interfaces.
 - g. Verify that required third party software applications required with the bid are installed and are functional.
 - h. Verify proper interface with fire alarm, lighting control system, photo voltaic system, gas and electrical meters.

- B. Submit start-up test report: Report shall be completed, submitted, and reviewed prior to Substantial Completion.

3.04 SENSOR CHECKOUT AND CALIBRATION

- A. General Checkout: Verify that sensor locations are appropriate and are away from causes of erratic operation. Verify that sensor with shielded cable are grounded only at one end.
- B. Calibration: Calibrate sensors using one of the following procedures:
 - 1. Sensors Without Transmitters – Standard Application: Make a reading with a calibrated test instrument within 6 inches of the site sensor at various points across the range. Verify that the sensor reading (via the permanent thermostat, gage, or ECEMS) is within the tolerances specified for the sensor. Where sensors are subject to wide variations in the sensed variable, calibrate sensor within the highest and lowest 20 percent for the expected range.
- C. Sensor Tolerance: Sensors shall be within the tolerances specified for the device.

3.05 COIL VALVE LEAK CHECK

- A. Verify proper close off of the valves. Ensure that valve seats properly by simulating the maximum anticipated pressure difference across the circuit. Calibrate air temperature sensor on each side of coil to be within 0.5 degrees F of each other. Via the Operator Interface, command the valve to close. Energize fans. After five minutes observe air temperature difference across coil. If a temperature difference is indicated, and the piping surface temperature entering the coil is within 3 degrees F of the water supply temperature, leakage is probably occurring. If it appears that it is occurring, close the isolation valve to the coil to ensure the conditions change. If they do, this validates that the valve is not closing. Remedy the condition by adjusting the stroke and range, increasing the actuator size/torque, replacing the seat, or replacing the valve as applicable.

3.06 VALVE STROKE SETUP AND CHECK

- A. For valve and actuator positions check, verify the actual position against the ECEMS display.
- B. Set pumps to normal operating mode. Command valve closed, verify that valve is closed, and adjust output zero signal as required. Command valve open, verify position is full open and adjust output signal as required. Command the valve to various few intermediate positions. If actual valve position does not reasonably correspond, replace actuator.

3.07 ECEMS DEMONSTRATION

- A. Demonstrate the operation of the ECEMS hardware, software, and related components and systems to the satisfaction of the CxA and Owner. Schedule the demonstration with the Owner's representative two weeks in advance. Demonstration shall not be scheduled until hardware and software submittals and the start-up test report are reviewed. If the work fails to be demonstrated to conform with contract specifications, so as to require scheduling of additional site visits by the CxA and Owner's representative for re-demonstration, reimburse owner for reasonable local costs of subsequent CxA site visits as detailed elsewhere in these specifications.

- B. Supply personnel and equipment for the demonstration, including, but not limited to, instruments, ladders, etcetera. Contractor-supplied personnel shall be competent with and knowledgeable of project-specific hardware, software, and the HVAC systems. Training documentation and submittals shall be at the job site.
- C. Demonstration shall typically involve small representative samples of systems and equipment randomly selected by the owner and CxA.
- D. The system shall be demonstrated following the same procedures used in the start-up test by using the Commissioning checklist. Demonstration shall include, but not necessarily be limited to, the following:
 - 1. Demonstrate that required software is installed on ECEMS workstations. Demonstrate that graphic screens, alarms, trends, and reports are installed as submitted. Demonstrate directory structure and file system matches that submitted.
 - 2. Demonstrate that points specified and shown can be interrogated or commanded (as applicable) from workstations, as specified, in less than the maximum response time.
 - 3. Demonstrate correct calibration of input/output devices using the same methods specified for the start-up tests. A maximum of 10 percent of I/O points shall be selected at random by the CxA or owner for demonstration. Upon failure of any device to meet the specified end-to-end accuracy, an additional 10 percent of I/O points shall be selected at random by CxA for demonstration. This process shall be repeated until 100 percent of randomly selected I/O points have been demonstrated to meet specified end-to-end accuracy.
 - 4. Demonstrate that DDC and other software programs exist at respective field panels. The DDC programming and point database shall be as submitted.
 - 5. Demonstrate that DDC programs accomplish the specified sequences of operation including failure sequences.
 - 6. Demonstrate that the panels automatically recover from power failure, as specified. Demonstrate alarms as specified.
 - 7. Demonstrate that the stand-alone operation of panels meets the requirements of these Specifications. Demonstrate that the panels' response to LAN communication failures meets the requirements of these Specifications.
 - 8. Identify access to equipment selected by CxA or by the owner. Demonstrate that access is sufficient to perform required maintenance.
 - 9. Demonstrate that required trend graphs and trend logs are set up per the requirements. Provide a sample of the data archive. Indicate the file names and locations.
- E. ECEMS demonstration shall be completed and prior to Substantial Completion.
- F. Tests successfully completed during the demonstration will be recorded as passed for the Functional Performance Testing (FPT) and will not have to be retested.

3.08 RESOLUTION OF DEFICIENCIES

- A. Maladjustments, misapplied equipment, or deficient Contractors performance may result in additional work being required for Cx acceptance.
 - 1. Perform work required to correct the 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 Article 3.07 above, Section 01 91 13, and Cx plan for retesting requirements necessary to achieve required system performance.
 - 2. If the system's Cx deadline, as defined in the CxP, goes beyond the scheduled completion of Cx without resolution of the problem, the Owner reserves the right to obtain supplementary services or equipment to resolve the problem.

3.09 ECEMS ACCEPTANCE PERIOD

- A. After approval of the ECEMS demonstration and prior to contract close-out acceptance phase shall commence. Acceptance period shall not be scheduled until HVAC systems are in operation and have been accepted, required cleaning and lubrication has been completed (i.e., filters changed, piping flushed, strainers cleaned, and the like), and Testing and Balancing report has been submitted and reviewed. Acceptance Period and its approval will be performed on a system-by-system basis if mutually agreed upon by the Contractor and the owner.
- B. Operational Test: At the beginning of the Acceptance Phase, the system shall operate properly for two weeks without malfunction, without alarm caused by control action or device failure, and with smooth and stable control of systems and equipment in conformance with these specifications. At the end of the two weeks, forward the trend logs to the CxA for review and acceptance. CxA shall determine if the system is ready for Functional Performance Testing (FPT) and document any problems requiring Contractor attention.
 - 1. If the systems are not ready for Functional Performance Testing (FPT), correct problems and provide notification to the owner's representative that problems have been corrected. The acceptance period shall be restarted at the mutually scheduled time for an additional one-week period. This process shall be repeated until CxA issues notice that the ECEMS is ready for Functional Performance Testing (FPT).
- C. During the acceptance period, maintain a hard copy log of alarms generated by the ECEMS. For each alarm received, diagnose the cause of the alarm, and list on the log for each alarm the diagnosed cause of the alarm, and the corrective action taken.

3.10 TREND LOGS

- A. Configure and analyze trends required under Section 23 09 23.

3.11 TREND GRAPHS

- A. Trend graphs as specified in Section 23 09 23 shall generally be used during the acceptance phase to facilitate and document testing. Prepare controller and workstation

software to display graphical format trends during the acceptance period. Trend graphs shall demonstrate compliance with contract documents.

- B. Each graph shall be clearly labeled with HVAC subsystem title, date, and times.

3.12 WARRANTY PHASE

- A. Trending: Throughout the Warranty phase, trend logs shall be maintained as required for the acceptance period. Forward archive trend logs to the CxA and Owner for review. CxA or Owner will review these and notify Contractor of Warranty work required.

3.13 SOFTWARE OPTIMIZATION ASSISTANCE

- A. Provide the services of an ECEMS technician at the project site to be at the disposal of the CxA and Owner. The technician is to make changes, enhancements, and additions to control unit or workstation software that has been identified by the CxA or Owner during the Construction and Commissioning of the project and that are beyond the specified contract requirements. The cost for this service to include a total of 40 hour will be included with the bid. Request for assistance shall be for contiguous or non-contiguous 8 hour days, unless otherwise mutually agreed upon by the Contractor, CxA, and OWNER. The Owner Authorized Representative (OWNER) shall notify Contractor two days in advance of each day of requested assistance.
- B. The ECEMS technician provided shall be trained in the programming and operation of the controller and workstation software. If the ECEMS technician provided cannot perform every software task requested by the CxA or Owner in a timely fashion, provide additional qualified personnel at the project site as requested by the CxA or Owner.

END OF SECTION

SECTION 23 09 23
ENVIRONMENTAL CONTROLS AND ENERGY MANAGEMENT SYSTEMS

PART 1 - GENERAL

1.01 SUMMARY

- A. Section Includes: Environmental controls and energy management systems, including equipment, materials, installation, start-up, testing, documentation and training according to construction documents. The project drawings establish the scope of HVAC controls work in conjunction with the scope of work indicated in Section 23 09 00: HVAC Instrumentation and Controls. This Section complements the requirements of Section 23 09 00, and construction drawings for controls and system communications.
- B. Related Requirements:
1. Division 01: General Requirements.
 2. Division 01: Testing and Inspection.
 3. Division 01: Maintenance and Operations Staff Demonstration and Training.
 4. Division 01: General Commissioning Requirements.
 5. Section 23 05 00: Common Work Results for HVAC.
 6. Section 23 05 13: Basic HVAC Materials and Methods.
 7. Section 23 08 13: Environmental Controls and Energy Management Systems Commissioning.
 8. Section 23 80 00: Heating, Ventilating and Air Conditioning Equipment.
 9. Section 26 05 00: Common Work Results for Electrical.
 10. Section 26 05 13: Basic Electrical Materials and Methods.
 11. Section 26 05 19: Low-Voltage Wires (600 Volt AC).
 12. Section 26 05 26: Grounding and Bonding.
 13. Section 26 09 23: Lighting Control Systems.
 14. Project Commissioning Plan (CxP).

1.02 REFERENCES

- A. The latest version of applicable codes, standards, and references. Inspections and tests shall be in accordance with the following applicable codes and standards, except as provided otherwise herein.
1. International Electrical Testing Association – NETA.
 2. National Electrical Manufacturers Association – NEMA.
 3. American Society for Testing and Materials – ASTM.

4. Institute of Electrical and Electronics 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 Mechanical Code – CMC.
10. Insulated Cables Engineers Association – ICEA.
11. Occupational Safety and Health Administration – OSHA.
12. National Institute of Standards and Technology – NIST.
13. National Fire Protection Association – NFPA.
14. American Society of Heating, Refrigerating, and Air-Conditioning Engineers – ASHRAE
(The HVAC Commissioning Process, ASHRAE Guideline).
15. International Building Code – IBC.
16. International Mechanical Code – IMC.
17. InterNational Electrical Testing Association (NETA) Acceptance Testing.

1.03 SUBMITTALS

- A. Provide in accordance with Division 01 and Section 23 05 00: Common Work Results for HVAC.
- B. Shop Drawings shall include but not limited to:
 1. Cover page with legend, common notes, symbol schedule, and drawing index.
 2. Complete point to point environmental controls and energy management network communication diagram(s) for Direct Digital Controls (DDC) of each system:
 - a. Identify all components.
 - b. Indicate conduit and wire characteristics, sizes and quantities.
 - c. Provide bill of materials.
 3. Floor plans showing control panels and intercommunication wiring.
 - a. Show system(s) interface connections.
 4. Valve Schedules where required.
 5. Operations and Maintenance Manuals.

6. As-built submittal drawings.
7. Installation Instructions of each control device.
8. PC Workstation.
9. Software flow diagram of each unique system sequence of operation.
10. Software licenses and electronic keys.
11. Supplemental local or factory training schedule for post warranty support.
12. A complete list of recommended spare parts with pricing for the OWNER's use in keeping the environmental control system downtime to a minimum.
13. Composite CD-ROM with AutoCAD drawings in a ".dwg" format.

1.04 QUALITY CONTROL

- A. CONTRACTOR shall have adequate experience installing systems of similar size and complexity with the control product line proposed for this project.
 1. Qualifications of Installer: Minimum five years experience installing products and systems of similar scope and complexity.
 2. Installer shall submit certification from the equipment manufacturer indicating that installer is an authorized representative of the equipment manufacturer and is trained on network applications.
 3. Installer shall maintain a fully equipped service organization capable of furnishing repair service to the equipment and shall maintain a spare set of major parts for the system at all times.
 4. Installer shall furnish a letter from manufacturer of equipment certifying equipment has been installed according to factory standards and that system is operating properly.
 5. CONTRACTOR shall have participated in the commissioning of a minimum of 10 projects of similar magnitude to those needed for this project.
 6. System startup and testing shall be performed under the direct observation of the Project Inspector and OAR.
- B. Materials and equipment installed shall be new.
- C. System installation shall not begin until Shop Drawings are submitted and reviewed by the Architect or Engineer of Record.
- D. Components for Direct Digital Control (DDC) shall comply with ASHRAE standards.
- E. The installer shall provide the system components required by code and for the life safety of the service personnel.
- F. System shall be able to interface with open protocol BACnet systems.
- G. Provide all ancillary components for the system to perform the required sequence of operations. Install, test and adjust the system accordingly.

- H. System components shall operate per industry standards. The standards shall be as defined by ASHRAE, SMACNA, AABC, NEBB, TABB, and the literature of the manufacturers listed in this Section.
- I. Provide field engineering tools including software and hardware needed for programming and/or modifying system controller and devices.

1.05 WARRANTY

- A. Components, system hardware and software, and parts and labor shall be guaranteed against defects in materials, fabrication, and execution for three years from date of system acceptance. Provide labor and materials to repair, reprogram, or replace defective components at no charge to the OWNER during the warranty period.
- B. Provide a list of applicable warranties for equipment and components, this list shall include warranty information, names, addresses, telephone numbers, and procedures for filing a claim and obtaining warranty services.
- C. CONTRACTOR shall respond to OWNER's request for warranty service within four hours of initial call to schedule a mutually agreeable time for service. Submit records of the nature of the call, the work performed, and the parts replaced or service rendered.

1.06 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.
 - 1. Provide four hours of onsite OWNER familiarization and training for the installed system. Training shall include system overview, time schedules, override commands, emergency operation, and programming and report generation. OWNER employees attending this training session shall be provided with the following documentation:
 - a. As-built drawings of System layouts and point to point connection diagrams.
 - b. System components cut sheets.
 - c. Operations and maintenance data.
 - 2. Programmer and maintenance training shall include database entry; trend logs application programs, diagnostic routines, reporting, failure recovery and calibration.
 - a. Provide 24 hours of training as follows:
 - 1) Training session 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.
 - a) Training shall be delivered in 6 hours per session increments.
 - b) Obtain OWNER's approval for training locations exceeding 50 miles. In such cases, the CONTRACTOR shall be responsible for transportation expenses.

- c) CONTRACTOR shall provide training computers for all attendees. Computers shall be ready for live training sessions.
- 2) Training shall cover instruction, theory, and expose the trainees to system's features, components, architecture, operations, programming, report generation, communications, and any other pertinent information required for the operations and maintenance of the system.
- 3) Each 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.
- 3) Instructor(s) shall give the trainees the opportunity to practice on simulated and actual (installed) systems.
- 4) The training session shall cover, but not be limited to the following instruction modules or sessions:
 - a) System Architecture:
 - (1) System layout and components interrelations and hierarchical structure.
 - (2) Controllers interfacing and functions.
 - (3) Server functionality and data management, error messages, and alarm conditions.
 - (4) Connectivity and communication losses.
 - (5) Replacement procedures for system components.
 - b) User Operations:
 - (1) Familiarization and navigation with the EMS operating System.
 - (2) Window panes, menus, navigation buttons, alarm response windows, system passwords and accessibility features and options, monitoring and managing data points (inputs, outputs, numeric values, time and date, strings).
 - (3) Views: Provide sufficient information as to train staff on how and where to access programs, functions, adjust or alter diagnostic points and related data, override messages, reports and actions taken.
 - c) Trending: Setting trend(s) intervals, accessing data trends and history logs for diagnosis points or groups, and reporting. Working with trended data graphical displays, including but not limited to hiding points, setting display types and colors, viewing and setting scales.

- d) Graphics: Standard symbols and color codes, graphics customization, how and where to access and manage the system with the graphic displays, including changing points and values, using HOA switches and viewing results, mapping to or with other graphic sources and functions, including groups, navigation, sequence of operations, and displays and reports.
- e) Alarms: Reading and interpreting alarms, acknowledging and silencing alarms, routing and setting priorities, viewing and responding e-mailed and paged alarms.

PART 2 - PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS

- A. Environmental controls and energy management systems shall be approved products of **Carrier**. No substitutions will be accepted.

2.02 SYSTEM ARCHITECTURE

- A. The system shall be capable of providing a peer-to-peer network of distributed stand-alone DDC controllers that meet ANSI/ASHRAE Standard 135 for open protocol communications.
- B. A maximum of 32 controllers shall be connected to any one MS/TP bus. Minimum Speed of 38kb and can support 127 devices per COM port. Provide a minimum of 2 ports.
 - 1. Provide a Building Automation System (BAS) that consists of Network Server/Controllers (NSCs), a family of Standalone Digital Control Units (SDCUs), Administration and Programming Workstations (APWs), and Web-based Operator Workstations (WOWs). The BAS shall provide control, alarm detection, scheduling, reporting and information management for the entire facility, WEB enable capabilities, and Wide Area Network (WAN).
 - 2. The Enterprise Level BAS shall consist of an Enterprise Server, which enables multiple NSCs (including all graphics, alarms, schedules, trends, programming, and configuration) to be accessible from a single Workstation simultaneously for operations and engineering tasks. The Enterprise Level BAS shall be able to host up to 250 servers, or NSCs, beneath it.
 - 3. For Enterprise and robust reporting capability outside of the trend chart and listing ability of the Workstation, a Reports Server shall be provided and installed on a Microsoft Windows based computer. The Reports Server can be installed on the same computer as the Enterprise Server.
 - 4. The system shall be a top-level 100/1000bT Ethernet network that utilizes BACnet/IP.
 - a. A sub-network of SDCUs using the BACnet MS/TP protocol shall connect the local, and stand-alone controllers with Ethernet-level Network Server Controllers/IP Routers.
 - 5. The system shall match the existing LonWorks IP, and/or Modbus TCP protocol.

- a. Integration to existing Modbus RTU/ASCII (and J-bus), Modbus TCP, LonTalk FTT-10A, and Web Services shall be native to the NSCs. There shall not be a need to provide multiple NSCs or additional software to allow all three protocols to be natively supported.
 - b. A sub-network of SDCUs using LonTalk FTT-10A, and/or Modbus RTU protocol shall connect the local, stand-alone controllers with Ethernet-level Network Server Controllers/IP Routers.
- C. Only systems that use HTML 5 structured language are allowed.
- D. The supplied computer software shall employ object-oriented technology (OOT) for representation of data and control devices within the system. For each global, system or unitary controller, provide a PICS document showing the installed device's compliance level. Minimum compliance is Level 3 with the ability to support data read and write functionality.
- E. Maximum acceptable response time from any alarm occurrence (at the point of origin) to the point of annunciation shall not exceed three seconds for network connected controllers or user interfaces.
 - 1. For each system point, alarms can be created based on high/low limits or in comparison to other point values.
 - 2. There is no limit to the number of alarms that can be created or stored in system hardware for any point, up to the system capacity.
 - 3. System shall generate configured alarms from single or multiple system conditions.
 - 4. Alarms will be generated from an evaluation of the alarm condition, and presented to the user in a fully configurable order, by priority, time, and category.
 - a. Alarm views shall be presented to the user upon logging into the system WorkStation and/or Webstation.
 - 5. Program the alarm management system to create and report alarm events history; the alarm events history data base shall provide the option to select alarm cause and action notes associated with an alarm event. The alarm management system shall also generate checklists for operators' use when utilizing a suggested mode of troubleshooting.
 - 6. Provide alarm event history for a feature use to permit assigning of events for resolution to OWNER staff. The system shall notify the user and assigned resolution personnel.
 - 7. Alarms shall be capable of being routed to any BACnet workstation that conforms to the B-OWS device profile and uses the BACnet/IP protocol.
- F. The system shall be able to interface with subsystems that utilize ANSI/CEA-709.1: Control Network Protocol Specification.

2.03 EMS SERVER AND USER INTERFACE WORKSTATION

- A. EMS Server: The EMS Server shall include a tower or rack mounted server with an Intel Xeon E5 2600 processor, 8 Gb RAM, RAID 1 configuration with two hot swap 2TB 7200 RPM SATA drive, DVDRW drive, keyboard, mouse, 27 inch LCD color display and the latest version of Microsoft Windows Server operating system software. The workstation shall connect to the network through an internal 1Gbps Ethernet interface card.

1. Software licensing shall be provided for local or remote unlimited simultaneous users of the system, unlimited future point expansion, user graphical display generation and non-vendor controllers. Licenses and electronic keys shall be included with the M&O manuals for project acceptance. Conditional Licenses will not be acceptable.
2. The system shall be programmed to email selected alarms to designated response personnel.
 - a. The ability to utilize email paging of alarms shall be a standard feature of the operating system's mail application interface (MAPI). No special software and no email client software must be running in order for the system to distribute emails.
 - b. The email notification shall be able to be sent to an individual user or a user group.
 - c. The NSC shall support the use of Web Services based on open standards, such as SOAP and REST. Use incoming third-party data (temperature forecast, energy cost) over the Web to determine site modes, scheduling, and programming.
3. Web-based operation shall be supported directly by the NSCs and shall not require additional software.
4. The supplied system shall incorporate the ability to access all data using HTML5 enabled browsers without requiring proprietary operator interface and configuration programs.
5. Programming of SDCUs shall be capable of being done either off-line or on-line from any operator workstation. All information shall be available in graphic or text displays stored at the NSC. Graphic displays shall feature animation effects to enhance the presentation of the data, to alert operators of problems, and to facilitate location of information throughout the DDC system. All operator functions shall be selectable through a mouse.
6. Programming in the NSC shall be either in graphical block format or line-programming format or both.
7. Programming of the NSC shall be available offline from system prior to deployment into the field. All engineering tasks shall be possible, except the viewing of live tasks or values.
8. The programmer's environment shall include access to a superset of the same programming language supported in the SDCUs.
9. Provided NSC devices shall support both script programming language as well as the graphical function block programming language. For both languages, the programmer will be able to configure application software for custom program development, and write global control programs. Both languages will have debugging capabilities in their editors.
10. The system shall be able to save custom programs as libraries for reuse throughout the system. A wizard tool shall be available for loading programs from a library file in the program editor.

11. The system shall be capable providing views of graphical programming in live and real-time from Workstation(s).
12. The system shall be capable of creating 'binding templates' allowing the user to bind multiple points to multiple objects all at once.
13. Automatic detecting zone that may be excessively driving the reset logic and generate an alarm.
14. Readily allow operator removal of zones from reset algorithm.
15. Applications shall be able to be assigned different priorities and cycle times for a prioritized execution of different function.
16. The provided system shall be able to create objects that allow common objects such as power meters, VFD drives, etc. to be integrated into the system with simple import actions without the need of complicated programming or configuration setups.
17. The BAS workstation software shall allow the creation of a custom, browser-style interface linked to the user when logging into any workstation. Additionally, it shall be possible to create customized workspaces that can be assigned to user groups. This interface shall support the creation of "hot-spots" that the user may link to view/edit any object in the system or run any object editor or configuration tool contained in the software. Furthermore, this interface shall be able to be configured to become a user's "PC Desktop" – with all the links that a user needs to run other applications. This, along with the Windows user security capabilities, shall enable a system administrator to setup workstation accounts that not only limit the capabilities of the user within the BAS software, but may also limit what a user can do on the PC and/or LAN/WAN. This might be used to ensure, for example, that the user of an alarm monitoring workstation is unable to shut down the active alarm viewer and/or unable to load software onto the PC.
18. The workstation software shall automatically log and timestamp every operation that a user performs at a workstation, from logging on and off a workstation to changing a point value, modifying a program, enabling/disabling an object, viewing a graphic display, running a report, modifying a schedule, etc.
19. Provide a Web Server to automatically convert system displays on the workstation to an Internet page. Internet page shall be readable from standard PC browsers. Acceptable browsers shall be latest version of internet explorer, Chrome, or Firefox. No additional plug-ins, programs, software, hardware, etc. shall be needed to access the Internet page. The server shall be a separate device to provide security protection for the building system from outside hackers.
 - a. Coordinate individual system components IP addresses, switch port assignments, security settings such as but not limited to SNMP alarm delivery, HTTPS/SSL settings, VLAN assignment and authorized IP address ranges with the OWNER's Information Technology Division. Coordination activities with ITD shall be executed through the OAR.
 - b. Provide IP address label on the interior of each cabinet door or equipment.
 - c. The system shall support the ability to notify school or OWNER designated personnel by SMS or Email messages, utilizing the OWNER's mail server when problems or situations that require immediate attention arise.

20. Operator Workstation shall display data associated with the project as called out on drawings or object type list supplied. Graphic files shall be created using digital, full color photographs of system installation, AutoCAD or Visio drawing files of field installation drawings and wiring diagrams from as-built drawings. Operator's workstation shall display data using three-dimensional graphic representations of mechanical equipment. System shall be capable of displaying graphic files, text, trend data and dynamic object data together on each display screen with animation of equipment operation.
 21. Controllers shall be programmed using graphical software tools that allow connection of function blocks for visual sequencing of control logic. Function blocks shall display real time data and be animated to show status of data inputs and outputs when in real time operation. Animation shall also show change of status on logic devices and countdown of timer devices in a graphical format.
 22. Operator Tracking Log shall record operator changes to the system for future review. This shall include, but not be limited to setpoint changes, time schedule overrides, alarm limits, etc.
 23. The system shall be equipped with a battery back-up source capable of providing 30 minutes of operation (computer and monitor) in the absence of normal power, to allow for an orderly shutdown and data back-up.
- B. EMS Workstation: The EMS Workstation shall be an enterprise level tower with an Intel Core™ i7 or better processor, 16GB of RAM, 256 GB solid state drive, DVD drive, keyboard, mouse, 27 inch LCD color display and the latest version of Microsoft Windows professional operating system software. The workstation shall connect to the network through an internal 1Gbps Ethernet interface card.

2.04 GLOBAL CONTROLLER

- A. Building controllers shall incorporate the functions of a 3-way BACnet router. Controller shall route BACnet messages between the high-speed LAN (Ethernet 100MHz), master slave token passing (MS/TP) LANs, a point-to-point (PTP/RS-232) connection and telephone modem.
- B. Provide global control strategies for the system based on information from any point objects in the system. Programming shall be object-oriented using graphical control function blocks. Global strategies shall include, but not limited to unit scheduling, electrical demand limiting, optimized start-stop of equipment, central plan reset control, etc.
- C. Battery shall retain static RAM memory and real-time clock functions for a minimum of 1.5 years (cumulative). Battery shall provide up to five minutes of powerless operation for orderly shutdown and data backup.
- D. Each building controller shall support a minimum of 250 BACnet Schedule Objects and 250 BACnet Calendar Objects.
- E. Each building controller shall log a minimum 1,000 trend logs. Any point object in the system (real or calculated) may be logged. Sample time interval shall be adjustable at the operator's workstation. Building controller shall periodically upload trended data to networked operator's workstation for long term archiving if desired. Archived data shall be available for use in third-party spreadsheet or database programs.
- F. Alarms may be generated within the system for any object change of value or state either real or calculated. This includes events such as analog object value changes, binary object state

changes and various controller communication failures. Each alarm may be automatically dialed out to a telephone pager or emailed to any Internet PC computer.

- G. Provide a 1.5 KVA UPS with battery back-up capability to provide a minimum of 30 minutes of operation (computer and monitor) for orderly shutdown and data backup. Make connections and test the system for proper operation in the presence of the Project Inspector.
- H. The global controller shall be equipped with ADR demand limiting capacity interface.
 - 1. The system shall include 5 DI for interfacing to local utility ADR program. The 5 DI shall be located in a 24 X 24 X 6 NEMA 12 cabinet mounted in the MDF or IDF room. Upon closer of each DI the control system shall raise or lower (depend on system mode) global room temperature set point 1 degree (user adjustable).
 - 2. The system shall also include a demand-limiting program that utilizes data from site utility meter. Features indicated below shall be available via a switchable graphical user interface in all operating stations:
 - a. Shed/Restore equipment in digital format shall include 5 data input points for interface to future ADR web appliance located in an MDF/IDF room. System server shall accept ADR command from utility service via web interface, and shall include at least 5 priority levels of equipment shedding. Load shedding on a given priority level shall include two methods. In one the loads shall be shed and restored in a "first-off/first-on" mode and in the other; the loads shall be shed/restored in a linear fashion.
 - b. Adjust operator selected control setpoints in analog format based on energy usage when compared to shed and restore settings.
 - c. Shedding may be implemented independently on each and every zone or piece of equipment connected to the system.
 - d. Status of every load shed shall be capable of being displayed on every operator terminal connected to the system. Statuses shall be displayed along with the English description of each load.

2.05 APPLICATION (system and unitary) DDC CONTROLLERS.

- A. Application controllers shall include universal inputs with 10-bit resolution that accept 3K and 10K thermistors, 0 to 10VDC, 0 to 5 VDC, 4 to 20 mA and dry contact signals. Any input on a controller may be either analog or digital with a minimum of three inputs that accept pulses. Controller shall include support and modifiable programming for interface to intelligent room sensor with digital display, and set point adjustment and override button. Controller shall include binary and analog outputs on board. Analog outputs shall be switch selectable as either 0–10VDC or 0–20mA. Software shall include scaling features for analog outputs. Application controller shall include a supply voltage to power external sensors.
- B. Program sequences shall be stored in EEPROM or flash memory. No batteries shall be needed to retain logic program. Controller shall execute program sequences 10 times per second and be capable of multiple PID loops for control of multiple devices. Calculations shall be completed using floating-point math. Programming of application controller shall be completely modifiable in the field over the installed BACnet LANs or remotely via modem interface.

- C. Central Plant Controllers shall interface to chiller gateways. Point objects shall reside in the central plant controller. Hand-Off-Auto switches shall be provided for direct wired output control circuits.
- D. Controllers for VAV boxes shall include one onboard airflow sensor microprocessor driven and pre-calibrated at the factory. Pre-calibration shall be at 16 flow points as a minimum. Factory calibration data shall be stored in EEPROM. Calibration data shall be field adjustable to compensate for variations in VAV box type and installation. Calibration parameters shall be adjustable through intelligent room sensor with digital display, and set point adjustment and override button. Operator workstation, portable computers and special hand-held field tools shall not be needed for field calibration. Boxes shall be controlled using pressure independent control algorithms and flow readings shall be in CFM
- E. Controllers for Dual Duct boxes shall include two onboard airflow sensors and function similar to the VAV box controller. Multiple VAV box controllers or controllers with remote airflow sensors are not acceptable.
- F. CONTRACTOR shall provide a laminated wiring diagram for each control panel. Locate diagrams on interior side of control panel's doors.

2.06 TEMPERATURE SENSORS

- A. Temperature sensors shall be 10K ohm thermistor factory-calibrated to within 0.5 degrees F, totally interchangeable with housings appropriate for the application.
- B. Wall sensors shall be installed 48 inches above finished floor. Duct sensors to be installed such that the sensing element is in the main air stream. Immersion sensors to be installed in wells filled with thermal compound. Outside air sensors shall be installed away from exhaust or relief vents, not in an outside air intake and in a location that is in the shade most of the day.
- C. Intelligent room sensors shall be equipped with digital display, set point adjustment and override button. Smart room temperature sensor/thermostat shall incorporate PIR motion sensor, temperature display, set point adjustment and override button. Acceptable Manufacturers: Schneider Electric SE8600 series, Viconics VT8600 series, Sigler 8600 series, **Carrier ZS series** or equal.
- D. Room thermostat shall be BACnet capable, Acceptable manufacturers: Schneider Electric SE8600 series, Viconics VT8600 series, Sigler VT8600 series, **Carrier ZS series** or equal.

2.07 CARBON DIOXIDE (CO₂) SENSORS

- A. Sensors shall be wall mounted at a height of approximately 4 feet. Locate sensors adjacent to room thermostat.
- B. Sensors are not permitted on marker boards, between shelving, in recesses or above heat producing equipment.
- C. Sensors shall be furnished with a display window that provides continuous monitoring and sensor status readings, and with tamperproof cover.
- D. Sensors shall be gold plated for long-calibration stability, be factory calibrated and certified for a minimum of five years.
- E. CO₂ sensors shall be BACnet capable, acceptable manufacturers: Honeywell C7232A, Telaire Ventostat Wall Mount, Johnson Control CD-WRD-00-0, or equal.

2.08 WINDOWS AND DOOR SENSOR

- A. Provide windows and door switches at every operable windows and door in controlled spaces. Each switch shall be connected to a DI point on the DDC controller. Each switch shall be wired independently. Wiring multiple switches in series shall not be acceptable. Acceptable Manufacturers: Illumra E3-MDCCP or equal.

2.09 PRESSURE SENSORS

- A. Differential and pressure sensors shall have a tensioned stainless steel diaphragm to form a variable capacitor that produces a linear output with an accuracy of 1.0 percent of full scale. The unit shall be able to withstand 10 PSIG over pressurization.
- B. Differential pressure switches shall utilize a diaphragm operated snap-acting switch with a setpoint range of 0.05 to 2.0 inches WC.
- C. Steam pressure sensors shall be mounted on a pigtail siphon with manual shutoff ball valve.

2.10 CARBON DIOXIDE (CO₂) SENSORS

- A. Carbon dioxide concentration levels shall be sensed by non-dispersive infrared technology. A corrosion-free sensing chamber shall be used for accurate, stable CO₂ sensing. An LCD shall display sensed CO₂ concentration.
- B. Sensor shall be gold plated and have a range of 0-2000 PPM at +/- 5 percent accuracy for long-term calibration stability. Both analog and binary relay output circuits shall be available on the sensor. An automatic background calibration algorithm shall reduce required maintenance.
- C. Acceptable Manufacturers: Telaire, Honeywell, Johnson Controls, or equal.

2.11 ELECTRONIC VALVES

- A. Control Valves ½ inch to 2-inch shall be characterized stainless steel ball valves with actuators sized to close off against twice the maximum fluid pressure. Valve body shall be NPT screwed for 2-way or 3-way application. A push button release shall be provided for manual operation.
- B. Control Valves 2 ½-inch and larger shall be butterfly type with actuators sized to close off against twice the maximum fluid pressure. Valve body shall be flanged for 2-way or 3-way application. Contacts shall be provided to mechanically indicate the full open and full closed position of the valve.
- C. Steam Valves shall be globe valves suitable for 35-PSI inlet steam service. Valve bodies shall be NPT screwed or flanged with spring-return normally closed valve actuators.
- D. Valve control shall be accomplish with 2-10 VDC. All valve shall provide feedback signal to EMS/BMS for monitoring on GUI.
- E. Acceptable Manufacturers: Belimo, Honeywell, Johnson Controls, Schneider Electric or equal.

2.12 DAMPER ACTUATORS

- A. Electric damper actuators (including VAV box actuators) shall be direct shaft mounted and use a V-bolt and toothed V-clamp. The actuator mounting arrangement and spring return feature shall permit normally open or normally closed positions of the damper as required.

- B. Actuators shall be sized for 200 percent of the design torque requirements.
- C. Damper actuators shall incorporate a release mechanism to manually position the damper for maintenance or emergency override.
- D. Damper Actuators located outdoors shall have a clear plastic weather shield specifically designed for the application.
- E. Damper motor control shall be with 2-10 VDC
- F. Acceptable Manufacturers: Belimo, Honeywell, Johnson Controls, Schneider Electric, or equal.

2.13 CURRENT SWITCH

- A. Current sensing switch shall be self-powered with solid-state circuitry and a dry contact output. A multi-turn setpoint adjustment shall set the trip point status. An LED shall indicate the on or off status.

2.14 CONTROL RELAY

- A. The relay shall be contained in a plenum rated NEMA 12 enclosure with a ¾" NPT conduit fitting. Coil voltage shall be 24 or 120 VAC with a contact rating of 10A. An LED on the enclosure cover shall indicate the relay is energized.

2.15 POWER SUPPLIES

Power supplies and panel assemblies shall be UL or NRTL listed.

2.16 ENCLOSURES

- A. Controllers, power supplies and relays shall be mounted in Hoffman A-LP NEMA 12 enclosures or equal when located in an indoor environment.
- B. Enclosures for outdoor applications shall be metal NEMA 4, Hoffman A-ALP, A-BLP or equal, and be mounted on the north exposure of the controlled unit.
- C. Enclosures shall have hinged, locking doors with common keying (CAT-60) for control panel on the Project Site.
- D. Enclosures shall have permanently affixed to the door an engraved nametag identifying the equipment served. The nametag shall be a minimum 1 inch by 3-inch with ½ inch lettering.

PART 3 - EXECUTION

3.01 CONTROLS INSTALLATION

- A. Wiring methods for control system shall be as defined in the Division 26 specifications. Wire types shall conform to manufacturers' recommendations.
- B. Mount control panels adjacent to associated equipment on vibration-free walls or freestanding angle iron supports. One cabinet may accommodate more than one system in same equipment room. Control panel assemblies must be UL listed.
- C. Provide software and hardware required to provide controls and monitoring of diagnostic points indicated in specification Section 23 80 00.

- D. Coordinate with Division 26 electrical installer so that "Hand/Off/Auto" selector switches are installed to override automatic interlock controls when switch is in the "Hand" position. Safety shutdown interlock wiring shall disable the equipment regardless of the position of the H-O-A switch.

3.02 ROOM SENSORS INSTALLATION

- A. Room sensors shall be wall mounted at a 48-inch height above finished floor. Room sensors are not permitted on outside walls, at chalkboards, between shelving, in recesses or above heat producing equipment. Coordinate with Division 26 for sensor or thermostat mounting adjacent to light switches.

3.03 COORDINATION

- A. Coordinate the work with other aspects of mechanical, electrical, fire-life safety and security systems, controls, and photo voltaic systems to obtain a complete and operating system in accordance with the contract documents.
- B. Meet with the OAR and school principal and other school staff to determine when each zone or building will be occupied, and to determine programming and scheduling of the heating, ventilating and air conditioning equipment.
- C. CONTRACTOR shall contact OAR to coordinate for timely availability of VPN access point(s) form OWNER's Information Technology Division.

3.04 DDC CONTROL SYSTEM ADJUSTMENTS

- A. Make adjustments under operating conditions to provide sequence of operation for each control system per design intent. If required operating conditions cannot be obtained prior to completion date of the contract due to outdoor seasonal temperatures, return to the job site when requested by the OWNER and re-adjust control system when outdoor temperatures will permit proper operating conditions. Start re-adjustment within seven calendar days after notification.

3.05 PERFORMANCE AND ACCEPTANCE:

- A. Test and calibrate each device including but not limited to the following for proper operation, connection, signal value or response.
 - 1. Building Controllers.
 - 2. Custom Application Controllers.
 - 3. Application Specific Controllers.
 - 4. Input / Output Devices. (Sensors, actuators and monitoring devices)
 - 5. Operator Interfaces.
- B. Verify that systems are standalone and operable upon network failure.
- C. Verify that systems return to normal operation automatically upon resumption of network operation or return of power.
- D. Test each system for functions of the required control sequence of operation either by normal control operation or forced operation as required. Log and submit results.

- E. Test the network for connectivity, data transmission rates, input/output responses, and other appropriate parameters. Failure modes, including network failure, individual control system failure, and power outages, shall be simulated and responses logged, with any effects on network operation noted and corrected.
- F. Test each preprogrammed time and holiday schedule.
- G. Commissioning requirements of Divisions 01, 23, and 26 apply to this Section.
- H. Schedule of Responsibilities: Refer to Appendix A. The schedule identifies the responsibilities of the CONTRACTOR for the installation of the environmental controls and energy management system. Deviations and clarifications of this schedule only if allowed by the OAR, provided trade CONTRACTOR coordination and schedule requirements are met. Submit a record copy of the Schedule of Responsibilities to the OAR at the commencement of this Section's Work.

3.06 WIRING AND INFRASTRUCTURE

- A. Provide necessary wiring, terminations, connections and conduit infrastructure for the complete system as indicated in the construction documents.
- B. Exterior cables whether above or below ground level shall be rated for exterior applications. When entering a building provide a code sized pull box with necessary hardware to transition exterior rated cables to interior applications.
- C. Underground EMS cables are permitted to be installed with lighting control wiring in underground applications. Provide innerduct to separate EMS cables from lighting control system cables.
- D. Provide both labeling and record documentation for all EMS system cabling. A cable management schedule and diagram shall be provided at each system panel or cabinet, in addition to a complete cabling diagram to be provided at the head end equipment location.
 - 1. The cable management spread file shall include the following:
 - a. Cable Schedule.
 - b. Cable Test Forms.
 - c. Cable Label sequence and nomenclature.
 - d. Network chart.
 - 2. Cable numbering shall be based on a defined format which readily identifies cable type, and allows maintenance technicians to determine originating and terminating locations.
 - 3. Present the data in an Excel spreadsheet that will operate on the latest Windows platform. Information shall be presented in paper and electronic formats.
 - 4. A copy of the cable schedule in a transparent plastic sleeve shall be affixed in the interior side of the front door of each network cabinet or cables convergence hub points.

3.07 DATA LOGGING REQUIREMENTS

- A. The system must be capable of storing the system's collected and diagnosis data for a minimum of seven days.
- B. Program the system for a standard seven day schedule including holidays.

3.08 CLEANUP

- A. Remove rubbish, debris and waste materials and legally dispose of off Project Site.

3.09 PROTECTION

- A. Protect Work of this Section until Substantial Completion.

END OF SECTION

APPENDIX A

SCHEDULE OF RESPONSIBILITIES

	ITEM	FURNISH BY	INSTALL BY	POWER BY	CONTROL WIRING BY
1	Magnetic Motor Starters:				
	a. Automatic controlled, with or without HOA switches.	E	E	E	DDC
	b. Manually controlled	E	E	E	N/A
	c. Manually controlled furnished as factory wired unit equipment	M	M	E	E
	d. Special duty type (part winding, multi-speed, etc.)	M	See Note 1	E	See Note 1
	e. Adjustable frequency drives with or without manual bypass.	DDC	E	E	DDC See Note 2
	f. Domestic booster pump. Motor Controls	M	M	E	DDC
2	Line voltage contactors.	E	E	E	DDC
3	Control relay transformers (other than starters).	DDC	DDC	E	DDC
4	Control and Instrumentation panels	DDC	NI	E	DDC
5	Automatic control valves, automatic dampers and damper operators, solenoid valves, insertion temperature and pressure sensors including wells	DDC	M	E	DDC
6	Control interlock wiring between chillers, pumps, cooling towers, fans and air handling units and other miscellaneous mechanical equipment.	DDC	DDC	E	DDC
7	Duct Smoke Detectors	E	M	E	E
8	Dampers				
	a. Control Dampers	M	M	N/A	DDC
	b. Smoke Dampers and Combination Fire/Smoke Dampers	M	M	E	E
9	Airflow Stations with transmitter.	M	M	E	DDC

10	Air terminal devices (I.e., VAV and fan powered boxes).	M	M	E	DDC
11	Intelligent Devices and Control Units provided with packaged mechanical equipment such as: Large VAV and constant volume package units Boilers and Chillers.	M	M	E	NI
12	Intelligent Devices and Control Units not provided by equipment manufacturer such as: Air handling units, Heat pumps, AC units (small < 20 tons), Air terminal units (VAV boxes)	DDC	DDC	E	DDC
13	Intelligent Devices and Control Units provided with electrical systems such as: Occupancy / motion sensors, Lighting Control Panels, Switches and dimmers, Switch Multiplexing Control Units, Door Entry Control Units.	E	E	E	DDC
14	Gateways for proprietary non-BACnet equipment	M	M	E	DDC
15	Communications network devices such as Routers, Bridges and Repeaters.	DDC	DDC	DDC	DDC

Abbreviations

DD C	DDC CONTRACTOR (controls CONTRACTOR)
M	Mechanical CONTRACTOR
E	Electrical CONTRACTOR
N/A	Not Applicable

Notes:

1. Magnetic motor starters (special duty type) shall be set in place under electrical division except when part of factory wired equipment, in which case they shall be set in place under mechanical division.
2. Where a remote motor disconnect is required in addition to the one provided integral to a Variable Frequency Drive (VFD), controls CONTRACTOR shall provide the necessary control interlock between the disconnects.

SECTION 23 31 13
METAL DUCTS

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SUMMARY

A. Section Includes:

1. Single-wall round ducts and fittings.
2. Sheet metal materials.
3. Sealants and gaskets.
4. Hangers and supports.

B. Related Sections:

1. Division 23 Section "Testing, Adjusting, and Balancing for HVAC" for testing, adjusting, and balancing requirements for metal ducts.
2. Division 23 Section "Nonmetal Ducts" for fibrous-glass ducts, thermoset fiber-reinforced plastic ducts, thermoplastic ducts, PVC ducts, and concrete ducts.
3. Division 23 Section "HVAC Casings" for factory- and field-fabricated casings for mechanical equipment.
4. Division 23 Section "Air Duct Accessories" for dampers, sound-control devices, duct-mounting access doors and panels, turning vanes, and flexible ducts.

1.03 PERFORMANCE REQUIREMENTS

- A. Delegated Duct Design: Duct construction, including sheet metal thicknesses, seam and joint construction, reinforcements, and hangers and supports, shall comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" and performance requirements and design criteria indicated.

1. Static-Pressure Classes:

- a. Exhaust Ducts (Negative Pressure): 1-inch wg.

- B. Structural Performance: Duct hangers and supports and seismic restraints shall withstand the effects of gravity and seismic loads and stresses within limits and under conditions described in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" SMACNA's "Seismic Restraint Manual: Guidelines for Mechanical Systems."

1. Seismic Hazard Level A: Seismic force to weight ratio, 0.48.
2. Seismic Hazard Level B: Seismic force to weight ratio, 0.30.
3. Seismic Hazard Level C: Seismic force to weight ratio, 0.15.

1.04 SUBMITTALS

- A. Product Data: For each type of the following products:
 - 1. Sealants and gaskets.
- B. Shop Drawings:
 - 1. Fabrication, assembly, and installation, including plans, elevations, sections, components, and attachments to other work.
 - 2. Factory- and shop-fabricated ducts and fittings.
 - 3. Duct layout indicating sizes, configuration, liner material, and static-pressure classes.
 - 4. Elevation of top of ducts.
 - 5. Dimensions of main duct runs from building grid lines.
 - 6. Fittings.
 - 7. Reinforcement and spacing.
 - 8. Seam and joint construction.
 - 9. Equipment installation based on equipment being used on Project.
 - 10. Locations for duct accessories, including dampers, turning vanes, and access doors and panels.
 - 11. Hangers and supports, including methods for duct and building attachment, seismic restraints, and vibration isolation.
- C. Delegated-Design Submittal:
 - 1. Sheet metal thicknesses.
 - 2. Joint and seam construction and sealing.
 - 3. Reinforcement details and spacing.
 - 4. Materials, fabrication, assembly, and spacing of hangers and supports.
 - 5. Design Calculations: Calculations, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation for selecting hangers and supports and seismic restraints.
- D. Coordination Drawings: Plans, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of the items involved:
 - 1. Duct installation in congested spaces, indicating coordination with general construction, building components, and other building services. Indicate proposed changes to duct layout.
 - 2. Suspended ceiling components.

3. Structural members to which duct will be attached.
4. Size and location of initial access modules for acoustical tile.
5. Penetrations of smoke barriers and fire-rated construction.
6. Items penetrating finished ceiling including the following:
 - a. Lighting fixtures.
 - b. Air outlets and inlets.
 - c. Sprinklers.
 - d. Access panels.
 - e. Perimeter moldings.
- E. Welding certificates.
- F. Field quality-control reports.

1.05 QUALITY ASSURANCE

- A. Welding Qualifications: Qualify procedures and personnel according to AWS D9.1M/D9.1, "Sheet Metal Welding Code," for duct joint and seam welding.
- B. Welding Qualifications: Qualify procedures and personnel according to the following:
 1. AWS D1.1/D1.1M, "Structural Welding Code - Steel," for hangers and supports.
 2. AWS D1.2/D1.2M, "Structural Welding Code - Aluminum," for aluminum supports.
 3. AWS D9.1M/D9.1, "Sheet Metal Welding Code," for duct joint and seam welding.
- C. Mockups:
 1. Before installing duct systems, build mockups representing static-pressure classes in excess of 3-inch wg. Build mockups to comply with the following requirements, using materials indicated for the completed Work:
 - a. Five transverse joints.
 - b. One access door(s).
 - c. Two typical branch connections, each with at least one elbow.
 - d. Perform leakage tests specified in "Field Quality Control" Article. Revise mockup construction and perform additional tests as required to achieve specified minimum acceptable results.
 2. Approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

PART 2 - PRODUCTS

2.01 SINGLE-WALL ROUND DUCTS AND FITTINGS

- A. General Fabrication Requirements: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Chapter 3, "Round, Oval, and Flexible Duct," based on indicated static-pressure class unless otherwise indicated.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following
 - a. Lindab Inc.
 - b. McGill AirFlow LLC.
 - c. SEMCO Incorporated.
 - d. Sheet Metal Connectors, Inc.
 - e. Spiral Manufacturing Co., Inc.
 - f. Or Equal.
- B. Flat-Oval Ducts: Indicated dimensions are the duct width (major dimension) and diameter (diameter of the round sides connecting the flat portions of the duct).
- C. Transverse Joints: Select joint types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-2, "Transverse Joints - Round Duct," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."
1. Transverse Joints in Ducts Larger Than 60 Inches in Diameter: Flanged.
- D. Longitudinal Seams: Select seam types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-1, "Seams - Round Duct and Fittings," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."
1. Fabricate round ducts larger than 90 inches in diameter with butt-welded longitudinal seams.
 2. Fabricate flat-oval ducts larger than 72 inches in width (major dimension) with butt-welded longitudinal seams.
- E. Tees and Laterals: Select types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-4, "90 Degree Tees and Laterals," and Figure 3-5, "Conical Tees," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

2.02 SHEET METAL MATERIALS

Note: All roof mounted ducts to be 22 gage.

- A. General Material Requirements: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" for acceptable materials, material thicknesses, and

duct construction methods unless otherwise indicated. Sheet metal materials shall be free of pitting, seam marks, roller marks, stains, discolorations, and other imperfections.

- B. Stainless-Steel Sheets: Comply with ASTM A 480/A 480M, Type 304 or 316, as indicated in the "Duct Schedule" Article; cold rolled, annealed, sheet. Exposed surface finish shall be No. 2B, No. 2D, No. 3, or No. 4 as indicated in the "Duct Schedule" Article.
- C. Aluminum Sheets: Comply with ASTM B 209 Alloy 3003, H14 temper; with mill finish for concealed ducts, and standard, one-side bright finish for duct surfaces exposed to view.
- D. Factory- or Shop-Applied Antimicrobial Coating:
 - 1. Apply to the surface of sheet metal that will form the interior surface of the duct. An untreated clear coating shall be applied to the exterior surface.
 - 2. Antimicrobial compound shall be tested for efficacy by an NRTL and registered by the EPA for use in HVAC systems.
 - 3. Coating containing the antimicrobial compound shall have a hardness of 2H, minimum, when tested according to ASTM D 3363.
 - 4. Surface-Burning Characteristics: Maximum flame-spread index of 25 and maximum smoke-developed index of 50 when tested according to UL 723; certified by an NRTL.
 - 5. Shop-Applied Coating Color: Black.
 - 6. Antimicrobial coating on sheet metal is not required for duct containing liner treated with antimicrobial coating.
- E. Reinforcement Shapes and Plates: ASTM A 36/A 36M, steel plates, shapes, and bars; black and galvanized.
 - 1. Where black- and galvanized-steel shapes and plates are used to reinforce aluminum ducts, isolate the different metals with butyl rubber, neoprene, or EPDM gasket materials.
- F. Tie Rods: Galvanized steel, 1/4-inch minimum diameter for lengths 36 inches or less; 3/8-inch minimum diameter for lengths longer than 36 inches.

2.03 SEALANT AND GASKETS

- A. General Sealant and Gasket Requirements: Surface-burning characteristics for sealants and gaskets shall be a maximum flame-spread index of 25 and a maximum smoke-developed index of 50 when tested according to UL 723; certified by an NRTL.
- B. Two-Part Tape Sealing System:
 - 1. Tape: Woven cotton fiber impregnated with mineral gypsum and modified acrylic/silicone activator to react exothermically with tape to form hard, durable, airtight seal.
 - 2. Tape Width: 6 inches.

3. Sealant: Modified styrene acrylic.
4. Water resistant.
5. Mold and mildew resistant.
6. Maximum Static-Pressure Class: 10-inch wg, positive and negative.
7. Service: Indoor and outdoor.
8. Service Temperature: Minus 40 to plus 200 deg F.
9. Substrate: Compatible with galvanized sheet steel (both PVC coated and bare), stainless steel, or aluminum.

C. Water-Based Joint and Seam Sealant:

1. Application Method: Brush on.
2. Solids Content: Minimum 65 percent.
3. Shore A Hardness: Minimum 20.
4. Water resistant.
5. Mold and mildew resistant.
6. VOC: Maximum 75 g/L (less water).
7. Maximum Static-Pressure Class: 10-inch wg, positive and negative.
8. Service: Indoor or outdoor.
9. Substrate: Compatible with galvanized sheet steel (both PVC coated and bare), stainless steel, or aluminum sheets.

D. Solvent-Based Joint and Seam Sealant:

1. Application Method: Brush on.
2. Base: Synthetic rubber resin.
3. Solvent: Toluene and heptane.
4. Solids Content: Minimum 60 percent.
5. Shore A Hardness: Minimum 60.
6. Water resistant.
7. Mold and mildew resistant.
8. VOC: Maximum 395 g/L.
9. Maximum Static-Pressure Class: 10-inch wg, positive or negative.
10. Service: Indoor or outdoor.

11. Substrate: Compatible with galvanized sheet steel (both PVC coated and bare), stainless steel, or aluminum sheets.
- E. Flanged Joint Sealant: Comply with ASTM C 920.
 1. General: Single-component, acid-curing, silicone, elastomeric.
 2. Type: S.
 3. Grade: NS.
 4. Class: 25.
 5. Use: O.
 - F. Flange Gaskets: Butyl rubber, neoprene, or EPDM polymer with polyisobutylene plasticizer.
 - G. Round Duct Joint O-Ring Seals:
 1. Seal shall provide maximum leakage class of 3 cfm/100 sq. ft. at 1-inch wg and shall be rated for 10-inch wg static-pressure class, positive or negative.
 2. EPDM O-ring to seal in concave bead in coupling or fitting spigot.
 3. Double-lipped, EPDM O-ring seal, mechanically fastened to factory-fabricated couplings and fitting spigots.

2.04 HANGERS AND SUPPORTS

- A. Hanger Rods for Noncorrosive Environments: Cadmium-plated steel rods and nuts.
- B. Hanger Rods for Corrosive Environments: Electrogalvanized, all-thread rods or galvanized rods with threads painted with zinc-chromate primer after installation.
- C. Strap and Rod Sizes: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Table 4-1, "Rectangular Duct Hangers Minimum Size," and Table 4-2, "Minimum Hanger Sizes for Round Duct."
- D. Steel Cables for Galvanized-Steel Ducts: Galvanized steel complying with ASTM A 603.
- E. Steel Cables for Stainless-Steel Ducts: Stainless steel complying with ASTM A 492.
- F. Steel Cable End Connections: Cadmium-plated steel assemblies with brackets, swivel, and bolts designed for duct hanger service; with an automatic-locking and clamping device.
- G. Duct Attachments: Sheet metal screws, blind rivets, or self-tapping metal screws; compatible with duct materials.
- H. Trapeze and Riser Supports:
 1. Supports for Galvanized-Steel Ducts: Galvanized-steel shapes and plates.
 2. Supports for Stainless-Steel Ducts: Stainless-steel shapes and plates.

3. Supports for Aluminum Ducts: Aluminum or galvanized steel coated with zinc chromate.

2.05 SEISMIC-RESTRAINT DEVICES

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 1. Cooper B-Line, Inc.; a division of Cooper Industries.
 2. Ductmate Industries, Inc.
 3. Hilti Corp.
 4. Kinetics Noise Control.
 5. Loos & Co.; Cableware Division.
 6. Mason Industries.
 7. TOLCO; a brand of NIBCO INC.
 8. Unistrut Corporation; Tyco International, Ltd.
 9. Or Equal.
- B. General Requirements for Restraint Components: Rated strengths, features, and applications shall be as defined in reports by an agency acceptable to authorities having jurisdiction.
 1. Structural Safety Factor: Allowable strength in tension, shear, and pullout force of components shall be at least four times the maximum seismic forces to which they will be subjected.
- C. Channel Support System: Shop- or field-fabricated support assembly made of slotted steel channels rated in tension, compression, and torsion forces and with accessories for attachment to braced component at one end and to building structure at the other end. Include matching components and corrosion-resistant coating.
- D. Restraint Cables: ASTM A 603, galvanized-steel cables with end connections made of cadmium-plated steel assemblies with brackets, swivel, and bolts designed for restraining cable service; and with an automatic-locking and clamping device or double-cable clips.
- E. Hanger Rod Stiffener: Reinforcing steel angle clamped to hanger rod.
- F. Mechanical Anchor Bolts: Drilled-in and stud-wedge or female-wedge type. Select anchor bolts with strength required for anchor and as tested according to ASTM E 488.

PART 3 - EXECUTION

3.01 DUCT INSTALLATION

- A. Drawing plans, schematics, and diagrams indicate general location and arrangement of duct system. Indicated duct locations, configurations, and arrangements were used to size ducts and calculate friction loss for air-handling equipment sizing and for

other design considerations. Install duct systems as indicated unless deviations to layout are approved on Shop Drawings and Coordination Drawings.

- B. Install ducts according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" unless otherwise indicated.
- C. Install round ducts in maximum practical lengths.
- D. Install ducts with fewest possible joints.
- E. Install factory- or shop-fabricated fittings for changes in direction, size, and shape and for branch connections.
- F. Unless otherwise indicated, install ducts vertically and horizontally, and parallel and perpendicular to building lines.
- G. Install ducts close to walls, overhead construction, columns, and other structural and permanent enclosure elements of building.
- H. Install ducts with a clearance of 1 inch, plus allowance for insulation thickness.
- I. Route ducts to avoid passing through transformer vaults and electrical equipment rooms and enclosures.
- J. Where ducts pass through non-fire-rated interior partitions and exterior walls and are exposed to view, cover the opening between the partition and duct or duct insulation with sheet metal flanges of same metal thickness as the duct. Overlap openings on four sides by at least 1-1/2 inches.
- K. Where ducts pass through fire-rated interior partitions and exterior walls, install fire dampers. Comply with requirements in Division 23 Section "Air Duct Accessories" for fire and smoke dampers.
- L. Protect duct interiors from moisture, construction debris and dust, and other foreign materials. Comply with SMACNA's "Duct Cleanliness for New Construction Guidelines."

3.02 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.

3.03 SEAM AND JOINT SEALING

- A. Seal duct seams and joints for duct static-pressure and leakage classes specified in "Performance Requirements" Article, according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Table 1-2, "Standard Duct Sealing Requirements," unless otherwise indicated.
 - 1. For static-pressure classes 1- and 1/2-inch wg, comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Seal Class C, except as follows:
 - a. Systems for residential occupancy.
 - b. Ducts that are located directly in zones they serve.

- B. Seal Classes: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Table 1-2, "Standard Duct Sealing Requirements."
 - 1. For static-pressure classes 1- and 1/2-inch wg, comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Seal Class C, except as follows:
 - a. Systems for residential occupancy.
 - b. Ducts that are located directly in zones they serve.

3.04 HANGER AND SUPPORT INSTALLATION

- A. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Chapter 4, "Hangers and Supports."
- B. Building Attachments: Concrete inserts, powder-actuated fasteners, or structural-steel fasteners appropriate for construction materials to which hangers are being attached.
 - 1. Where practical, install concrete inserts before placing concrete.
 - 2. Install powder-actuated concrete fasteners after concrete is placed and completely cured.
 - 3. Use powder-actuated concrete fasteners for standard-weight aggregate concretes or for slabs more than 4 inches thick.
 - 4. Do not use powder-actuated concrete fasteners for lightweight-aggregate concretes or for slabs less than 4 inches thick.
 - 5. Do not use powder-actuated concrete fasteners for seismic restraints.
- C. Hanger Spacing: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Table 4-1, "Rectangular Duct Hangers Minimum Size," and Table 4-2, "Minimum Hanger Sizes for Round Duct," for maximum hanger spacing; install hangers and supports within 24 inches of each elbow and within 48 inches of each branch intersection.
- D. Hangers Exposed to View: Threaded rod and angle or channel supports.
- E. Support vertical ducts with steel angles or channel secured to the sides of the duct with welds, bolts, sheet metal screws, or blind rivets; support at each floor and at a maximum intervals of 16 feet.
- F. Install upper attachments to structures. Select and size upper attachments with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.

3.05 SEISMIC-RESTRAINT-DEVICE INSTALLATION

- A. Install ducts with hangers and braces designed to support the duct and to restrain against seismic forces required by applicable building codes. Comply with SMACNA's "Seismic Restraint Manual: Guidelines for Mechanical Systems."
 - 1. Space lateral supports a maximum of 40 feet o.c., and longitudinal supports a maximum of 80 feet o.c.

2. Brace a change of direction longer than 12 feet.
- B. Select seismic-restraint devices with capacities adequate to carry present and future static and seismic loads.
 - C. Install cables so they do not bend across edges of adjacent equipment or building structure.
 - D. Install cable restraints on ducts that are suspended with vibration isolators.
 - E. Install seismic-restraint devices using methods approved by an agency acceptable to authorities having jurisdiction.
 - F. Attachment to Structure: If specific attachment is not indicated, anchor bracing and restraints to structure, to flanges of beams, to upper truss chords of bar joists, or to concrete members.
 - G. Drilling for and Setting Anchors:
 1. Identify position of reinforcing steel and other embedded items prior to drilling holes for anchors. Do not damage existing reinforcement or embedded items during drilling. Notify the Architect if reinforcing steel or other embedded items are encountered during drilling. Locate and avoid prestressed tendons, electrical and telecommunications conduit, and gas lines.
 2. Do not drill holes in concrete or masonry until concrete, mortar, or grout has achieved full design strength.
 3. Wedge Anchors: Protect threads from damage during anchor installation. Heavy-duty sleeve anchors shall be installed with sleeve fully engaged in the structural element to which anchor is to be fastened.
 4. Set anchors to manufacturer's recommended torque, using a torque wrench.
 5. Install zinc-coated steel anchors for interior applications and stainless-steel anchors for applications exposed to weather.

3.06 CONNECTIONS

- A. Make connections to equipment with flexible connectors complying with Division 23 Section "Air Duct Accessories."
- B. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" for branch, outlet and inlet, and terminal unit connections.

3.07 PAINTING

- A. Paint interior of metal ducts that are visible through registers and grilles and that do not have duct liner. Apply one coat of flat, black, latex paint over a compatible galvanized-steel primer. Paint materials and application requirements are specified in Division 09 painting Sections.

3.08 FIELD QUALITY CONTROL

- A. Perform tests and inspections.
- B. Leakage Tests:

1. Comply with SMACNA's "HVAC Air Duct Leakage Test Manual."
 2. Test the following systems:
 - a. Exhaust air.
 3. Disassemble, reassemble, and seal segments of systems to accommodate leakage testing and for compliance with test requirements.
 4. Test for leaks before insulation application.
 5. Conduct tests at static pressures equal to maximum design pressure of system or section being tested. If static-pressure classes are not indicated, test entire system at maximum system design pressure. Do not pressurize systems above maximum design operating pressure. Give seven days' advance notice for testing.
- C. Duct System Cleanliness Tests:
1. Visually inspect duct system to ensure that no visible contaminants are present.
 2. Test sections of metal duct system, chosen randomly by Owner, for cleanliness according to "Vacuum Test" in NADCA ACR, "Assessment, Cleaning and Restoration of HVAC Systems."
 - a. Acceptable Cleanliness Level: Net weight of debris collected on the filter media shall not exceed 0.75 mg/100 sq. cm.
- D. Duct system will be considered defective if it does not pass tests and inspections.
- E. Prepare test and inspection reports.

3.09 DUCT CLEANING

- A. Clean new and existing duct system(s) before testing, adjusting, and balancing.
- B. Use service openings for entry and inspection.
 1. Create new openings and install access panels appropriate for duct static-pressure class if required for cleaning access. Provide insulated panels for insulated or lined duct. Patch insulation and liner as recommended by duct liner manufacturer. Comply with Division 23 Section "Air Duct Accessories" for access panels and doors.
 2. Disconnect and reconnect flexible ducts as needed for cleaning and inspection.
 3. Remove and reinstall ceiling to gain access during the cleaning process.
- C. Particulate Collection and Odor Control:
 1. When venting vacuuming system inside the building, use HEPA filtration with 99.97 percent collection efficiency for 0.3-micron-size (or larger) particles.
 2. When venting vacuuming system to outdoors, use filter to collect debris removed from HVAC system, and locate exhaust downwind and away from air intakes and other points of entry into building.

- D. Clean the following components by removing surface contaminants and deposits:
1. Air outlets and inlets (registers, grilles, and diffusers).
 2. Supply, return, and exhaust fans including fan housings, plenums (except ceiling supply and return plenums), scrolls, blades or vanes, shafts, baffles, dampers, and drive assemblies.
 3. Coils and related components.
 4. Return-air ducts, dampers, actuators, and turning vanes except in ceiling plenums and mechanical equipment rooms.
 5. Supply-air ducts, dampers, actuators, and turning vanes.
 6. Dedicated exhaust and ventilation components and makeup air systems.
- E. Mechanical Cleaning Methodology:
1. Clean metal duct systems using mechanical cleaning methods that extract contaminants from within duct systems and remove contaminants from building.
 2. Use vacuum-collection devices that are operated continuously during cleaning. Connect vacuum device to downstream end of duct sections so areas being cleaned are under negative pressure.
 3. Use mechanical agitation to dislodge debris adhered to interior duct surfaces without damaging integrity of metal ducts, duct liner, or duct accessories.
 4. Clean fibrous-glass duct liner with HEPA vacuuming equipment; do not permit duct liner to get wet. Replace fibrous-glass duct liner that is damaged, deteriorated, or delaminated or that has friable material, mold, or fungus growth.
 5. Clean coils and coil drain pans according to NADCA 1992. Keep drain pan operational. Rinse coils with clean water to remove latent residues and cleaning materials; comb and straighten fins.
 6. Provide drainage and cleanup for wash-down procedures.
 7. Antimicrobial Agents and Coatings: Apply EPA-registered antimicrobial agents if fungus is present. Apply antimicrobial agents according to manufacturer's written instructions after removal of surface deposits and debris.

3.10 DUCT SCHEDULE

- A. Fabricate ducts with galvanized sheet steel except as follows:
1. Moist Environment Ducts: Aluminum.
- B. Intermediate Reinforcement:
1. Galvanized-Steel Ducts: Galvanized steel.
 2. Stainless-Steel Ducts: Galvanized steel.

3. Aluminum Ducts: Aluminum or galvanized sheet steel coated with zinc chromate.
- C. Elbow Configuration:
1. Round Duct: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-3, "Round Duct Elbows."
 - a. Minimum Radius-to-Diameter Ratio and Elbow Segments: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Table 3-1, "Mitered Elbows." Elbows with less than 90-degree change of direction have proportionately fewer segments.
 1. Velocity 1000 fpm or Lower: 0.5 radius-to-diameter ratio and three segments for 90-degree elbow.
 2. Velocity 1000 to 1500 fpm: 1.0 radius-to-diameter ratio and four segments for 90-degree elbow.
 3. Velocity 1500 fpm or Higher: 1.5 radius-to-diameter ratio and five segments for 90-degree elbow.
 - b. Round Elbows, 12 Inches and Smaller in Diameter: Stamped or pleated.
- D. Branch Configuration:
1. Round and Flat Oval: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-4, "90 Degree Tees and Laterals," and Figure 3-5, "Conical Tees." Saddle taps are permitted in existing duct.
 - a. Velocity 1000 fpm or Lower: 90-degree tap.
 - b. Velocity 1000 to 1500 fpm: Conical tap.
 - c. Velocity 1500 fpm or Higher: 45-degree lateral.

END OF SECTION

**SECTION 23 33 00
AIR DUCT ACCESSORIES**

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SUMMARY

A. Section Includes:

1. Backdraft dampers.
2. Flange connectors.
3. Duct accessory hardware.

B. Related Sections:

1. Division 23 Section "HVAC Gravity Ventilators" for roof-mounted ventilator caps.

1.03 SUBMITTALS

A. Product Data: For each type of product indicated.

1. For duct silencers, include pressure drop and dynamic insertion loss data. Include breakout noise calculations for high transmission loss casings.

B. Shop Drawings: For duct accessories. Include plans, elevations, sections, details and attachments to other work.

1. Detail duct accessories fabrication and installation in ducts and other construction. Include dimensions, weights, loads, and required clearances; and method of field assembly into duct systems and other construction. Include the following:

- a. Special fittings.
- b. Wiring Diagrams: For power, signal, and control wiring.

C. Coordination Drawings: Reflected ceiling plans, drawn to scale, on which ceiling-mounted access panels and access doors required for access to duct accessories are shown and coordinated with each other, using input from Installers of the items involved.

D. Source quality-control reports.

E. Operation and Maintenance Data: For air duct accessories to include in operation and maintenance manuals.

1.04 QUALITY ASSURANCE

- A. Comply with NFPA 90A, "Installation of Air Conditioning and Ventilating Systems," and with NFPA 90B, "Installation of Warm Air Heating and Air Conditioning Systems."

- B. Comply with AMCA 500-D testing for damper rating.

PART 2 - PRODUCTS

2.01 MATERIALS

- A. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" for acceptable materials, material thicknesses, and duct construction methods unless otherwise indicated. Sheet metal materials shall be free of pitting, seam marks, roller marks, stains, discolorations, and other imperfections.
- B. Aluminum Sheets: Comply with ASTM B 209, Alloy 3003, Temper H14; with mill finish for concealed ducts and standard, 1-side bright finish for exposed ducts.
- C. Extruded Aluminum: Comply with ASTM B 221, Alloy 6063, Temper T6.
- D. Reinforcement Shapes and Plates: Galvanized-steel reinforcement where installed on galvanized sheet metal ducts; compatible materials for aluminum and stainless-steel ducts.
- E. Tie Rods: Galvanized steel, 1/4-inch minimum diameter for lengths 36 inches or less; 3/8-inch minimum diameter for lengths longer than 36 inches.

2.02 BACKDRAFT AND PRESSURE RELIEF DAMPERS

- A. Backdraft dampers shall be installed at locations indicated in accordance with the State of California Building Energy Efficiency Standards, Title 24, CCR.

Manufacturers: Subject to compliance with requirements, provide products by one of the following:

- 1. Pottorff
 - 2. Ruskin
 - 3. Or equal
- B. 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.

2.03 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.

2.04 DUCT-MOUNTED ACCESS DOORS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 1. American Warming and Ventilating; a division of Mestek, Inc.
 2. Cesco Products; a division of Mestek, Inc.
 3. Ductmate Industries, Inc.
 4. Flexmaster U.S.A., Inc.

5. Greenheck Fan Corporation.
 6. McGill AirFlow LLC.
 7. Nailor Industries Inc.
 8. Pottorff; a division of PCI Industries, Inc.
 9. Ventfabrics, Inc.
 10. Ward Industries, Inc.; a division of Hart & Cooley, Inc.
- B. Duct-Mounted Access Doors: Fabricate access panels according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible"; Figures 2-10, "Duct Access Doors and Panels," and 2-11, "Access Panels - Round Duct."
1. Door:
 - a. Double wall, rectangular.
 - b. Galvanized sheet metal with insulation fill and thickness as indicated for duct pressure class.
 - c. Vision panel.
 - d. Hinges and Latches: 1-by-1-inch butt or piano hinge and cam latches.
 - e. Fabricate doors airtight and suitable for duct pressure class.
 2. Frame: Galvanized sheet steel, with bend-over tabs and foam gaskets.
 3. Number of Hinges and Locks:
 - a. Access Doors Less Than 12 Inches Square: No hinges and two sash locks.
 - b. Access Doors up to 18 Inches Square: Two hinges and two sash locks.
 - c. Access Doors up to 24 by 48 Inches: Three hinges and two compression latches with outside and inside handles.
 - d. Access Doors Larger Than 24 by 48 Inches: Four hinges and two compression latches with outside and inside handles.
- C. Pressure Relief Access Door:
1. Door and Frame Material: Galvanized sheet steel.
 2. Door: Double wall with insulation fill with metal thickness applicable for duct pressure class.
 3. Operation: Open outward for positive-pressure ducts and inward for negative-pressure ducts.
 4. Factory set at 10-inch wg.

5. Doors close when pressures are within set-point range.
6. Hinge: Continuous piano.
7. Latches: Cam.
8. Seal: Neoprene or foam rubber.
9. Insulation Fill: 1-inch- thick, fibrous-glass or polystyrene-foam board.

2.05 DUCT ACCESS PANEL ASSEMBLIES

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 1. Ductmate Industries, Inc.
 2. Flame Gard, Inc.
 3. 3M.
- B. Labeled according to UL 1978 by an NRTL.
- C. Panel and Frame: Minimum thickness 0.0428-inch stainless steel.
- D. Fasteners: Stainless steel. Panel fasteners shall not penetrate duct wall.
- E. Gasket: Comply with NFPA 96; grease-tight, high-temperature ceramic fiber, rated for minimum 2000 deg F.
- F. Minimum Pressure Rating: 10-inch wg, positive or negative.

2.06 FLEXIBLE CONNECTORS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 1. Ductmate Industries, Inc.
 2. Duro Dyne Inc.
 3. Ventfabrics, Inc.
 4. Ward Industries, Inc.; a division of Hart & Cooley, Inc.
- B. Materials: Flame-retardant or noncombustible fabrics.
- C. Coatings and Adhesives: Comply with UL 181, Class 1.
- D. Metal-Edged Connectors: Factory fabricated with a fabric strip 5-3/4 inches wide attached to 2 strips of 2-3/4-inch- wide, 0.028-inch- thick, galvanized sheet steel or 0.032-inch- thick aluminum sheets. Provide metal compatible with connected ducts.
- E. Indoor System, Flexible Connector Fabric: Glass fabric double coated with neoprene.

1. Minimum Weight: 26 oz./sq. yd..
 2. Tensile Strength: 480 lbf/inch in the warp and 360 lbf/inch in the filling.
 3. Service Temperature: Minus 40 to plus 200 deg F.
- F. Thrust Limits: Combination coil spring and elastomeric insert with spring and insert in compression, and with a load stop. Include rod and angle-iron brackets for attaching to fan discharge and duct.
1. Frame: Steel, fabricated for connection to threaded rods and to allow for a maximum of 30 degrees of angular rod misalignment without binding or reducing isolation efficiency.
 2. Outdoor Spring Diameter: Not less than 80 percent of the compressed height of the spring at rated load.
 3. Minimum Additional Travel: 50 percent of the required deflection at rated load.
 4. Lateral Stiffness: More than 80 percent of rated vertical stiffness.
 5. Overload Capacity: Support 200 percent of rated load, fully compressed, without deformation or failure.
 6. Elastomeric Element: Molded, oil-resistant rubber or neoprene.
 7. Coil Spring: Factory set and field adjustable for a maximum of 1/4-inch movement at start and stop.

2.07 DUCT ACCESSORY HARDWARE

- A. Instrument Test Holes: Cast iron or cast aluminum to suit duct material, including screw cap and gasket. Size to allow insertion of pitot tube and other testing instruments and of length to suit duct-insulation thickness.
- B. Adhesives: High strength, quick setting, neoprene based, waterproof, and resistant to gasoline and grease.

PART 3 - EXECUTION

3.01 INSTALLATION

- A. Install duct accessories according to applicable details in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" for metal ducts and in NAIMA AH116, "Fibrous Glass Duct Construction Standards," for fibrous-glass ducts.
- B. Install duct accessories of materials suited to duct materials; use galvanized-steel accessories in galvanized-steel and fibrous-glass ducts, stainless-steel accessories in stainless-steel ducts, and aluminum accessories in aluminum ducts.
- C. Install backdraft dampers at inlet of exhaust fans or exhaust ducts as close as possible to exhaust fan unless otherwise indicated.
- D. Set dampers to fully open position before testing, adjusting, and balancing.

- E. Install test holes at fan inlets and outlets and elsewhere as indicated.
- F. Install duct access doors on sides of ducts to allow for inspecting, adjusting, and maintaining accessories and equipment at the following locations:
 - 1. On both sides of duct coils.
 - 2. Downstream from manual volume dampers, control dampers, and equipment.
 - 3. Adjacent to and close enough to fire or smoke dampers, to reset or reinstall fusible links. Access doors for access to fire or smoke dampers having fusible links shall be pressure relief access doors and shall be outward operation for access doors installed upstream from dampers and inward operation for access doors installed downstream from dampers.
 - 4. At each change in direction and at maximum 50-foot spacing.
 - 5. Upstream of turning vanes.
 - 6. Elsewhere as indicated.
- G. Install access doors with swing against duct static pressure.
- H. Access Door Sizes:
 - 1. One-Hand or Inspection Access: 8 by 5 inches.
 - 2. Two-Hand Access: 12 by 6 inches.
 - 3. Head and Hand Access: 18 by 10 inches.
 - 4. Head and Shoulders Access: 21 by 14 inches.
 - 5. Body Access: 25 by 14 inches.
 - 6. Body plus Ladder Access: 25 by 17 inches.
- I. Label access doors according to Division 23 Section "Identification for HVAC Piping and Equipment" to indicate the purpose of access door.
- J. Install flexible connectors to connect ducts to equipment.
- K. For fans developing static pressures of 5-inch wg and more, cover flexible connectors with loaded vinyl sheet held in place with metal straps.
- L. Install duct test holes where required for testing and balancing purposes.
- M. Install thrust limits at centerline of thrust, symmetrical on both sides of equipment. Attach thrust limits at centerline of thrust and adjust to a maximum of 1/4-inch movement during start and stop of fans.

3.02 FIELD QUALITY CONTROL

- A. Tests and Inspections:
 - 1. Operate dampers to verify full range of movement.

2. Inspect locations of access doors and verify that purpose of access door can be performed.
3. Operate fire, smoke, and combination fire and smoke dampers to verify full range of movement and verify that proper heat-response device is installed.
4. Inspect turning vanes for proper and secure installation.
5. Operate remote damper operators to verify full range of movement of operator and damper.

END OF SECTION

**SECTION 23 33 01
AIR DUCT SILENCERS**

PART 1 - GENERAL

- 1.01 Basis-of-Design Product: Silencers shall be Vibro-Acoustics or approved equal.
- 1.02 Alternate manufacturers must request and obtain written approval by the Engineer to bid the project at least 10 day prior to the bid due-date. As a condition of pre-approval, alternate manufacturers must submit to the Engineer a minimum of twenty (20) different HVAC silencer test reports. Each report shall be for a silencer tested in full accordance with the ASTM E-477-13 silencer test standard in an aero-acoustic test facility which is NVLAP accredited for the ASTM E477-13 standard. Each test shall have been conducted within the last 12 month period. A copy of the laboratory's NVLAP accreditation certificate must be included with the submitted reports. Any changes to the specifications must be submitted and approved in writing by the Engineer at least 10 days prior to the bid due-date.
- 1.03 If products other than those of the basis of design manufacturer are supplied on the project, the **purchasing contractor** assumes full performance, project schedule and monetary responsibility for meeting the project noise criteria, including any retrofit work that may be required

1.04 SUBMITTALS

A. Performance Data:

1. Silencer manufacturer to provide submittal drawings detailing all duct silencer data specified in the mechanical drawing schedule.
2. The silencer manufacturer shall provide, for approval, acoustical system calculations for all duct systems with silencers to demonstrate that the submitted silencers will reduce mechanical fan noise to following NC-Levels in the occupied space. Use sound power levels of actual equipment to be installed on project. Analysis shall include breakout noise calculations.
3. Supplier shall be responsible for the overall system pressure loss of the installation based on duct conditions upstream and downstream of the silencer to ensure required airflow is provided. Supplier shall submit detailed pressure drop analysis for the installation and detailed procedure outlining methodology for site measurement of overall system pressure loss for approval prior to manufacture.
 - a. Silencer internal design will provide ideal pressure drop value as scheduled
 - b. Installed pressure drop including system effect is maintained at maximum as scheduled.
2. Acoustical and pressure drop calculations must be supplied with PE/P.Eng stamp at the time of submittal

B. Source quality-control reports:

1. Silencer manufacturer to provide a copy of their laboratory NVLAP accreditation certificate for the ASTM E-477-06a test standard with the submittals. Data from non-NVLAP accredited test facilities will not be accepted.

PART 2 - PRODUCTS

2.01 DUCT SILENCERS

A. General Requirements:

1. Silencers shall be of the size, configuration, capacity and acoustic performance as scheduled on the drawings. All silencers shall be factory fabricated and supplied by the same manufacturer. Provide with non-fibrous materials.
2. Transitions on inlet and outlet will not be accepted. Silencers shall fit the ducting system they are installed in without requiring duct fittings/transitions. Silencer inlet and outlet must match duct dimensions. See contract documents for silencer configuration. Non-basis of design suppliers must submit details of internal geometry of silencers to be supplied.
3. Silencer inlet and outlet connection dimensions must be equal to the duct sizes shown on the drawings. Duct transitions at silencers are not permitted unless shown on the contract drawings.
4. Silencers shall be constructed in accordance with ASHRAE and SMACNA standards for the pressure and velocity classification specified for the air distribution system in which it is installed. Material gauges noted in other sections are minimums. Material gauges shall be increased as required for the system pressure and velocity classification. The silencers shall not fail structurally when subjected to a differential air pressure of 8 inches water gauge.
5. All casing seams and joints shall be lock-formed and sealed or stitch welded and sealed except as noted in Section G below, to provide leakage-resistant construction. Airtight construction shall be achieved by use of a duct-sealing compound supplied and installed by the contractor at the jobsite.
6. All perforated steel shall be adequately stiffened to insure flatness and form.
7. Fire-Performance Characteristics: Silencer assemblies, sealants, and acoustical spacer, shall have flame-spread index not exceeding 25 and smoke-developed index not exceeding 50 when tested according to ASTM E 84, NFPA 255 or UL 723.
8. Airstream Surfaces: Surfaces in contact with the airstream shall comply with requirements in ASHRAE 62.1-2007.

- B. Rectangular Silencers including models RD, RED: Outer casing shall be ASTM A 653/A 653M, G90 galvanized sheet steel, Gauge 22 and Gauge 18 respectively. Inner perforated metal liner: ASTM A 653/A 653M, G90 galvanized sheet steel, Gauge 26 and Gauge 22

C. Principal Sound-Absorbing Mechanism:

1. Dissipative silencers:
 - a. Models RD, RED: type with acoustic media. Media shall be of acoustic quality, shot-free glass fiber insulation with long, resilient fibers bonded with a thermosetting resin. Glass fiber density and compression shall be as required to insure conformance with laboratory test data. Glass fiber shall be packed with a minimum of 15% compression during silencer assembly. Media shall be resilient such that it will not crumble or break, and conform to irregular surfaces. Media

shall not cause or accelerate corrosion of aluminum or steel. Mineral wool will not be permitted as a substitute for glass fiber.

- D. HTL Casings: Where indicated on the silencer schedule, silencers shall have high transmission loss (HTL) walls externally applied and completely sealed to the silencer casing by the silencer manufacturer to assure quality controlled transmission loss. The HTL walls shall consist of media, airspace, mass and outer protective metal skin, as required, to obtain the specified room noise criteria. Standard acoustical panels will not be accepted as HTL walls. If requested by the Engineer, break-out noise calculations for each air handling and fan system shall be provided with the silencer submittal to insure compliance with the room noise criteria. Break-out noise calculations shall be based on the sound power levels of the specified equipment.

PART 3 - EXECUTION

3.01 INSTALLATION

- A. Install silencer according to manufacturer's written installation instructions.

END OF SECTION

SECTION 23 34 23
HVAC POWER VENTILATORS

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SUMMARY

A. This Section includes the following

1. Ceiling-mounting ventilators.

1.03 PERFORMANCE REQUIREMENTS

A. Project Altitude: Base fan-performance ratings on sea level.

B. Operating Limits: Classify according to AMCA 99.

1.04 SUBMITTALS

A. Product Data: Include rated capacities, furnished specialties, and accessories for each type of product indicated and include the following:

1. Certified fan performance curves with system operating conditions indicated.
2. Certified fan sound-power ratings.
3. Motor ratings and electrical characteristics, plus motor and electrical accessories.
4. Material thickness and finishes, including color charts.
5. Dampers, including housings, linkages, and operators.
6. Roof curbs.
7. Fan speed controllers.

B. Shop Drawings: Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.

1. Wiring Diagrams: Power, signal, and control wiring.
2. Design Calculations: Calculate requirements for selecting vibration isolators and seismic restraints and for designing vibration isolation bases.
3. Vibration Isolation Base Details: Detail fabrication, including anchorages and attachments to structure and to supported equipment. Include auxiliary motor slides and rails, and base weights.

- C. Coordination Drawings: Reflected ceiling plans and other details, drawn to scale, on which the following items are shown and coordinated with each other, based on input from installers of the items involved:
 - 1. Roof framing and support members relative to duct penetrations.
 - 2. Ceiling suspension assembly members.
 - 3. Size and location of initial access modules for acoustical tile.
 - 4. Ceiling-mounted items including light fixtures, diffusers, grilles, speakers, sprinklers, access panels, and special moldings.
- D. Field quality-control test reports.
- E. Operation and Maintenance Data: For power ventilators to include in emergency, operation, and maintenance manuals.

1.05 QUALITY ASSURANCE

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
- B. AMCA Compliance: Products shall comply with performance requirements and shall be licensed to use the AMCA-Certified Ratings Seal.
- C. NEMA Compliance: Motors and electrical accessories shall comply with NEMA standards.
- D. UL Standard: Power ventilators shall comply with UL 705.

1.06 DELIVERY, STORAGE, AND HANDLING

- A. Deliver fans as factory-assembled unit, to the extent allowable by shipping limitations, with protective crating and covering.
- B. Disassemble and reassemble units, as required for moving to final location, according to manufacturer's written instructions.
- C. Lift and support units with manufacturer's designated lifting or supporting points.

1.07 COORDINATION

- A. Coordinate size and location of structural-steel support members.
- B. Coordinate size and location of concrete bases. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork requirements are specified in Division 03.
- C. Coordinate installation of roof curbs, equipment supports, and roof penetrations. These items are specified in Division 07 Section "Roof Accessories."

PART 2 - PRODUCTS

2.01 CEILING-MOUNTING VENTILATORS

- A. Basis-of-Design Product: Subject to compliance with requirements, provide the product indicated on Drawings or a comparable product by one of the following:
1. American Coolair Corp.
 2. Ammerman; General Resource Corp.
 3. Breidert Air Products.
 4. Broan Mfg. Co., Inc.
 5. Carnes Company HVAC.
 6. Dayton Electric Manufacturing Co.; a division of W. W. Grainger, Inc.
 7. FloAire.
 8. Greenheck.
 9. JencoFan; Div. of Breidert Air Products.
 10. Loren Cook Company.
 11. NuTone Inc.
 12. Penn Ventilation.
 13. Panasonic
- B. Description: Centrifugal fans designed for installing in ceiling or wall or for concealed in-line applications.
- C. Housing: Steel, lined with acoustical insulation.
- D. Fan Wheel: Centrifugal wheels directly mounted on motor shaft. Fan shrouds, motor, and fan wheel shall be removable for service.
- E. Grille: Plastic, louvered grille with flange on intake and thumbscrew attachment to fan housing.
- F. Electrical Requirements: Junction box for electrical connection on housing and receptacle for motor plug-in.
- G. Accessories:
1. Variable-Speed Controller: Solid-state control to reduce speed from 100 to less than 50 percent.
 2. Manual Starter Switch: Single-pole rocker switch assembly with cover and pilot light.

3. Time-Delay Switch: Assembly with single-pole rocker switch, timer, and cover plate.
4. Motion Sensor: Motion detector with adjustable shutoff timer.
5. Ceiling Radiation Damper: Fire-rated assembly with ceramic blanket, stainless-steel springs, and fusible link.
6. Filter: Washable aluminum to fit between fan and grille.
7. Isolation: Rubber-in-shear vibration isolators.
8. Manufacturer's standard roof jack or wall cap, and transition fittings.

2.02 MOTORS

- A. Comply with requirements in Division 23 Section "Common Motor Requirements for HVAC Equipment."
- B. Enclosure Type: Totally enclosed, fan cooled.

2.03 SOURCE QUALITY CONTROL

- A. Sound-Power Level Ratings: Comply with AMCA 301, "Methods for Calculating Fan Sound Ratings from Laboratory Test Data." Factory test fans according to AMCA 300, "Reverberant Room Method for Sound Testing of Fans." Label fans with the AMCA-Certified Ratings Seal.
- B. Fan Performance Ratings: Establish flow rate, pressure, power, air density, speed of rotation, and efficiency by factory tests and ratings according to AMCA 210, "Laboratory Methods of Testing Fans for Rating."

PART 3 - EXECUTION

3.01 INSTALLATION

- A. Install power ventilators level and plumb.
- B. Ceiling Units: Suspend units from structure; use steel wire or metal straps.
- C. Support suspended units from structure using threaded steel rods and elastomeric hangers having a static deflection of 1 inch. Vibration-control devices are specified in Division 23 Section "Vibration and Seismic Controls for HVAC Piping and Equipment."
- D. Install units with clearances for service and maintenance.
- E. Label units according to requirements specified in Division 23 Section "Identification for HVAC Piping and Equipment."

3.02 CONNECTIONS

- A. Duct installation and connection requirements are specified in other Division 23 Sections. Drawings indicate general arrangement of ducts and duct accessories.

Make final duct connections with flexible connectors. Flexible connectors are specified in Division 23 Section "Air Duct Accessories."

- B. Install ducts adjacent to power ventilators to allow service and maintenance.
- C. Ground equipment according to Division 26 Section "Grounding and Bonding for Electrical Systems."
- D. Connect wiring according to Division 26 Section "Low-Voltage Electrical Power Conductors and Cables."

3.03 FIELD QUALITY CONTROL

- A. Perform the following field tests and inspections and prepare test reports:
 - 1. Verify that shipping, blocking, and bracing are removed.
 - 2. Verify that unit is secure on mountings and supporting devices and that connections to ducts and electrical components are complete. Verify that proper thermal-overload protection is installed in motors, starters, and disconnect switches.
 - 3. Verify that cleaning and adjusting are complete.
 - 4. Disconnect fan drive from motor, verify proper motor rotation direction, and verify fan wheel free rotation and smooth bearing operation. Reconnect fan drive system, align and adjust belts, and install belt guards.
 - 5. Adjust belt tension.
 - 6. Adjust damper linkages for proper damper operation.
 - 7. Verify lubrication for bearings and other moving parts.
 - 8. Verify that manual and automatic volume control and fire and smoke dampers in connected ductwork systems are in fully open position.
 - 9. Disable automatic temperature-control operators, energize motor and adjust fan to indicated rpm, and measure and record motor voltage and amperage.
 - 10. Shut unit down and reconnect automatic temperature-control operators.
 - 11. Remove and replace malfunctioning units and retest as specified above.
- B. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

3.04 ADJUSTING

- A. Adjust damper linkages for proper damper operation.
- B. Adjust belt tension.
- C. Refer to Division 23 Section "Testing, Adjusting, and Balancing for HVAC" for testing, adjusting, and balancing procedures.
- D. Replace fan and motor pulleys as required to achieve design airflow.

E. Lubricate bearings.

END OF SECTION

SECTION 23 37 13
DIFFUSERS, REGISTERS, AND GRILLES

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SUMMARY

- A. This Section includes ceiling- and wall-mounted diffusers, registers, and grilles.
- B. Related Sections include the following:
 - 1. Division 08 Section "Louvers and Vents" for fixed and adjustable louvers and wall vents, whether or not they are connected to ducts.
 - 2. Division 23 Section "Air Duct Accessories" for fire and smoke dampers and volume-control dampers not integral to diffusers, registers, and grilles.

1.03 SUBMITTALS

- A. Product Data: For each product indicated, include the following:
 - 1. Data Sheet: Indicate materials of construction, finish, and mounting details; and performance data including throw and drop, static-pressure drop, and noise ratings.
 - 2. Diffuser, Register, and Grille Schedule: Indicate Drawing designation, room location, quantity, model number, size, and accessories furnished.
- B. Coordination Drawings: Reflected ceiling plans, drawn to scale, on which the following items are shown and coordinated with each other, based on input from installers of the items involved:
 - 1. Ceiling suspension assembly members.
 - 2. Method of attaching hangers to building structure.
 - 3. Size and location of initial access modules for acoustical tile.
 - 4. Ceiling-mounted items including lighting fixtures, diffusers, grilles, speakers, sprinklers, access panels, and special moldings.
 - 5. Duct access panels.
- C. Samples for Initial Selection: For diffusers, registers, and grilles with factory-applied color finishes.
- D. Samples for Verification: For diffusers, registers, and grilles, in manufacturer's standard sizes to verify color selected.

PART 2 - PRODUCTS

2.01 AIR DISTRIBUTION DEVICES

- A. 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.
- B. Sponge neoprene, rubber, vinyl or felt border gaskets shall be provided for surface-mounted registers, grilles or diffusers.
- C. Provide suitable frame types to match the ceiling types as specified or indicated on the Architectural Drawings.
- D. Ceiling diffusers shall be provided with equalizing grids.
- E. Ceiling mounted grilles, registers and diffusers shall be provided with a factory applied, baked enamel, dull finish, bone white to match acoustical ceiling tile.
- F. 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.
- G. 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.
- H. Diffusers, registers and grilles indicated or scheduled on the drawings to comply with special requirements shall take precedence over the standard items specified.

2.02 MANUFACTURERS

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

2.03 GRILLES AND REGISTERS

- A. Adjustable Bar Grille:
 - 1. Manufacturers:
 - a. Anemostat (see schedule for model)

- b. Krueger.
 - c. Price Industries.
 - d. Titus.
 - 2. Material: Steel
 - 3. Finish: Baked enamel, color selected by Architect
 - 4. Face Blade Arrangement: Fixed horizontal spaced 1/2 inch apart.
- B. Fixed Face Grille:
 - 1. Manufacturers:
 - a. Anemostat (see schedule for model)
 - b. Krueger.
 - c. Price Industries.
 - d. Titus.
 - 2. Material: Steel.
 - 3. Finish: Baked enamel, color selected by Architect.

2.04 CEILING DIFFUSER OUTLETS

- A. Louver Face Diffuser:
 - 1. Manufacturers:
 - a. Anemostat (see schedule for model)
 - b. Krueger
 - c. Price Industries.
 - d. Titus.
 - 2. Material: Steel.
 - 3. Finish: Baked enamel, color selected by Architect.
 - 4. Mounting: Surface.
 - 5. Pattern: Four-way core style.
 - 6. Dampers: Radial opposed blade.
 - 7. Accessories:
 - a. Square to round neck adaptor.

- b. Adjustable pattern vanes.
- c. Plaster ring.
- d. Safety chain.
- e. Wire guard.

2.05 SOURCE QUALITY CONTROL

- A. Verification of Performance: Rate diffusers, registers, and grilles according to ASHRAE 70, "Method of Testing for Rating the Performance of Air Outlets and Inlets."

PART 3 - EXECUTION

3.01 EXAMINATION

- A. Examine areas where diffusers, registers, and grilles are to be installed for compliance with requirements for installation tolerances and other conditions affecting performance of equipment.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 INSTALLATION

- A. Install diffusers, registers, and grilles level and plumb.
- B. Ceiling-Mounted Outlets and Inlets: Drawings indicate general arrangement of ducts, fittings, and accessories. Air outlet and inlet locations have been indicated to achieve design requirements for air volume, noise criteria, airflow pattern, throw, and pressure drop. Make final locations where indicated, as much as practicable. For units installed in lay-in ceiling panels, locate units in the center of panel. Where architectural features or other items conflict with installation, notify Architect for a determination of final location.
- C. Install diffusers, registers, and grilles with airtight connections to ducts and to allow service and maintenance of dampers, air extractors, and fire dampers.

3.03 ADJUSTING

- A. After installation, adjust diffusers, registers, and grilles to air patterns indicated, or as directed, before starting air balancing.

END OF SECTION

**SECTION 23 37 16
NON-METAL DUCTWORK**

PART 1 - GENERAL

1.01 DESCRIPTION OF WORK:

- A. Extent of non-metal ductwork is indicated on drawings and by requirements of this section.
- B. Types of non-metal ductwork required for this project include the following:
 - 1. Textile Air Dispersion Products.

1.02 QUALITY ASSURANCE:

- A. Building Codes and Standards:
 - 1. Product must be Classified by Underwriter's Laboratories in accordance with the 25/50 flame spread / smoke developed requirements of NFPA 90-A and UL 2518. Also Classified by UL-C (Canada) S102.2, BS 5867 Part 2, 1980; GB8624-2006.
 - 2. All product sections must be labeled with the logo and classification marking of Underwriter's Laboratories.
- B. Design & Quality Control
 - 1. Manufacturer must have documented design support information including duct sizing; vent, orifice, and/or nozzle location; vent, orifice, and/or nozzle sizing; length; and suspension. Parameters for design, including maximum air temperature, velocity, pressure and textile permeability, shall be considered and documented.

1.03 SUBMITTALS:

- A. Product Data: Submit manufacturer's specifications on materials and manufactured products used for work of this section.
- B. Building Code Data: Submit UL file number under which product is Classified by Underwriter's Laboratories for both NFPA 90-A and UL 2518.
- C. Provide detailed drawings confirming configuration of Textile Dispersion System (diameter, lengths, airflow, pressure, and textile permeability).
- D. Provide detailed installation instructions for components to be installed.
- E. Provide warranty and maintenance documentation.

1.04 WARRANTY:

- A. Manufacturer must provide a 10 Year Product Warranty for products supplied for the fabric portion of this system as well as a Design and Performance Warranty.

1.05 DELIVERY, STORAGE AND HANDLING:

- A. Protect textile air dispersion system and SkeleCore Pull-Tight components from damage during shipping, storage, and handling.
- B. Where possible, store products inside and protect from weather. Where necessary to store outside, store above grade and enclose with a vented waterproof wrapping.

PART 2 - PRODUCTS

2.01 MANUFACTURER: Subject to compliance with requirements, choose one of the following:

- A. DuctSox® Corporation
Phone: (866) DUCTSOX or (563) 588-5300
FAX: (866) 398-1646 or (563) 588-5330
www.DuctSox.com

Or Approved Equal.

2.02 TEXTILE AIR DISPERSION SYSTEM:

- A. SkeleCore Pull-Tight System: Air diffusers shall be constructed with both internal retention and external tensioning.
 - 1. System shall consist of internal tensioning baskets with cable or track stops that externally tension the system off of the suspension system selected below along with 360 degree internal retention hoops that are spaced 5' on center between tensioning baskets.
 - 2. Tensioning baskets are designed to self-lock when tension is applied to the system.
 - 3. All straight sections utilize both internal retention hoops and external tensioning with the use of the tension baskets, all fittings(crosses, elbows, reducers, and tees) utilize internal retention hoops.
 - 4. Distance between consecutive tensioning baskets should not be more than 40'.
 - 5. System shall be installed with a one row suspension system located 1.5" above top-dead-center of the textile system.
 - 6. System attachment to cable or U-Track shall be made using Gliders spaced no further than 12 inches apart.
 - 7. Available for diameters from 8" – 60".
 - 8. Not available for natatorium applications.
 - 9. One row suspension options(must specify if multiple on same project):
 - a. Cable suspension hardware to include cable, eye bolts, thimbles, cable clamps, and turnbuckle(s) as required.
 - 1. Cable suspension options(must specify if multiple on same project)
 - a). Galvanized steel cable

b). Stainless steel cable

2. Support lengths available in 5'(standard), 10', 15', & 30'.

b. U-Track suspension hardware to include 8' sections of aluminum track, aluminum splice connectors, track endcaps and vertical cable support kits – consisting of a length of cable with cable connectors. Radius aluminum track must be included for all horizontal/flat radius sections.

1. U-Track suspension options(must specify if multiple on same project)

a. Galvanized steel cable

b. Stainless steel cable

c.

2. Support lengths available in 5'(standard), 10', 15', & 30'.

B. TEXTILE

1. Verona

a. Textile Construction: Filament/filament twill polyester, fire retardant in accordance with UL 2518.

b. Air Permeability: 2 (+2/-1) CFM/ft² per ASTM D737, Frazier

c. Weight: 6.8 oz. /yd² per ASTM D3776

d. Warranty: 10 years

2. Textile Color

a. Standard: blue, white, tan, red, green, silver, black

b. Custom

C. SOUND ATTENUATOR (OPTIONAL)

1. Test reports: The laboratory method used in conduction these tests in accordance with ASTM Standard E477-2013. Sound pressure level data obtained using a Bruel and Kjar Pulse Analyzer.

2. Acoustical performance data must be submitted for both dynamic insertion loss and generated noise values for octave band frequencies from 63Hz to 8000Hz.

3. All sound testing to be completed by a NVLAP acoustical testing service accredited third party laboratory.

4. Material meets the flame and smoke development of NFPA 90-A of < than 25 flame and <50 smoke development when tested in accordance with ASTM E84.

5. System shall include full 360 degree tension rings with quick connection spacer tubes concealed inside the fabric attenuator.

6. Cylindrical ring on each side shall require a vertical metal to metal cable safety attachment.
7. Available for diameters from 12" – 30".
8. Attenuator to have a 5 year warranty.
9. Shop drawings to include thickness, pressure losses, and connection details.
10. Available with and without a bullet.
11. Fabric on outer shell of attenuator to match DuctSox.
12. With a bullet. Based on a 24" diameter by 52" length with bullet, the minimum acoustical data must be met: minimum data for DIL and maximum for GN.

a. Performance

1. Direction: Forward Flow (+)
2. Dynamic Insertion Loss
3. Generated Noise

PERFORMANCE

Direction: Forward Flow (+)

Dynamic Insertion Loss (dB)

		Octave Band Center Frequency (Hz)							
		63	125	250	500	1000	2000	4000	8000
Velocity (FPM)	1500	4	8	13	23	34	36	25	18
	750	4	8	13	24	35	36	25	18
	0	5	9	14	25	36	36	24	17

Generated Noise L_w (dB; 10^{-12} Watts)

		Octave Band Center Frequency (Hz)							
		63	125	250	500	1000	2000	4000	8000
Velocity (FPM)	1500	66	56	51	47	44	39	35	30
	750	59	44	38	32	28	24	< 20	< 20

FPM	Static Pressure Drop
1500	0.14 iwg
750	0.03 iwg

13. Without a bullet. Based on a 24" diameter by 52" length without a bullet, the minimum acoustical data must be met: minimum data for DIL and maximum for GN.

a. Performance:

1. Direction: Forward Flow (+)
2. Dynamic Insertion Loss

3. Generated Noise

PERFORMANCE

Direction: Forward Flow (+)

Dynamic Insertion Loss (dB)

		Octave Band Center Frequency (Hz)							
		63	125	250	500	1000	2000	4000	8000
Velocity (FPM)	1500	4	7	10	16	16	12	11	9
	750	4	7	10	17	17	12	11	9
	0	5	8	11	18	18	12	11	9

Generated Noise L_w (dB; 10^{-12} Watts)

		Octave Band Center Frequency (Hz)							
		63	125	250	500	1000	2000	4000	8000
Velocity (FPM)	1500	63	55	49	43	42	37	34	25
	750	54	43	36	30	29	22	< 20	< 20

FPM	Static Pressure Drop
1500	0.03 iwg
750	0.01 iwg

D. TEXTILE SYSTEM FABRICATION REQUIREMENTS:

1. Textile system to be constructed in modular lengths (zippered) with proper radial securing clips (inlets, endcaps, and mid-sections) and top access zippers for tension lock attachments.
2. Integrated air dispersion shall be specified and approved by manufacturer. (select only those that apply)
 - a. Linear Vents
 1. Air dispersion accomplished by linear vent and permeable fabric. Linear vents must be sized in 1 CFM per linear foot increments (based on .5" SP), starting a 1 CFM through 90 CFM per linear foot. Linear vent is to consist of an array of open orifices rather than a mesh style vent to reduce maintenance requirements of mesh style vents. Linear vents should also be designed to minimize dusting on fabric surface.
 2. Size of vent openings and location of linear vents to be specified and approved by manufacturer.
 - b. Orifices – 2" & 3" SG's (Sewn-in Grommets)
 1. Air dispersion and extended throws are accomplished by reinforced orifices and permeable fabric. Reinforced orifices are to be installed to keep the integrity of opening and withstand laundry processes.
 2. Diameter, quantity, and location of reinforced orifices to be specified and approved by manufacturer.
 - c. Fixed Nozzles
 1. Air dispersion accomplished by using conical aerodynamic nozzles and permeable fabric. Diameter of nozzles height to be minimum 1/2". Due to

exact requirements of throw and maximum level of noise alternative flow models are not acceptable.

2. Color of nozzles must match color of fabric. Unless otherwise specifically mentioned on drawings or otherwise in this specification, suppliers standard table is used for selection of color.
3. Location and number of nozzles to be specified and approved by manufacturer.

d. Adjustable Nozzles

1. Air dispersion accomplished by adjustable ball nozzles and permeable fabric. Adjustable ball nozzles to have multiaxial rotation to redirect airflow to desired area. Adjustable ball nozzles are able to completely close off airflow without adding caps or plugs. Adjustable ball nozzles should lock into place once set, preventing constant adjustment. Adjustable ball nozzle should have inset design to be a condensation resistant product.
 2. Colors of adjustable nozzles available are white and black. With white material receiving white adjustable nozzles and all other material colors receiving black adjustable nozzles unless otherwise specifically mentioned on drawings or otherwise in the specification.
 3. Quantity and location of adjustable ball nozzles to be specified and approved by manufacturer.
3. Inlet connection to metal duct via fabric draw band with anchor patches as supplied by manufacturer. Anchor patches to be secured to metal duct via zip screw fastener – supplied by contractor.
 4. Inlet connection includes zipper for easy removal / maintenance.
 5. Lengths to include required intermediate zippers as specified by manufacturer.
 6. System to include Adjustable Flow Devices to balance turbulence, airflow and distribution as needed. Flow restriction device shall include ability to adjust the airflow resistance from 0.06 – 0.60 in w.g. static pressure.
 7. End cap includes zipper for easy maintenance.
 8. Each section of the textile shall include identification labels documenting order number, section diameter, section length, piece number, code certifications and other pertinent information.

E. DESIGN PARAMETERS:

1. Textile air diffusers shall be designed from 0.25” water gage minimum to 3.1” maximum, with 0.5” as the standard.
2. Textile air diffusers shall be limited to design temperatures between 0 degrees F and 180 degrees F (-17.8 degrees C and 82 degrees C).
3. System overall design; diameter, length, airflow, operating static pressure and dispersion shall be designed or approved by the manufacturer.

4. Do not use textile diffusers in concealed locations.
5. Use textile air dispersion systems only for positive pressure air distribution components of the mechanical ventilation system.

PART 3 - INSTALLATION

3.01 INSTALLATION OF TEXTILE AIR DISPERSION SYSTEM:

- A. Install chosen suspension system in accordance with the requirements of the manufacturer. Instructions for installation shall be provided by the manufacturer with product.

3.02 CLEANING AND PROTECTION:

- A. Clean air handling unit and ductwork prior to the DuctSox system unit-by-unit as it is installed. Clean external surfaces of foreign substance which may cause corrosive deterioration of facing.
- B. Temporary Closure: At ends of ducts which are not connected to equipment or distribution devices at time of ductwork installation, cover with polyethylene film or other covering which will keep the system clean until installation is completed.
- C. If DuctSox systems become soiled during installation, they should be removed and cleaned following the manufacturers standard terms of laundry.

END OF SECTION

SECTION 23 80 00
HEATING, VENTILATING AND AIR CONDITIONING EQUIPMENT

PART 1 - GENERAL

1.01 SUMMARY

- A. Section Includes: Air conditioning and air handling equipment including but not limited to:
 - 1. Single Packaged Air Conditioning Units.
 - 2. Split System Air Conditioning Units.
 - 3. Split System Heat Pump Units.
 - 4. Fans.
- B. Related Requirements:
 - 1. Division 01: General Requirements.
 - 2. Section 22 1000: Plumbing.
 - 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 0923: Environmental Control and Energy Management System.

1.02 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.

1.03 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.

1.04 QUALITY ASSURANCE

- A. Provide submittals in accordance with Section 23 0500: Common Work Results for HVAC.

1.05 PROJECT RECORD DOCUMENTS

- A. Provide Owner instructions on equipment operation and maintenance procedures, as indicated in Section 23 0500: Common Work Results for HVAC.

1.06 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

2.01 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.

2.02 AIR CONDITIONING UNITS

- A. Manufacturers: Carrier, Trane, York, or equal.
 - 1. Basis of Design: [Carrier]
- B. Furnish packaged air conditioning unit with gas heating for roof top installation. Unit shall be self-contained, completely factory assembled, with complete internal wiring and controls. 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. Unit shall be field configurable for down-flow or horizontal discharge. Cooling and heating capacities, electrical characteristics, and operating conditions shall be as indicated on Drawings.
- C. Quality Assurance:
 - 1. Units shall be CSA certified for outdoor installation.
 - 2. Cooling capacity shall be rated in accordance with current ANSI/AHRI Standard 210/240.
 - 3. Unit shall be UL listed and designed to conform to ANSI/ASHRAE Standard 15 Safety Code for Mechanical Refrigeration and ANSI Z21.47-2016/CSA 2.3-2016 Gas
 - 4. ANSI/NFPA 70: National Electrical Code.
 - 5. Unit cooling efficiency EER/SEER ratings shall comply with CCR, Title 24, Building Energy Efficiency Standards for Residential and Nonresidential Buildings, and shall not be less than ratings indicated on drawings.
 - 6. Unit heating efficiencies AFUE ratings shall comply with current CCR, Title 24, Building Energy Efficiency Standards for Residential and Nonresidential Buildings, and shall not be less than ratings indicated on drawings.

7. Unit shall comply with California Maximum Oxides of Nitrogen (NOX) Emission Regulations and current SCAQMD regulations.
8. The unit roof curbs shall conform to NRCA standards.
9. Insulation and adhesive shall meet NFPA 90A and 90B requirements for flame spread and smoke generation.
10. Unit casing shall be capable of withstanding ASTM B117 500-hour salt spray test.
11. Each unit shall be run tested at factory per ANSI/ASHRAE 37 and provided with a certificate indicating tested pressures, amperages, dates, and inspector.

D. Unit Cabinet:

1. Galvanized steel with baked enamel finish on external surfaces that are exposed to weather.
2. Interior surfaces exposed to conditioned and return air streams shall be insulated with a minimum ½-inch thick, 1 pound density foil-faced cleanable insulation.
3. Cabinet top cover shall be of one piece construction or where seams exist, shall be double hemmed and gasket sealed.
4. Cabinet panels shall be hinged access panels for filter, compressors, evaporator fan, control box and heat section areas. Each panel shall use multiple quarter-turn latches. Each major external hinged access panel shall be permanently attached to rooftop unit. Panels shall also include tiebacks.
5. Return air filters shall be accessible through a hinged access panel and be on a slide-out track using standard size filters.
6. Holes shall be provided in base rails (minimum 16 gage) for rigging shackles and level travel and movement during overhead rigging operations.
7. Unit shall have a factory-installed internally sloped condensate drain pan, providing a minimum ¾-inch-14 NPT connection to prevent standing water from accumulating. Pan shall be fabricated of high impact polycarbonate material, epoxy powder coated steel or stainless steel and shall slide out for cleaning or maintenance. An alternate vertical drain (¾-inch NPT) connection shall also be available. Drain pans shall conform to ASHRAE 62 self-draining provisions.

E. Compressors:

1. Unit shall be furnished with single (If single compressor is used, then it shall be Two Stage type) or multiple fully hermetic scroll compressors with internal vibration isolators.
2. Dual electrically and mechanically independent refrigerant circuits for 7.5 tons and above.
3. Compressors shall be provided with service access valves.
4. Compressor motors shall be cooled by refrigerant passing through motor windings.

5. Compressors shall be provided with line break thermal and current overload protection.
 6. Compressors shall be provided with crankcase heaters, internal high-pressure and temperature protection.
 7. Compressors on unit rated 90,000 BTU and below shall be of two stage types.
- F. Refrigerant circuit components:
1. Thermostatic expansion valve (TXV) with removable power element.
 2. Refrigerant strainer.
 3. Service gage connections on suction, discharge, and liquid lines.
 4. Solid core refrigerant filter driers.
- G. Evaporator and Condenser Coils: Standard Evaporator and condenser coils shall be furnished with:
1. Acceptable Condenser Coils:
 - a. Copper-tube, Aluminum-fin coil, with liquid subcooler. Internally enhanced OD seamless copper tubing mechanically bonded to aluminum fins in combination with a factory applied Corrosion-Resistant Epoxy Coating. Provide Protective Hail Guard.
 - b. Spine Fin condenser coil shall be continuously wrapped, corrosion resistant aluminum with minimum brazed joints. This coil is 3/8 inch OD seamless aluminum tubing glued to a continuous aluminum fin. Coils are lab tested to withstand 2,000 pounds of pressure per square inch. The outdoor coil provides low airflow resistance and efficient heat transfer. The coil is protected on four sides by louvered panels.
 - c. Coil shall be air-cooled Micro-Channel Heat Exchanger Technology (MCHX) and shall have a series of flat tubes containing a series of multiple, parallel flow microchannels layered between the refrigerant manifolds. Coils shall consist of a two-pass arrangement. Coil construction shall consist of aluminum alloys for fins, tubes, and manifolds in combination with a factory applied Corrosion-Resistant Epoxy Coating. Provide protective Hail Guard.
 2. Evaporator coils
 - a. Aluminum plate fins mechanically bonded to enhanced copper tubes with joints brazed.
 - b. Tube sheet openings shall be belled to prevent tube wear.
 - c. Evaporator coil shall be of full-face active design.
 - d. Dual circuit models shall have face-split type evaporator coil.
- H. Evaporator and Condenser Coils shall be furnished with copper plate fins mechanically bonded to enhanced copper tubes with copper tube sheets and brazed joints with a factory

applied Corrosion-Resistant Epoxy Coating utilizing dipping process. Provide protective Hail Guard.

I. Fans and Motors:

1. Evaporator fan shall be a dynamically balanced, double width, double inlet, forward curved centrifugal type, fabricated of steel with a corrosion resistant finish that was tested and rated in accordance with AMCA requirements.
2. Evaporator fans shall be direct-driven for the AC Units with the cooling capacity of less than or equal to 48,000 BTU/H, and belt or direct-driven for the AC units with the cooling capacity of greater than 48,000 BTU/H, as indicated on Drawings.
3. Direct drive fans shall be provided with ECM motor.
4. Evaporator blower and motor shall have permanently lubricated, factory-sealed ball bearings and automatic-reset thermal overload protection.
5. Belt drive shall include an adjustable-pitch motor pulley. Belt drive fans shall accommodate from 0.6 inch to 1.6-inch external static pressure without changing drives or motors.
6. Condenser fan shall be a dynamically balanced, propeller type, fabricated of aluminum blades riveted to corrosion resistant steel spiders and direct-driven by a totally enclosed motor. Condenser air shall be discharged vertically. Condenser fan motor shall be high efficiency or ECM type motor and provide cooling operation down to 25 degrees F outdoor temperature with automatic-reset thermal overload protection.

J. Heating Section:

1. Induced draft combustion type with energy saving direct spark ignition system, redundant main gas valve, and 2-stage heat.
2. The heat exchanger shall be of tubular section type fabricated of a minimum of 20 gage steel coated with a nominal 1.2 mil aluminum-silicone alloy or 20 gage type 409 stainless steel, including stainless steel tubes, vestibule plate.
3. Burners shall be of in-shot type fabricated of aluminum coated steel or stainless steel.
4. Gas piping shall enter unit cabinet at a single location.
5. Integrated Controls shall provide following:
 - a. Timed control of evaporator fan functioning and burner ignition,
 - b. Anti-cycle protection for gas heat operation (after one cycle on high temperature limit switch and one cycle on flame rollout switch).
 - c. Diagnostic information.
6. Induced draft motor shall be provided with permanently lubricated, sealed bearings and inherent automatic reset thermal overload protection.

K. Controls, Safeties and Diagnostic Points:

1. Unit Controls: Unit shall be furnished with self-contained, network capable and ready direct digital controls.
 - a. Controls shall be factory-installed.
 - b. Controls shall operate with zone control systems.
 - c. Controls shall furnish built-in diagnostics for thermostat commands for staged heating and cooling, evaporator-fan operation, and economizer operation.
 - d. Controls shall be furnished with a 5-minute time delay between modes of operation.
 - e. Control circuit shall be protected by a fuse on 24-V transformer side.
 - f. Control shall incorporate passive infrared detection for sensing occupancy in space serve.
2. Compressor high temperature, high current, internal overloads, internal thermostat.
 - a. Compressor reverse rotation protection.
 - b. Loss-of-charge/low-pressure switch.
 - c. Freeze-protection thermostat, evaporator coil.
 - d. High-pressure switch. The lockout protection shall be easily disconnected at control board, if necessary.
 - e. Internal relief valve.
 - f. Anti-recycle relay, or time cycle device to prevent rapid cycling of compressor after any off cycle.
3. Heating section shall be provided with following minimum protections:
 - a. High-temperature limit switches.
 - b. Induced draft motor speed sensor.
 - c. Flame rollout switch.
 - d. Flame proving controls.
 - e. Redundant main gas valve.
 - f. Heating controls shall consist of:
 - 1) 2-stage automatic combination gas valve.
 - 2) Pressure regulator.
 - 3) Electric spark intermittent ignition system or hot surface ignition system.

4) Time delay fan control.

4. Operating Characteristics:

- a. Unit shall be capable of starting and operating at 125 degrees F ambient outdoor temperature, meeting maximum load criteria of AHRI Standard 210/240 or 360 at plus or minus 10 percent voltage.
- b. Compressor with standard controls shall be capable of operation down to 25 degrees F ambient outdoor temperature.

5. EMS Diagnostic Points: Provide diagnostic points for units, including those at projects with no EMS.

- a. Supply air temperature.
- b. Return air temperature.
- c. Space temperature.
- d. Outdoor air temperature.
- e. Filter status.
- f. Fan status.
- g. Compressor status.
- h. Economizer damper current position.
- i. Other diagnostic point required by current Title 24, automated fault detection and diagnostics (FDD).

L. Filter Section:

1. Provide filter section with factory-installed low-velocity, throwaway 2-inch thick high capacity, MERV 13 Class 2, or equal, filters of commercially available sizes unless noted otherwise on the drawings.
2. Filter face velocity shall not exceed 300 fpm at nominal airflows.
3. Filter section shall allow installation of standard size air filter.
4. Return air filters shall be accessible through a hinged access panel using standard size filters.

M. 100 Percent Outdoor Air Economizer:

1. Provide 100 percent outdoor air economizers as indicated on drawings.
2. Gear-driven integrated economizers.
3. Integrated integral-modulating type capable of simultaneous economizer and compressor operation.

4. Furnish hardware and controls to provide cooling with outdoor air.
 5. Low-leakage dampers not to exceed 3 percent leakage, at one inch wg pressure differential (variable sliding economizer).
 6. Barometric relief damper. Damper shall close upon unit shutoff.
 7. Differential temperature and enthalpy controller unless indicated otherwise on drawings.
 8. Provide units with centrifugal power exhaust controlled by a pressure sensor in space or outdoor air measurement and tracking as indicated on drawings. The controller shall modulate VFD in centrifugal power exhaust to maintain a pressure differential of 0.03 inch of water between indoor and atmospheric pressure. Furnish field wiring to power exhaust and install tubing in space. Provide other accessories as required to comply with UL or ETL requirements.
 9. Base Rail: Factory installed on both horizontal and down-flow units.
 10. Dampers Using Electronic Actuators:
 - a. Manufacturer: Belimo, Honeywell, Invensys, Johnson Controls, or equal.
 - b. Size for torque required for damper seal at load conditions.
 - c. Coupling: V-bolt dual nut clamp with a V-shaped, toothed cradle.
 - d. Overload Protection: Electronic overload or digital rotation-sensing circuitry without the use of end switches to prevent damage to the actuator during a stall condition.
 - e. Fail-Safe Operation: Mechanical, spring-return mechanism.
 - f. Power Requirements: Maximum of 10 VA at 24 VAC or 8 W at 24 VDC.
 - g. Proportional Actuators shall be fully programmable. Control input, position feedback and running time shall be factory or field programmable by use of external computer software. Diagnostic feedback shall provide indications of hunting or oscillation, mechanical overload and mechanical travel. Programming shall be through EEPROM without the use of actuator mounted switches.
 - h. Actuators shall be listed by ISO 9001, ULC, and CSA C22.2.
- N. Furnish programmable digital thermostat with following features for single zone units that are not provided with variable volume and variable temperature type controls:
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. 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.
 6. 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.
- O. Demand Controlled Ventilation:
1. Units with 100 percent outdoor air economizers 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 wall mounted 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 0-10 VDC signal to expansion board.
- P. Parts Availability: Submit proof in writing that majority (minimum 80 percent) of the 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.

2.03 COOLING ONLY FAN COIL UNITS AND CONDENSING UNITS

- A. Manufacturer: Carrier, Trane, York, or equal.
1. Basis of Design: Carrier
- B. FCU and CU: Furnish fan coil unit (FCU) and condensing unit (CU), split type, air-cooled, roof or ground for ducted connections or free blow. Units shall be air-cooled condensing unit/direct expansion fan coil combinations. Condensing unit outdoor section shall be factory assembled with a direct-drive condenser fans with horizontal or vertical air discharge, scroll-type compressor, refrigerant coil, fan motors, pre-wired control panel and a holding charge of a non-ozone depleting refrigerant. Contractor shall provide additional refrigerant for extended lines. Indoor fan coil unit shall be furnished with horizontal discharge and will include evaporator coil, fan and motor, condensate pan with drain, thermal expansion valve, pre-wired control panel and remote thermostat control. Unit shall provide an EER/SEER complying with CCR, Title 24, Building Energy Efficiency Standards for Residential and Nonresidential Buildings. UL listed and rated at AHRI Standard 210/240.
- C. Nominal unit cooling, heating capacities, electrical characteristics, and operating conditions shall be as indicated on Drawings.
- D. Condenser coils:

1. Acceptable Condenser Coils:
 - a. Copper-tube, aluminum-fin coil, with liquid subcooler. Internally enhanced 3/8-inch outside diameter, seamless copper tubing mechanically bonded to aluminum fins with a factory applied Corrosion-Resistant Epoxy Coating. Provide Protective Hail Guard.
 - b. Spine Fin™ condenser coil shall be continuously wrapped, corrosion resistant aluminum with minimum brazed joints. This coil is 3/8 inch outside diameter seamless aluminum tubing glued to a continuous aluminum fin. Coils are lab tested to withstand 2,000 pounds of pressure per square inch. The outdoor coil provides low airflow resistance and efficient heat transfer. The coil is protected on four sides by louvered panels.
 - c. Coil shall be air-cooled Micro-Channel heat exchanger technology (MCHX) and shall have a series of flat tubes containing a series of multiple, parallel flow microchannels layered between the refrigerant manifolds. Coils shall consist of a two-pass arrangement. Coil construction shall consist of aluminum alloys for fins, tubes, and manifolds in combination with a factory applied Corrosion-Resistant Epoxy Coating. Provide Protective Hail Guard.
- E. Condenser Coils shall be furnished with copper plate fins mechanically bonded to enhanced copper tubes with copper tube sheets and brazed joints. Coated coils are not acceptable.
- F. Evaporator coils:
 1. Aluminum plate fins mechanically bonded to enhanced copper tubes with joints brazed.
 2. Tube sheet openings shall be belled to prevent tube wear.
 3. Evaporator coil shall be of full-face active design. Dual circuit models shall have face-split type evaporator coil.
- G. Evaporator 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. Coated coils are not acceptable.
- H. Condenser Fan and Motors: Condenser fan shall be a dynamically balanced, propeller type, fabricated of aluminum blades riveted to corrosion resistant steel spiders and direct-driven by a totally enclosed motor. Condenser air shall be discharged horizontally or vertically. Condenser fan motors shall be high efficiency or ECM type motor.
- I. Cabinets: Fabricated of galvanized steel, bonderized and finished with baked enamel.
- J. Compressor shall be serviceable two stage or variable speed type hermetic scroll. Compressor shall be furnished with access valves and shall be installed on rubber isolators to reduce sound vibration. It shall be furnished with high and low-pressure protection. Each horizontal discharge condensing unit shall be furnished with a factory installed suction accumulator. Field installed accumulators are not permitted. 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.

- K. Controls: 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. Unit shall incorporate an automatic relay for indoor circulating air blower. Control panel shall be pre-wired in unit casing. The control circuit shall incorporate a manual reset safety circuit to render refrigerant system (compressor and outdoor air motor) inoperative should there be a loss of airflow or refrigerant. Units shall also be furnished with automatic condenser-fan motor protection, high condensing temperature protection, compressor motor current and temperature overload protection, high pressure relief, and condenser fan failure protection.
- L. EMS Diagnostic Points:
 - 1. Supply air temperature.
 - 2. Return air temperature.
 - 3. Space temperature.
 - 4. Filter status.
 - 5. Fan status.
 - 6. Compressor status.
 - 7. Other diagnostic point required by current Title 24, automated fault detection and diagnostics (FDD).
- M. Low Ambient Operation: Head pressure control shall be provided for operation at outside air temperature below 45 degrees F.
- N. Filters: Filters shall be 2-inch standard size high capacity replaceable media type MERV 13, or equal, installed in an external 2-inch rack filter section and complete with an access door.
- O. An in-line filter-drier shall be provided with equipment and shall be installed at Project site.
- P. 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.

2.04 HEAT PUMP AND FAN COIL UNITS

- A. Manufacturer: Carrier, Trane, York, or equal.
 - 1. Basis of Design: Carrier
- B. HP and matching indoor fan coil unit and condenser 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 condenser 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 evaporator 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 label of approval. Units shall have CSA 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. Evaporator and condenser coils: Evaporator and condenser 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. Evaporator and Condenser 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. Coated coils are not acceptable.

F. Fans:

1. Condenser Fan and Motors: Condenser fan shall be ECM type motor direct driven, propeller type arranged for horizontal or vertical discharge. Condenser 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. Evaporator 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 airflow or refrigerant.
 4. Units shall also be furnished with automatic condenser-fan motor protection, high condensing temperature protection, compressor motor current and temperature overload protection, high pressure relief and condenser fan failure protection.
- K. EMS Diagnostic Points:
1. Supply air temperature.
 2. Return air temperature.
 3. Space temperature.
 4. Filter status.
 5. Fan status.
 6. Compressor status.
 7. Other diagnostic point required by current Title 24, automated fault detection and diagnostics (FDD).

- L. Low Ambient Operation: Head pressure control shall be provided for operation at outside air temperature below 45 degrees F.
- M. Safeties:
1. High condensing temperature protection.
 2. Compressor motor current and temperature overload protection.
 3. High pressure relief.
 4. Outdoor fan failure protection.
- N. Filters:
1. Filters shall be 2-inch standard size high capacity replaceable media type, MERV 13, or equal, 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.
- O. 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.
- P. 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.
- Q. 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.
- R. 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.
- S. 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.

2.05 ROOF MOUNTED POWER EXHAUST VENTILATORS

1. Manufacturer:

CARNES	GREENHECK	LOREN COOK	PENNBARRY	TWIN CITY & BLOWER	OR EQUAL
VUBK Series	CUBE Series	ACRUB	Fumex-Belt Drive	BCRU	

2. Spun aluminum, roof mounted, belt driven, upblast 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 a one piece inlet spinning and continuously welded curb cap corners for maximum leak protection. The windband shall have a rolled bead for added strength. A two piece top cap shall have stainless steel, or galvanized quick release latches to provide access into motor compartment without use of tools, or screws. An integral conduit chase shall be provided into motor compartment to facilitate wiring connections. The motor, bearings and drives shall be mounted on a minimum 16 gage steel power assembly, isolated from unit structure with rubber vibration isolators. These components shall be enclosed in a weather-tight compartment, separated from exhaust airstream. Lifting lugs shall be

provided to help prevent damage from improper lifting. 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. Wheel inlet shall overlap an aerodynamic aluminum inlet cone to provide 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 ball bearings and furnished at specified voltage, phase, and enclosure.
7. Bearing: Bearings shall be designed and individually tested specifically for use in air handling applications. Construction shall be heavy-duty regreasable ball type in a cast iron pillow block housing selected for a minimum L50 life in excess of 200,000 hours at maximum cataloged operating speed.
8. Belts and Drives: Belts shall be oil and heat resistant, non-static type. Drives shall be precision machined cast iron, or galvanized steel type, keyed and securely attached to wheel and motor shafts. Drives shall be sized for 150 percent of installed motor horsepower. The variable pitch motor drive must be factory set to specified fan RPM.

2.06 ROOF MOUNTED POWER EXHAUST VENTILATORS

1. Manufacturer:

CARNES	GREENHECK	LOREN COOK	PENNBARRY	TWIN CITY & BLOWER	OR EQUAL
VUDK Series	CUE Series	ACRUD	Fumex-Direct Drive	DCRU	

2. Spun aluminum, roof mounted, direct driven, upblast 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: 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 a one piece inlet spinning and continuously welded curb cap corners for maximum leak protection. The windband shall have a rolled bead for added strength. An integral conduit chase shall be provided 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.

2.07 MAKE UP AIR UNIT

- A. Unit shall be supplied to meet this specification without substitution except by engineer's approval.

Captive-Aire brand product identified below is basis of design.

1. Provide packaged, outdoor heating and makeup air, power vented units as Captive-Aire brand equipment. The units shall be minimum 81% efficiency, designed for slab or roof curb mounting. The gas furnace is to be arranged for ducted flue gas exhaust.
2. The packaged heating and makeup air system shall be design-certified to ANSI Z83.8 and CSA 2.6 Standards. The energy usage shall be designed to meet ASHRAE Standard 90.1.

- B. Air Distribution & Dampers

1. Unit to be manufactured with Downturn Plenum with two-position Motorized Damper.

- C. Cabinet Construction, for outdoor installation.

1. Cabinet shall have through-the-base utility knockouts. Control, burner, and blower service compartment doors shall be hinged. Blower door hardware shall be heavy duty stainless. Control and burner door hardware shall have heavy duty external hardware.
2. Unit cabinet to be supplied with double wall steel construction with factory installed 1 1/2 Lb. density insulation. R value of said insulation shall be 3.8 or greater. Insulation with foil backing is not acceptable.
3. The packaged system shall have a pre-coat RAL 1001 white paint finish. Finish shall be a minimum 80 gloss on G90 galvanized steel.
4. All painted metal shall pass 1,000 hour salt spray test per ASTM B-117.
5. Unit shall be designed with heavy 16 gauge prepainted steel rail perimeter base. Said base shall feature provisions for corner lifting, with lifting strap holes to facilitate handling and installation.

- D. Combustion Air and Venting

1. The unit shall have a factory-installed power venter device with a centrifugal wheel and direct drive motor to draw combustion air through an inlet in the cabinet.

- E. Electrical Specifications & Control Systems

1. All units shall be equipped with 24-volt control transformer; protective air proving switch; resiliently isolated venter motor; and a high temperature limit control. Operation shall be controlled through an integrated circuit board. The circuit board shall monitor heater operation and have LED diagnostic indicator lights to identify abnormalities in control functions.
2. Unit to be configured with Left side control location (facing airstream).

3. Unit Shall be configured for 208 Volt, Three Phase, 60 cycle supply voltage.
4. Factory to install Exhaust fan interlock relay (Specify use).
5. Unit shall have BacNet communication card (MSTP). The unit shall provide the following points for make-up air sequence.

P125 Sequence (D21) BACnet Point List 8/10/13

Analog Variables

Name, Description, Read/Write, BMS Address, Unit, Default, Min, Max

- CC_Temp,Cooling Coil Discharge Air Temp,R,AV1,Deg F,,,,.
- Comp_Mod_Out,DX Modulation Output %,R,AV2,%,,0,100
- DA_NAClg_SP,Discharge Air Temp Neutral Cooling SP,R/W,AV3,Deg F,70,50,100
- DA_NAhtg_SP,Discharge Air Temp Neutral Heating SP,R/W,AV4,Deg F,70,50,140
- DA_SP,Discharge Air Temp Active SP,R,AV5,Deg F,,,,.
- DA_SpcClg_SP,Discharge Air Temp Space Cooling SP,R/W,AV6,Deg F,55,50,100
- DA_SpcHtCl_SP,Discharge Air Temp Space Heat Mode Cooling SP,R/W,AV7,Deg F,55,50,100
- DA_SpcHtg_SP,Discharge Air Temp Space Heating Sp,R/W,AV8,Deg F,90,50,140
- DA_Temp,Discharge Air Temp,R,AV9,Deg F,,,,.
- Damper_Cmd,Damper Output Command,R,AV10,%,,0,100
- DhOADP_SP,Dehum OA Dew Point SP,R/W,AV11,Deg F,58,50,100
- EF_Spd_Cmd,Exhaust Fan Speed Command,R,AV12,%,,15,100
- ERV_DA_Temp,Energy Recovery Wheel Discharge Air Temp,R,AV13,Deg F,,,,.
- Ext_Dmpr_Cmd,External Unit Damper Command,R,AV14,%,,0,100
- HX_Mod_Cmd,Heating Modulation Command,R,AV15,%,,0,100
- MA_Temp,Mixed Air Temp,R,AV16,Deg F,,,,.
- OA_Dew_Point,Outside Air Dew Point,R,AV17,Deg F,,,,.
- OA_Hum_BMS,Outside Air Humidity BMS -Sets OA Humidity when OA_Hum_Sel is set to 1=BMS,R/W,AV18,%rH,,,,.
- OA_Hum_Raw,Outside Air Humidity,R,AV19,%rH,,,,.
- OA_Temp_BMS,Outside Air Temp BMS - Sets OA Temp when OA_Temp_Sel is set to 1=BMS,R/W,AV20,Deg F,,,,.

- OA_Temp_Raw, Outside Air Temp, R, AV21, Deg F, , , , ,
- OACHgOv_SP, OA Change Over SP, R/W, AV22, Deg F, 65, 45, 80
- RH_Mod_Out, Reheat Modulation Output %, R/W, AV23, % , , , 0, 100
- SF_VFD_Cmd, Supply Fan VFD Command, R, AV24, % , , , 0, 100
- Spc_Temp, Space Temp, R, AV25, Deg F, , , , ,
- SpcEffClgSP, Space Effective Cooling SP, R, AV26, Deg F, , , , ,
- SpcEffHtgSP, Space Effective Heating SP, R, AV27, Deg F, , , , ,
- SpcTempSP, Space Temp SP, R/W, AV28, Deg F, 72, 65, 85
- Air_Pressure*, Duct or Building Static Pressure, R, AV1007, w.c., , , , ,
- Bldg_Press_SP*, Building Static Pressure SP, R/W, AV1008, w.c., 100, -500, 500
- Duct_Press_SP*, Duct Static Pressure SP, R/W, AV1009, w.c., 500, 0, 2500
- Spc_Humidity, Space Humidity, R, AV1010, %rH, , , , ,
- SpcHumSP, Space Humidity SP, R/W, AV1011, %rH, 55, 35, 75
- State_Sel, State Select 2=AUTO 3=COOL 4=HEAT 5=OFF, R/W, AV1012, , , 5, 2, 5
- OccMode_Sel, Occ Mode Select 0= Schedule 1= Digital Input 2=BMS, R/W, AV1013, , , 1, 0, 2

6. Manufacturer shall provide for field installation, a 30 amp, 240 volt, fusible outdoor raintight disconnect switch. Switch shall be UL listed.
7. The unit shall operate to maintain one the following discharge air temperature setpoints:
 - Space Cooling Required: 55F DAT (Range 50 – 100F)
 - Space Heating Required: 90F DAT (Range 50 – 100F)
 - Space cooling required during winter operation. 55F DAT (Range 50 – 100F)
 - Neutral Air - Dehumidified: 70F DAT @ 52-55 Dewpoint (Range 50 – 100F)
 - Neutral Air - Heating: 70F DAT (Range 50 – 100F)

The unit shall operate based upon a 7-day programmable time schedule, contact closure or a BMS command to operate in either occupied or unoccupied mode. In the occupied mode the unit supply fan shall run continuous based upon one of the following controls: Constant volume (summer/winter), duct static pressure, or building static pressure. See fan sequence for further details. In the unoccupied mode the fan shall run intermittently to maintain a space temperature setpoint. (84F cooling/ 64F heating).

The optional unit supplied exhaust fan shall run whenever the supply fan is on,

otherwise it is OFF. The exhaust fan shall operate based upon one of the following: Constant volume, building static pressure, supply fan tracking. See fan sequence for further details. In the unoccupied mode the exhaust shall be OFF. The intake dampers shall operate based upon one of the following: 100% outside, external input from user supplied 0-10v, 2 position, 4 position or building static pressure. In the unoccupied period the outside air damper shall be 100% closed while the return air damper shall be 100% open. For units only having one damper, the damper shall be 100% open whenever the supply fan is running. The mechanical heating and cooling shall operate to maintain the discharge air temperature setpoint. The energy recovery wheel shall be operation in the occupied mode and OFF in the unoccupied mode. The control system shall incorporate all the necessary safeties. Please see IOM for detail sequences.

F. Evaporative Cooling / Air Intake Options

1. Manufacturer shall supply 12" cellulose evaporative cooling media.
2. Factory shall supply unit with an Evaporative cooling module constructed of pre-painted steel with a stainless steel sump.
3. Manufacturer to provide factory installed Evaporative Cooling water distribution system . Said system shall provide a water metering device that automatically adjusts its wetting cycle based on changes in the ambient dry bulb temperature.

G. Supply Motor

1. Unit shall be supplied from factory with EPACT compliant (3 horsepower) Totally Enclosed Fan Cooled blower motor.
2. Factory shall provide a Variable Frequency Drive, Installed in Unit. Said Variable Frequency Drive shall feature a NEMA 1 Enclosure, Swinging Choke, Sensorless vector Control, and Factory programming set-up.

H. Filtering

1. Manufacturer shall furnish unit with a filter rack and 2 inch disposable pleated filters. Said filters shall have an average arrestance at least 90% when tested in accordance with ASHRAE 52-76.
2. Factory shall provide said unit with 1" permanent pre-filters.

I. Fuel & Burner Type

1. Unit to be supplied for operation with natural gas as fuel source.
2. Units to be supplied from factory adjusted for installation at altitudes from elevations sea level-2000 Feet.
3. Burner shall be of a single body design with Stainless Steel face insert. Said burner shall require one orifice supplying multiple heat exchanger tubes. The units shall incorporate a single, one piece burner assembly with a single orifice per staging. The burner shall have a continuous wound close pressed stainless steel ribbon separating the flame from the burner interior. All units shall have a single venturi tube and orifice supplying fuel to a one piece burner housing per staging.

Each heat exchanger cell shall use balanced draft induction to maintain optimum flame control.

J. Gas Train, Controls & Ignition

1. Gas controls for said furnace shall be designed for makeup air heating application. The unit shall have electronic modulation offering at least full modulation to 28% of full fire (capacity) input rate (Note: 50% MODULATING GAS VALVES WILL NOT BE ACCEPTED). Modulating gas control shall be certified by CSA for use in the United States and Canada. The furnace shall maintain an average thermal efficiency over the range of modulation that is equal to or exceeds the full input rate thermal efficiency. The furnace shall ignite at any fire rate within its modulation range, not just high fire on start. Furnace shall be provided with an electronic modulating gas regulator which provides for firing rates between 25% and 100%, or 4 to 1 turndown ratio, while maintaining part-load thermal efficiency to comply with and exceed the current 75% minimum requirement of the ASHRAE 90.1 standard. Said modulating regulator shall be controlled by an electronic signal conditioner that will use a direct digital control signal of either 4-20 mA., or 0-10 Volts, provided by an external D.D.C. system. A main redundant safety shut-off valve shall include a servo regulator which maintains constant gas pressure to the modulating regulator under wide variations in gas supply pressure. Said valve shall also include the safety pilot valve, and the manual shutoff valve. On/off control of the unit shall be by external D.D.C. system.

K. Heat Exchanger

1. Heat exchanger shall be manufactured from die-formed halves of 409 (E-3) Stainless Steel.
2. Note: Manufacturer's Limited Warranty for heat exchangers applies. Refer to written limited warranty for terms.
3. The heater shall be equipped with a multicell, 4 pass serpentine style steel heat exchanger. Heat exchanger tubes shall be press fabricated. All heat exchangers shall be fabricated with no welding or brazing, only tool pressed mechanical joints. All heat exchanger cells shall be designed with an aerodynamic cross section to provide maximum airflow.

2.08 FILTERS

- A. Air filters shall be of pleated, high capacity, disposable type of efficiencies indicated on drawings. Each filter shall consist of a non-woven cotton fabric media, media support grid, and enclosing frame. 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, Kch, or AAF.

2.09 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

3.01 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.

3.02 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.

3.03 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.

3.04 ROOF-TOP EQUIPMENT MOUNTING

- A. Downflow Packaged Units: Install unit on a prefabricated mounting frame or pitched curb secured directly to roof. Follow manufacturers recommended installation manuals. Submit Shop Drawings for review by Architect.
- B. Horizontal Flow Packaged Units: Install unit on platform or prefabricated mounting frame or pitched curb secured directly to roof designed to suit roof conditions and requirements of provided unit. Submit Shop Drawings for review by Architect.

3.05 MAKE UP AIR UNIT MOUNTING

- A. Installation & Mounting
 - 1. **CODE REQUIREMENTS**
The unit shall be installed in accordance with the standards of the National Fire Protection Association or the National Fuel Gas Code for gas-fired duct furnaces, and these standards should be followed carefully. Authorities having jurisdiction should be consulted before installations are made to verify local codes and installation procedures. The unit shall be installed in accordance with the National Fuel Gas Code ANSI Z223.1. In Canada, the installation of these appliances is to be in accordance with CAN/C.G.A.-B149.1 and B149.2, Installation Code for Gas Burning Appliances and Equipment, and local codes.
 - 2. **ELECTRICAL SUPPLY AND CONNECTIONS**
All electrical wiring and connections including electrical grounding should be made in accordance with the National Electric Code ANSI/NFPA No. 70 or, in Canada, the Canadian Electrical Code, Part I-CSA. Standard C22.1. Check any local ordinance or power company requirements that apply. A separate line voltage supply should be run directly from the main panel to a fused disconnect switch, at the unit, and then making connection to leads in the unit junction box. All external wiring must be made within approved conduit and have a minimum temperature rise rating of 60 degrees C. The unit must be electrically grounded in accordance with the National Electrical Code, ANSI/NFPA No. 70 or CSA Standard C22.1 when installed, if an external electrical source is utilized.

3. GAS PIPING AND PRESSURE
All piping must be in accordance with requirements outlined in the National Fuel Gas Code ANSIZ223.1 or CAN/C.G.A.-B149 (.1 or .2). Where regulations require an for ease of servicing, install a ground joint union and manual shut-off valve upstream of unit control system.
 4. Factory to supply a field installed 16" pitched roof curb for Base Unit and One Section.
 5. Furnace Section shall have a factory-installed Heat Exchanger Condensate Drain.
- B. Miscellaneous Features
- C. To be prepared for shipment via a flatbed truck.
- D. Supply Blower
1. Manufacturer to provide said unit with factory-installed Adjustable V-Belt Drive Blower.
 2. The blower section shall include an adjustable belt-driven vibration isolated centrifugal blower and vibration isolated motor.
 3. To be available with rubber vibration isolation limiting motor and blower vibration transmission.

3.06 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.

3.07 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.

3.08 REFRIGERANT PIPING

- A. Unless otherwise indicated, main liquid and suction lines from condensing unit to evaporator 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 leak tested. Field fabricated lines shall be thoroughly flushed and cleaned before connection. Bleed nitrogen through lines during silver brazing, and cap and seal lines when not completed and connected to equipment.
- 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 heat pump systems, insulate both vapor and liquid lines. For insulation materials, refer to Section 23 0700: HVAC Insulation.
- N. Provide aluminum jacketing to all weather exposed piping on grade or roof.

3.09 CLEANUP

- A. Remove rubbish, debris and waste materials and legally dispose of off Project site.

3.10 PROTECTION

- A. Protect Work of this Section until Substantial Completion.

END OF SECTION

SECTION 23 80 01
HEAT PUMP VARIABLE REFRIGERANT FLOW EQUIPMENT

PART 1 - GENERAL

1.01 SYSTEM DESCRIPTION

A. SUMMARY

A. Related Requirements:

1. Division 01: General Requirements.
2. Section 22 1000: Plumbing.
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 0923: Environmental Control and Energy Management System.

The heat pump variable refrigerant flow system is a two-pipe system consisting of a single or multiple outdoor units, multiple indoor units of various types and capacities, individual or central indoor unit controls with on/off temperature settings, all connected by fully insulated refrigerant lines utilizing factory supplied, fully insulated, branching kits. Indoor units are connected to condensate piping that shall be terminated to the nearest drain point.

- B. The system shall be fully capable of providing heating or cooling as requested by the individual indoor zones that can consist of single or multiple indoor units. The heating priority shall be the default factory setting and can be changed to cooling, majority or a single zone priority.
- C. The maximum number of connected indoor units shall not exceed 64.
- D. The total connected indoor unit capacity shall range between 50 and 150% of the outdoor unit capacity based on indoor unit type & size selected.

1.02 QUALITY ASSURANCE

- A. Units shall be listed by ETL (Engineering Testing Laboratory) and be evaluated in accordance with UL standard 1995, 4th. edition.
- B. Units shall be listed in the AHRI directory.
- C. All units shall meet the Federal minimum efficiency standards and be tested per AHRI 1230 Standard.

1.03 DELIVERY, STORAGE, AND HANDLING

- A. Units shall be shipped in one piece and shall be stored and handled per unit manufacturer's recommendations.
- B. Units shall be supplied with a base rail that provides openings for moving the unit by fork truck or rigging the unit by crane.

1.04 WARRANTY

- A. Compressors shall be provided with manufacturer's five year warranty, replacement only.

PART 2 - PRODUCTS

2.01 EQUIPMENT

- A. Manufacturers: Toshiba, Mitsubishi, Daikin.

- 1. Basis of Design: [Toshiba]

General:

Factory-assembled, single piece air-cooled outdoor unit. Contained within the unit enclosure shall be all factory wiring, piping, controls, and the multiple inverter-driven twin rotary compressors.

- 1. The maximum sound pressure rating for a single module shall not exceed 64 dBA sound pressure in cooling and 65 dBA in heating and for multiple modular systems the sound pressure numbers should not exceed 68 dBA and 69 dBA. Sound pressure ratings are measured at a distance of 3 ft out and 4 ½ ft up from the side of the outdoor unit.
- 2. The outdoor unit shall include an oversized accumulator and a liquid tank for proper heating performance while allowing the indoor unit PMV (pulse modulating valve) metering device to shut off completely when a zone is satisfied.
- 3. The outdoor unit shall be protected by a high-pressure switch, high-pressure sensor, low-pressure sensor, fusible plug, PC board, and inverter overload protector.
- 4. The outdoor unit shall be capable of operating in cooling mode down to 14F ambient air temperature and down to -13 F wet bulb ambient air temperature in heating.
- 5. The outdoor unit shall include a total oil management system that balances oil between compressors within a module, replenishes compressor oil to the compressors in a module from the oil separator if required, and allows oil and refrigerant to move between multiple modular units if required, even if one of the units is not running.

B. Unit Cabinet:

- 1. Unit cabinet shall be constructed of pre-coated steel, finished on both inside and outside.
- 2. Unit access panels shall be removable with minimal screws and shall provide full access to the compressors, fan, and control components.
- 3. Compressors shall be isolated in a compartment and have an acoustic wrap to assure quiet operation.
- 4. The outdoor unit control panel shall include a sliding window to access adjustable controls and an LED display for setup and diagnostics.
- 5. Unit cabinet shall be capable of withstanding 500-hour salt spray test per Federal Test Standard No. 141 (method 6061).

C. Fans:

- 1. Outdoor fan shall discharge air vertically and be driven by a DC inverter variable speed motor with 64 steps that is capable of running down to 60 rpm.
- 2. Outdoor fan motor shall be totally-enclosed with permanently-lubricated bearings.
- 3. Motor shall be protected by internal thermal overload protection.

4. Fan blade shall be non-metallic and shall be statically and dynamically balanced.
5. Outdoor fan shall be protected by a raised non metallic protective grille.

D. Compressors:

1. Each outdoor unit module shall be equipped with two inverter-driven twin rotary compressors with full range control to an accuracy of ± 0.1 Hz.
2. Compressor shall be totally enclosed in the machine compartment.
3. Compressors shall be equipped with factory mounted crankcase heaters.
4. Internal overloads shall protect the compressor from over-temperature operation.
5. Motor shall be suitable for operation in an R-410A refrigerant atmosphere.
6. Compressor assembly shall be installed on rubber vibration isolators.
7. To maximize compressor reliability, multiple compressors within a module shall be started and operated in variable patterns to ensure equal run time on all compressors.
8. To ensure maximum efficiency throughout the system operation range, no compressor is required to run at maximum speed under any condition.

E. Outdoor Coil:

1. Coil shall be constructed of aluminum fins mechanically bonded to seamless copper tubes, which are cleaned, dehydrated, and sealed.
2. The coil configuration shall be 4-sided and fully separated from the machine compartment for more effective heat transfer and sound isolation.
3. The coil fins shall have a factory-applied corrosion resistant blue-fin finish.

F. Controls and Safeties:

Operating controls and safeties shall be factory selected, assembled, and tested. The minimum control functions shall include the following:

1. Controls:
 - a. Compressor speed to match the refrigerant flow and capacity with the system requirements.
 - b. Outdoor fan motor speed for higher efficiency and lower sound.
 - c. Oil control for improved system reliability and comfort
 - d. Pulse modulating valve control for precise control of the refrigerant distribution and accurate capacity management to avoid starving any units.
 - e. Control of compressor staging to maximize reliability and minimum run time on all compressors.
 - f. Module control of compressor operation, compressor speed, and outdoor heat exchanger surface to maximize efficiency and sound level and reliability across the entire operating range of the system.

- g. Control of the outdoor heat exchanger surface (main vs sub heat exchangers) for maximum efficiency and comfort.
2. Safeties:
The following safety devices shall be part of the condensing unit:
- a. High-pressure switch
 - b. Fuses
 - c. Crankcase heater
 - d. Fusible plug
 - e. Overcurrent relay for the compressor
 - f. Thermal protectors for compressor and fan motor
 - g. Compressor time delay
 - h. Oil recovery system
 - i. Oil level sensor
 - j. Overcurrent sensor
 - k. Compressor suction and discharge temperature sensor
 - l. Compressor suction and discharge pressure sensor

G. Electrical Requirements:

- 1. All sizes shall utilize 208/230-3-60 or 460-3-60 (V-Ph-Hz) field power supply.
- 2. Multiple systems shall have separate field power supply to each module.
- 3. Two-core, standard, shielded low voltage cable shall be required for communication between outdoor and indoor unit.
- 4. All power and control wiring must be installed per NEC and all local electrical codes.

H. Refrigerant Piping and Line Lengths:

- 1. Piping connections shall be from the front or the bottom of the unit. The unit shall be capable of operating with maximum connected refrigerant line lengths up to 3281 (ft) actual based on total system capacity and refrigerant amount.
- 2. The outdoor unit shall have the ability to operate with a maximum height of 230 ft between the outdoor and the lowest indoor unit.
- 3. The maximum distance between the outdoor unit and the furthest fan coil shall not exceed 623 ft actual or 771 ft equivalent. No line size changes or oil traps shall be required.
- 4. The system shall be capable of operating when the height difference between the upper and the lower fan coil is 131 ft.

I. Auxiliary Refrigerant Components:

1. All field-supplied copper tubing connecting the outdoor unit to the indoor unit shall use factory-supplied branching kits consisting of either Y joints or headers to ensure even refrigerant flow.
2. To ensure piping flexibility, the system shall allow having Y joints or headers downstream of another header.
3. When combining multiple modules, and in order to maximize efficiency and comfort, a 3/8-in. oil balance line shall be used to allow the flow oil and refrigerant between the two units, even when one of the units is not running.

END OF SECTION

SECTION 23 80 02
HIGH-WALL INDOOR VARIABLE REFRIGERANT FLOW FAN/COIL EQUIPMENT

PART 1 – GENERAL

- 1.01 SYSTEM DESCRIPTION
Indoor, high wall mounted, direct-expansion indoor units are matched with heat pump or heat recovery VRF (variable refrigerant flow) outdoor unit.
- 1.02 QUALITY ASSURANCE
Unit shall be ETL (Engineering Testing Laboratory) listed and certified to UL 1995 4th edition standard.
- 1.03 DELIVERY, STORAGE, AND HANDLING
Units shall be stored and handled per unit manufacturer's recommendations.
- 1.04 Warranty (For Inclusion by Specifying Engineer)

PART 2 – PRODUCTS

- A. Manufacturers: Toshiba, Mitsubishi, Daikin.
1. Basis of Design: [Toshiba]
- 2.01 EQUIPMENT
- A. General:
Indoor, direct-expansion, wall-mounted fan coil. Unit shall be complete with coil, fan driven by DC inverter motor, PMV (pulse modulating valve), piping connectors, electrical controls, microprocessor control system, and integral temperature sensing. Unit shall be furnished with integral wall mounting bracket and mounting hardware.
- B. Unit Cabinet:
Cabinet discharge and inlet grilles shall be attractively styled, high-impact nonmetallic material.
- C. Fans:
1. Fan shall be tangential direct-drive blower type with air intake at the top of the unit and discharge at the bottom front. Automatic, motor-driven vertical air sweep shall be standard.
2. Vertical air sweep operation shall be user selectable using the remote control and the horizontal air direction may be set manually.
- D. Coil:
Coil shall be copper tube with aluminum fins and galvanized steel tube sheets. Fins shall be bonded to the tubes by mechanical expansion and specially coated for enhanced wettability. A drip pan under the coil shall have a factory-installed drain connection (on both ends) for hose attachment to remove condensate.
- E. Motors:
Motors shall be totally enclosed, permanently lubricated ball bearing with inherent overload protection. Fan motors shall be inverter controlled variable speed.
- F. Controls:
The system shall be microprocessor-controlled to maintain precise room temperature and minimum power consumption. The controls system shall employ a genetic algorithm for temperature control. Any of the following user interface accessories shall be compatible with the unit.
1. Wireless Remote Controller
Wireless remote controller kit shall include a hand held device and a receiver integral to the unit.

2. **Wired Remote Controller (Lite Vision Plus)**
 Wired remote controller shall communicate over two-core shielded wire up to 1640 ft. It shall be capable of controlling groups of up to 8 indoor units. It shall be able to operate as a primary or secondary controller when two remote controllers are connected to a single indoor unit or group. The system shall be able to be configured so that the return air (TA) can be sensed at the unit, at the remote controller or through a remote sensor. The local controller shall minimally be able to control On-OFF, set point, mode, and be able to display system generated error codes.

3. **Central Controller (Smart Manager)**
 Central controller shall communicate over two-core shielded wire up to 6500 ft and use existing indoor – outdoor communication protocol to communicate. A single central controller shall be capable of controlling up to 128 indoor units individually with capability to program maximum of 10 setups for each day. It shall be able to create 2 indoor unit line-ups with 64 units on each line. It shall provide master, weekly, four special day and monthly scheduling feature. During schedule operation, user can set the power status (ON/OFF), operation mode, temperature setup, and remote control operation, restricted / allowed, return back and ventilation operation. It shall provide a web interface for remote monitoring, control, and scheduling. It shall be capable of monitoring energy consumption for each tenant and generate monthly billing reports.

4. **Central Controller (Touch Screen)**
 Central controller shall communicate over two-core shielded wire up to 1600 ft and use existing indoor – outdoor communication protocol to communicate. A single central controller shall be capable of controlling up to 512 indoor units individually with capability to program maximum of 20 setups for each day. It shall provide master, weekly, five special day and monthly scheduling feature. In addition, an optional digital I/O interface shall provide alarm, fire and locking signals. It shall provide a web interface for remote monitoring, control, and scheduling. It shall be capable of monitoring energy consumption for each tenant and generate monthly billing reports.

5. **Management Systems**
 The system shall be able to be controlled by BACnet* or LonWorks† protocols either directly or through an external gateway.
 BACnet and LonWorks shall be able to control:
 - a. ON / OFF
 - b. operation mode
 - c. fan speed
 - d. louver
 - e. set temperature
 - f. permit / prohibit local operation
 BACnet and LonWorks shall be able to monitor:
 - a. ON / OFF
 - b. operation mode
 - c. fan speed

- d. louver
 - e. set temperature
 - f. permit / prohibit local operation
 - g. room temperature
 - h. error status
 - i. error code
6. The unit shall have the following functions as a minimum:
- a. Selectable automatic restart. After power failure the system will restart at the same operating conditions as before the failure.
 - b. Temperature-sensing controls shall sense return air temperature at the unit or at the remote control
 - c. Indoor coil freeze protection in both cooling and heating (reversing valve failure) modes.
 - c. Automatic air sweep control to provide multiple operating modes of the air sweep louvers.
 - d. Dehumidification mode shall provide increased latent removal through total system modulation.
 - e.
 - f. Fan-only operation to provide room air circulation when no cooling is required.
 - g.
 - h. Fan speed control shall be user-selectable: high, medium, low, or microprocessor determined (Auto) based on the differential between the room temperature and the set point during all modes of operations.
 - i.
 - g. Indoor coil high temperature protection shall be provided to detect excessive indoor discharge temperature in heating.
 - h. Cold blow prevention in heating.
 - i. Adjustable compensation for air stratification in heating.

G. Filters:

Unit shall have factory-supplied resin net (cleanable) type filters. The return air filter material shall have the following characteristics:

- 1. Odorless
- 2. Temperature resistant to 185 F
- 3. Humidity resistant up to 95% RH

H. Electrical Requirements:

Indoor units are 208/230-1-60 (V-Ph-Hz).

I. Special Features (Accessories):

Condensate pump

END OF SECTION

SECTION 23 80 03

HEAT RECOVERY VARIABLE REFRIGERANT FLOW EQUIPMENT

PART 1 – GENERAL

1.01 SYSTEM DESCRIPTION

A. SUMMARY

a. Related Requirements:

1. Division 01: General Requirements.
2. Section 22 1000: Plumbing.
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 0923: Environmental Control and Energy Management System.

The heat recovery variable refrigerant flow system is a three-pipe system consisting of a single or multiple outdoor units, multiple indoor units of various types and capacities, and multiple flow selector boxes, individual or central indoor unit controls with on/off temperature settings, all connected by fully insulated refrigerant lines utilizing factory-supplied, fully insulated branching kits. Indoor units are connected to condensate piping that shall be terminated to the nearest drain point.

- B. The system shall be fully capable of simultaneous heating and cooling operation as requested by the individual indoor zones that can consist of single or multiple indoor units.
- C. The maximum number of connected indoor units shall not exceed 64.
- D. The total connected indoor unit capacity shall range between 50 and 150% of the outdoor unit capacity.

1.02 QUALITY ASSURANCE

- A. Units shall be listed by ETL (Engineering Testing Laboratory) and be evaluated in accordance with UL standard 1995, 4th. edition.
- B. Units shall be listed in the AHRI directory.
- C. All units shall meet the Federal minimum efficiency standards and be tested per AHRI 1230 Standard

1.03 DELIVERY, STORAGE, AND HANDLING

- A. Units shall be shipped in one piece and shall be stored and handled per unit manufacturer's recommendations.
- B. Units shall be supplied with a base rail that provides openings for moving the unit by fork truck or rigging the unit by crane.

1.04 WARRANTY

- A. Compressors shall be provided with manufacturer's five year warranty, replacement only.

PART 2 - PRODUCTS

2.01 EQUIPMENT

- A. Manufacturers: Toshiba, Mitsubishi, Daikin.

- 1. Basis of Design: [Toshiba]

General:

Factory-assembled, single-piece, air-cooled outdoor unit. Contained within the unit enclosure shall be all factory wiring, piping, controls, and the multiple inverter-driven twin rotary compressors.

- 1. The maximum sound pressure rating for a single module shall not exceed 66.5 dBA sound pressure in cooling and 67.0 dBA in heating. For twinned systems the sound pressure level shall not exceed 69.5 dBA and 70.0 dBA. For 3-module systems the sound pressure level shall not exceed 71.5 dBA and 71.5 dBA. Sound pressure ratings are measured at a distance of 3.28 ft out and 4.92 ft up from the side of the outdoor unit.
 - 2. The outdoor unit shall include an oversized accumulator and a liquid tank for proper heating performance while allowing the indoor unit PMV (pulse modulating valve) metering device to shut off completely when a zone is satisfied.
 - 3. The outdoor unit shall be protected by a high-pressure switch, high-pressure sensor, low-pressure sensor, fusible plug, PC board, and an inverter overload protector.
 - 4. The outdoor unit shall be capable of operating in cooling mode down to 14 F dry bulb ambient air temperature and down to -13 F wet bulb ambient air temperature in heating. For simultaneous heating and cooling the unit shall be capable of operating between 14 F and 60 F ambient air temperature.
 - 5. The outdoor unit shall include a total oil management system that balances oil between compressors within a module, replenishes compressor oil to the compressors in a module from the oil separator if required, and allows oil and refrigerant to move between twinned or 3-module units if required, even if one of the units is not running.

B. Unit Cabinet:

- 1. Unit cabinet shall be constructed of pre-coated steel, finished on both inside and outside.
 - 2. Unit access panels shall be removable with minimal screws and shall provide full access to the compressors, fan, and control components.
 - 3. Compressors shall be isolated in a compartment and have an acoustic wrap to assure quiet operation.
 - 4. The outdoor unit control panel shall include a sliding window to access adjustable controls and an LED display for setup and diagnostics.
 - 5. Unit cabinet shall be capable of withstanding 500-hour salt spray test per Federal Test Standard No. 141 (method 6061).

C. Fans:

1. Outdoor fan shall discharge air vertically and be driven by a DC-inverter variable-speed motor with 64 steps that is capable of running down to 60 rpm.
2. Outdoor fan motor shall be totally-enclosed with permanently-lubricated bearings.
3. Motor shall be protected by internal thermal overload protection.
4. Fan blade shall be non-metallic and shall be statically and dynamically balanced.
5. Outdoor fan shall be protected by a raised non-metallic protective grille.

D. Compressors:

1. Each outdoor unit module shall be equipped with two inverter-driven twin rotary compressors with full-range control to an accuracy of ± 0.1 Hz.
2. Compressor shall be totally enclosed in the machine compartment.
3. Compressors shall be equipped with factory-mounted crankcase heaters.
4. Internal safety logic shall protect the compressor from over-temperature operation.
5. Motor shall be suitable for operation in an R-410A refrigerant atmosphere.
6. Compressor assembly shall be installed on rubber vibration isolators.
7. To maximize compressor reliability, multiple compressors within a module shall be started and operated in variable patterns to ensure equal run time on all compressors.
8. To ensure maximum efficiency throughout the system operation range, no compressor is required to run at maximum speed under any condition.

E. Outdoor Coil:

1. Coil shall be constructed of aluminum fins mechanically bonded to seamless copper tubes, which are cleaned, dehydrated, and sealed.
2. The coil configuration shall be 4-sided and fully separated from the machine compartment for more effective heat transfer and sound isolation.
3. The coil fins shall have a factory-applied corrosion resistant blue-fin finish.

F. Controls and Safeties:

Operating controls and safeties shall be factory selected, assembled, and tested. The minimum control functions shall include the following:

1. Controls:
 - a. Compressor speed to match the refrigerant flow and capacity with the system requirements.
 - b. Outdoor fan motor speed for higher efficiency and lower sound.
 - c. Oil control for improved system reliability and comfort
 - d. Pulse modulating valve control for precise control of the refrigerant distribution and accurate capacity management to avoid starving any units.

- e. Control of compressor staging to maximize reliability and minimum run time on all compressors.
 - f. Module control of compressor operation, compressor speed, and outdoor heat exchanger surface to maximize efficiency and sound level and reliability across the entire operating range of the system.
 - g. Control of the outdoor heat exchanger surface (main vs sub heat exchangers) for maximum efficiency and comfort.
2. Safeties:
The following safety devices shall be part of the condensing unit:
- a. High-pressure switch
 - b. Fuses
 - c. Crankcase heater
 - d. Fusible plug
 - e. Over current relay for the compressor
 - f. Thermal protectors for compressor and fan motor
 - g. Compressor time delay
 - h. Oil recovery system
 - i. Oil level sensor
 - j. Over-current sensor
 - k. Compressor suction and discharge temperature sensor
 - l. Compressor suction and discharge pressure sensor

G. Electrical Requirements:

- 1. All sizes shall utilize 208/230-3-60 or 460-3-60 (V-Ph-Hz) field power supply.
- 2. Modular systems shall have separate field power supply to each module.
- 3. Two-core, stranded, shielded low voltage cable shall be required for communication between outdoor and indoor unit.
- 4. All power and control wiring must be installed per NEC and all local electrical codes.

H. Refrigerant Piping and Line Lengths:

- 1. Piping connections shall be from the front or the bottom of the unit.
- 2. The unit shall be capable of operating with maximum connected refrigerant line lengths of 3281 ft (actual).
- 3. The outdoor unit shall have the ability to operate with a maximum height of 230 ft. between the outdoor and the lowest indoor unit.

4. The maximum distance between the outdoor unit and the furthest fan coil shall not exceed 591 ft actual or 656 ft equivalent. No line size changes or oil traps shall be required.
5. The system shall be capable of operating when the height difference between the upper and the lower fan coil is 131 ft.

I. Auxiliary Refrigerant Components:

1. All field supplied copper tubing connecting the outdoor unit to the indoor unit shall use factory-supplied branching kits consisting of either Y joints or headers to ensure even refrigerant flow.
 2. To ensure piping flexibility the system shall allow having Y joints or headers downstream of
 3. another header.
3. For modular systems, in order to maximize efficiency and comfort, a 3/8-in. oil balance line shall be used to allow the flow of oil and refrigerant between the modular units even when one of the units is not running.
4. A flow selector box will be required to regulate the flow of high-pressure hot gas or high-pressure liquid to the fan coil requiring heating or cooling.
5. Up to 8 fan coils, all requiring same duty cycle, may be connected to a single flow selector box.
6. A fan coil that runs in cooling only shall not be required to connect to a flow selector box.
7. The single port flow selector box can be installed up to 49 ft from the indoor unit.
8. The multi port flow selector box can be installed up to 164 ft from the indoor unit.
9. The single port flow selector box shall be wired from the indoor unit using a factory-supplied power and control wire harness.
10. The multi port flow selector box shall be powered by a dedicated 208/230-1-60 field power supply.
11. The single port flow selector box shall not require a drain connection.
12. The multi port flow selector shall require a drain connection.
13. The single port and multi port flow selector box shall include a galvanized steel enclosure, and shall be tested prior to shipment.
14. The single port flow selector box shall include full interior insulation.

END OF SECTION

SECTION 23 81 26
SPLIT-SYSTEM AIR-CONDITIONERS

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SUMMARY

- A. This Section includes split-system air-conditioning and heat pump units consisting of separate evaporator-fan and compressor-condenser components. Units are designed for exposed or concealed mounting, and may be connected to ducts.

1.03 SUBMITTALS

- A. Product Data: Include rated capacities, furnished specialties, and accessories for each type of product indicated. Include performance data in terms of capacities, outlet velocities, static pressures, sound power characteristics, motor requirements, and electrical characteristics.
- B. Shop Drawings: Diagram power, signal, and control wiring.
- C. Samples for Initial Selection: For units with factory-applied color finishes.
- D. Field quality-control test reports.
- E. Operation and Maintenance Data: For split-system air-conditioning units to include in emergency, operation, and maintenance manuals.
- F. Warranty: Special warranty specified in this Section.

1.04 QUALITY ASSURANCE

- A. Product Options: Drawings indicate size, profiles, and dimensional requirements of split-system units and are based on the specific system indicated. Refer to Division 01 Section "Product Requirements."
- B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
- C. Energy-Efficiency Ratio: Equal to or greater than prescribed by ASHRAE 90.1, "Energy Efficient Design of New Buildings except Low-Rise Residential Buildings."
- D. Coefficient of Performance: Equal to or greater than prescribed by ASHRAE 90.1, "Energy Efficient Design of New Buildings except Low-Rise Residential Buildings."
- E. Units shall be designed to operate with HCFC-free refrigerants.

1.05 COORDINATION

- A. Coordinate size and location of concrete bases for units. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork are specified in Division 03 Section "Cast-in-Place Concrete."
- B. Coordinate size, location, and connection details with roof curbs, equipment supports, and roof penetrations specified in Division 07 Section "Roof Accessories."

1.06 WARRANTY

- A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of split-system air-conditioning units that fail in materials or workmanship within specified warranty period.
 - 1. Parts Only Warranty Period from date of Substantial Completion:
 - a. Compressor: Five Years
 - b. All other components: One Year

1.07 EXTRA MATERIALS

- A. Furnish extra materials described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 - 1. Filters: One set of filters for each unit.
 - 2. Fan Belts: One set of belts for each unit.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

- A. Basis-of-Design Product: Subject to compliance with requirements, provide the product indicated on Drawings, or a comparable product by one of the following:
 - 1. Carrier Air Conditioning; Div. of Carrier Corporation.
 - 2. Mitsubishi Electronics America, Inc.; HVAC Division.
 - 3. Trane Company (The); Unitary Products Group.
- B. Wiring Terminations: Connect motor to chassis wiring with plug connection.

2.02 CEILING-MOUNTING, EVAPORATOR FAN COMPONENTS

- A. Cabinet: Enameled steel with removable panels on front and ends in color selected by Architect, and discharge drain pans with drain connection.
- B. Refrigerant Coil: Copper tube, with mechanically bonded aluminum fins, complying with ARI 210/240, and with thermal-expansion valve.
- C. Fan: Direct drive, centrifugal fan and integral condensate pump.

- D. Fan Motors: Comply with requirements in Division 23 Section "Common Motor Requirements for HVAC Equipment."
 - 1. Special Motor Features: Multitapped, multispeed with internal thermal protection and permanent lubrication.
- E. Filters: Permanent, cleanable.

2.03 AIR-COOLED, COMPRESSOR-CONDENSER COMPONENTS

- A. Casing: Steel, finished with baked enamel in color selected by Architect, with removable panels for access to controls, weep holes for water drainage, and mounting holes in base. Provide brass service valves, fittings, and gage ports on exterior of casing.
- B. Compressor: Hermetically sealed with crankcase heater and mounted on vibration isolation. Compressor motor shall have thermal- and current-sensitive overload devices, start capacitor, relay, and contactor.
 - 1. Compressor Type: Scroll.
 - 2. Refrigerant Charge: R-410A.
- C. Refrigerant Coil: Copper tube, with mechanically bonded aluminum fins, complying with ARI 210/240, and with liquid subcooler.
- D. Heat Pump Components: Reversing valve and low-temperature air cut-off thermostat.
- E. Fan: Aluminum-propeller type, directly connected to motor.
- F. Motor: Permanently lubricated, with integral thermal-overload protection.
- G. Low Ambient Kit: Permits operation down to 45 deg F.
- H. Mounting Base: Polyethylene.

2.04 ACCESSORIES

- A. Control equipment and sequence of operation are specified in Division 23 Sections "Instrumentation and Control for HVAC" and "Sequence of Operations for HVAC Controls."
- B. Thermostat: Low voltage with subbase to control compressor and evaporator fan.
- C. Thermostat: Wireless infrared functioning to remotely control compressor and evaporator fan, with the following features:
 - 1. Compressor time delay.
 - 2. 24-hour time control of system stop and start.
 - 3. Liquid-crystal display indicating temperature, set-point temperature, time setting, operating mode, and fan speed.
 - 4. Fan-speed selection, including auto setting.

- D. Automatic-reset timer to prevent rapid cycling of compressor.
- E. Refrigerant Line Kits: Soft-annealed copper suction and liquid lines factory cleaned, dried, pressurized, and sealed; factory-insulated suction line with flared fittings at both ends.
- F. Additional Monitoring:
 - 1. Monitor constant and variable motor loads.
 - 2. Monitor variable frequency drive operation.
 - 3. Monitor economizer cycle.
 - 4. Monitor cooling load.
 - 5. Monitor air distribution static pressure and ventilation air volumes.

PART 3 - EXECUTION

3.01 INSTALLATION

- A. Install units level and plumb.
- B. Install evaporator-fan components using manufacturer's standard mounting devices securely fastened to building structure.
- C. Install ground-mounting, compressor-condenser components on 4-inch- thick, reinforced concrete base; 4 inches larger on each side than unit. Concrete, reinforcement, and formwork are specified in Division 03 Section "Cast-in-Place Concrete." Coordinate anchor installation with concrete base.
- D. Install ground-mounting, compressor-condenser components on polyethylene mounting base.
- E. Install roof-mounting compressor-condenser components on equipment supports specified in Division 07 Section "Roof Accessories." Anchor units to supports with removable, cadmium-plated fasteners.
- F. Install seismic restraints.
- G. Install compressor-condenser components on elastomeric isolators. Refer to Division 23 Section "Vibration and Seismic Controls for HVAC Piping and Equipment."
- H. Install and connect precharged refrigerant tubing to component's quick-connect fittings. Install tubing to allow access to unit.
- I. Insulate piping per manufacturer's recommendations and per California Energy Code requirements.

3.02 CONNECTIONS

- A. Install piping adjacent to unit to allow service and maintenance.

- B. Duct Connections: Duct installation requirements are specified in Division 23 Section "Metal Ducts." Drawings indicate the general arrangement of ducts. Connect supply and return ducts to split-system air-conditioning units with flexible duct connectors. Flexible duct connectors are specified in Division 23 Section "Air Duct Accessories."
- C. Ground equipment according to Division 26 Section "Grounding and Bonding for Electrical Systems."
- D. Electrical Connections: Comply with requirements in Division 26 Sections for power wiring, switches, and motor controls.

3.03 FIELD QUALITY CONTROL

- A. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect field-assembled components and equipment installation, including connections. Report results in writing.
- B. Perform the following field tests and inspections and prepare test reports:
 - 1. Leak Test: After installation, charge system and test for leaks. Repair leaks and retest until no leaks exist.
 - 2. Operational Test: After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation.
 - 3. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
- C. Remove and replace malfunctioning units and retest as specified above.

3.04 STARTUP SERVICE

- A. Engage a factory-authorized service representative to perform startup service.
 - 1. Complete installation and startup checks according to manufacturer's written instructions.

3.05 DEMONSTRATION

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain units. Refer to Division 01 Section "Demonstration and Training."

END OF SECTION

**SECTION 26 05 00
COMMON WORK RESULTS FOR ELECTRICAL**

PART 1 - GENERAL

1.01 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. Division 09 - Painting and Coating.
 - 3. Division 31 - Excavating, backfilling and compacting for utilities.
 - 4. Division 23 - HVAC.

- C. Applicable Standards
 - 1. ASTM D 709 (2007) – Laminated Thermosetting materials.
 - 2. ANSI/NEMA FB-1 (2010) – Standard for Fittings, Cast Metal Boxes, and Conduit Bodies for Conduit, Electrical Metallic Tubing, and Cable.
 - 3. ANSI/NEMA 250 (2008) – Enclosure for Electrical Equipment (1000 Volts Maximum).
 - 4. California Electrical Code (CEC).
 - 5. UL 1 (2005) – Standard for Flexible Metal Conduit.
 - 6. UL 1242 (2007) – Standard for Electrical Intermediate Metal Conduit.
 - 7. UL 6 (2010) – Electrical Rigid Metal Conduit-Steel.
 - 8. UL 797 (2007) – Electrical Metallic Tubing-Steel.
 - 9. UL 870 (2008) – Standard for Wireways, Auxiliary Gutters, and Associated Fittings

1.02 BASIC ELECTRICAL REQUIREMENTS

A. DESCRIPTION

1. Provide all labor materials and equipment necessary for general electrical requirements where shown on the contract drawings and specified herein.
2. Included Work:
 - a) Provide all labor, materials, equipment, tools and appliances required to furnish and install all electrical work as shown on the Contract Drawing and the specifications. All systems must be constructed complete and operable. The scope includes but not limited to the following:
 - 1) All construction power and lighting and power for testing equipment and systems through final acceptance of test.
 - 2) Power, low voltage and lighting raceway(s) underground inside the property line boundaries.
 - 3) All underground power and low voltage conduits on and off site per the utility company's requirements, plans and provisions.
 - b) Complete lighting and power system(s) including branch circuits, fixtures, outlets, lamps, switches, controllers, and auxiliary equipment.
 - c) Complete distribution system(s) including switchboards, panel boards, transformers, feeders, and auxiliary equipment.
 - d) Complete system of exterior (vandal resistant) lighting.
 - e) Complete Grounding System.
 - f) All systems to be functional and tested.
 - g) All control wiring and devices for equipment specified in Sections of Division 26 and other technical Sections, except where specifically indicated or noted otherwise on the Contract Drawings or in the Specifications.
 - h) Complete, operable and certified fire alarm system.
 - i) All testing for all installed systems including all owner furnished items.
 - j) Applicable excavating, trenching and backfilling.

B. Quality Assurance:

1. Workers possessing the skills and experience obtained in performing work of similar scope and complexity shall perform the Work of this Division.
2. Refer to other sections of the Specifications for other qualification requirements.

C. 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 conduit. 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.
6. Coordinate electrical equipment and materials installation with building components and the Work of other trades
7. As much as practical, connect equipment for ease of disconnecting, with minimum of interference with other installations.
8. Coordinate connection of electrical systems with existing underground utilities and services.

D. Terminology:

1. Signal Systems: Applies to bell, fire alarm, annunciator, sound, public address, buzzer, inter-communication and lighting control 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.

E. 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.

F. Structural Considerations for Conduit Routing:

1. Where conduits pass through or interfere with any structural member, or where notching, boring or cutting of the structure is necessary, or where special openings are required through walls, floors, footings, or other buildings elements, conform to

CBC, Part 2, Title 24, Section 1906.3 for conduits and pipes embedded in concrete and Sections 2308.9.10 and 2308.9.11 for notches and bored holes in wood; for steel, as detailed on the structural steel Shop Drawings.

2. Where a concrete encasement for underground conduit abuts a foundation wall or underground structure which the conduits enter, encasement shall rest on a haunch integral with wall or structure, or shall extend down to footing projection, if any, or shall be doweled into structure unless otherwise indicated. Underground structures shall include maintenance holes; pull boxes, vaults, and buildings.
3. Holes required for conduit entrances into speaker poles, floodlight poles or other poles, shall be drilled with the conduit nipple or coupling welded to poles. Welds shall be provided by the electric arc process and shall be continuous around nipple or coupling.

G. Electrically Operated Equipment and Appliances:

1. Furnished Equipment and Appliances:

- a. Work shall include furnishing and installing wiring enclosures for, and the complete connection of electrically operated equipment and 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. Connections shall be provided as necessary to install equipment ready for use. Equipment shall be tested for proper operation and, if motorized, for proper rotation. If outlets are of incorrect electrical characteristics or any specified equipment fails to operate properly, repair and/or replace the outlet and/or equipment.

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.

H. Submittals:

1. Conform to applicable provisions of Division I of the General Requirements and as hereinafter specified.
2. Prepare, review and coordinate schedule of submittals, determining necessary lead time for preparation, submitting, checking, and ordering and delivering materials and equipment to the job-site for timely arrival and conformance with the overall Construction schedule.
3. All submittals will be checked for general compliance with Specifications only. Contractor will be responsible for deviations from the Drawings or Specifications and for errors or omissions of any sort in the Submittals.
4. All required submittals on electrical items and equipment shall include complete catalog information such as construction ratings. insulation systems, including manufacturer's certification that items or equipment meet or exceed and Trade Standards, and the Specifications. All items must be U.L. listed or listed per a recognized by code listing agency.
5. Conform to applicable provisions of Division I of the General Requirements and as hereinafter specified.
6. Prepare, review and coordinate schedule of submittals, determining necessary lead time for preparation, submitting, checking, and ordering and delivering materials and equipment to the job-site for timely arrival and conformance with the overall Construction schedule.
7. All submittals will be checked for general compliance with Specifications only. Contractor will be responsible for deviations from the Drawings or Specifications and for errors or omissions of any sort in the Submittals.
8. All required submittals on electrical items and equipment shall include complete catalog information such as construction ratings. insulation systems, including manufacturer's certification that items or equipment meet or exceed and Trade Standards, and the Specifications. All items must be U.L. listed or listed per a recognized by code listing agency.

9. Equipment Floor Plans: Submit after approval of material and/or equipment is secured. Prepare for each electrical equipment room drawn to 2" = 1'-0" scale. Layout drawing shall be to exact scale.
10. Materials list of items and equipment proposed to be provided for the work of this Division and shall include at least the following as applicable:
 - a. Service and distribution switchboard.
 - b. Lighting panel boards.
 - c. Lighting control panels.
 - d. Conduits.
 - e. Conductors.
 - f. Electrical equipment layout at scale indicating on drawings of equipment,
 - g. Clearances.
 - h. Disconnect switches, pull boxes and fuses.
 - i. Lighting fixtures.
 - j. Fire alarm and detection system.
 - k. Control devices, standard and special receptacles, switches and finish device plates.
 - l. All fabricated equipment.
 - m. Time clocks, contactors, control switches, etc. including wiring diagrams and sequence of operation.
11. Short Circuit, Arc flash and Coordination Study.
 - a. Submit, along with switchgear and distribution equipment submittal, system short circuit study based on the per unit method or in accordance with the latest IEEE recommendations, Report to be submitted with the shop drawings of the main service and the distribution system, each copy bound with a stiff cover.
 - b. Provide Arc flash calculations and provide a sticker with the value and the recommended protective gear.

- c. Submit, along with the short circuit study, a coordination study of all protective devices, including the utility company protective device through all feeder devices on the secondary of each transformer downstream to each panel board and motor control center. Settings shall be incorporated with the coordination study. Study both short circuit and coordination studies~ comprising the power systems study shall be signed by California Registered Electrical Engineer who shall determine the adjustable settings for protective devices. All switchgear and distribution equipment shall comply with the results and recommendations of the studies. The ampere interrupting capacity (A.I.C.) rating of devices shall be a minimum of at least ten percent greater than the calculated value of symmetrical three-phase fault current at that respective device. All circuit breakers shall be fully rated. Series rated breakers shall not be accepted. Feeder lengths and materials shall be determined independently by the installing contractor, and documented in the study. Studies shall include entire system from normal utility source, emergency source down to panel boards, and individual feeder loads serving specific equipment.
- d. Studies to be done by switchgear manufacturer and shall include a tabular form indicating calculated fault value, the A.I.C. value and the available arc flash energy and the recommended protective gear at each equipment.

12. Special Submissions:

I. Test Reports for the following:

- a. Megger Readings: Ground system, motors and feeders.
- b. Voltage Readings: Distribution, service and motors.
- c. Fire alarm system.

I. 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.

J. 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.

K. WARRANTIES

- 1. Provide one year warranty on all material and labor performed as a minimum, unless noted otherwise in specific sections.

PART 2 - PRODUCTS - NOT USED

PART 3 - EXECUTION

3.01 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 OWNER.
- 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.
- G. **LEGAL REQUIREMENTS AND STANDARDS**
 - a. Required: Comply with the latest, as applicable and effective, during the progress of Contracted Work.
 - 1. Latest Ventura County, Electrical, Fire and Building Codes and Supplemental addendums and requirements.
 - 2. California State Administrative Code, Title 24, State Building Standard.
 - 3. (CAUOSHA) California State Occupational Safety and Health Act.
 - 4. California State Fire Marshal Standards.
 - 5. Southern California Edison.
 - 6. U.L. - Underwriters Laboratories Inc.
 - 7. NEC - National Electric Code.
 - 8. ASTM - American Society of Testing and Materials.
 - 9. Current publications of the National Fire Protection Association.
 - 10. National and American Standards Association.

- b. General compliance as applicable
 - 1. Drawings and specification requirements shall govern where they exceed Code requirements, in case of a conflict between the plans, the codes and the specifications, the more stringent shall apply.
 - 2. Where requirements between governing Codes and Regulations vary, the more restrictive provision shall apply.
 - 3. Nothing contained in Contract Documents shall be construed as authority or permission to disregard or violate legal requirements.

3.02 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.

3.03 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.

3.04 PRELIMINARY OPERATIONS

- A. Required; Should the District require that any portion of the systems or equipment be operated prior to the final scheduled dates for completion and acceptance of the work, the Contractor shall consent. Such operation shall be under the direct supervision of, and at the expense of the Contractor, and shall not be construed as an acceptance of any of the work by the District.

3.05 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.

3.06 PROTECTION

- A. Protect the Work of this section until Substantial Completion.

3.07 COMPLETION

- A. Protect The work will not be reviewed for final acceptance until operating and maintenance data, manufacturer's literature, panel directories and nameplates specified herein have been approved and properly posted or installed and final cleaning of equipment and premises has been completed.
- B. When the installation is complete and all adjustments have been made, operate the systems for a period of one week, during which time demonstrate to the Engineer that the systems are completed and operating in conformance with the Specifications.

END OF SECTION

**SECTION 26 05 13
BASIC ELECTRICAL MATERIALS AND METHODS**

PART 1 - GENERAL

1.01 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.

PART 2 - PRODUCTS

2.01 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 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 a sufficient number of 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.
6. Underground Concrete Pull Boxes:


- a. Pre-cast concrete pull boxes. Concrete pull boxes shall be traffic type, reinforced for H-20 wheel loading, pre-cast concrete. Pull boxes with inside dimensions of 2 feet by 3 feet by 3 feet deep shall consist of a base section, top ring, and cover. Base section shall be furnished with 2 knockouts measuring 10 inch by 10 inch in each 3 feet side, and one 20 inch by 20 inch knockout in each 2-foot side. Pull boxes with inside dimension 4 feet by 4 feet by 4 feet deep shall consist of a base section, midsection, topping, and cover. Base section shall be furnished with 2 knockouts measuring 8-inch by 16-inch on each of two opposite sides, and one 20-inch by 20-inch knockout on each of other two opposite sides. Pull boxes shall be furnished with a minimum of 6-inch diameter sump knockout and one inch diameter ground rod knockout. In pull boxes, furnish and install cable racks on walls. Racks shall be furnished with 3 porcelain cable holders on vertical steel mounting bars. Pull boxes shall be furnished with 3/4 inch diameter pull irons. Covers shall be traffic-type consisting of steel safety plate bolted to frame. Covers shall be marked as electrical, power, or signal as required. Pull boxes shall be as manufactured by Oldcastle Precast, Jensen Precast, Kistner, Western Precast, or equal.
 - b. Provide end bells in duct entrances. Terminate each metal conduit with insulated bushing provided with a grounding terminal.
 - c. Install pulling irons on opposite walls and below horizontal centerlines of ducts and bricked-up openings, and in bottom. Install pulling irons with each end hooked around a reinforcing bar.
 - d. Remove floor drain knockout and provide a depth of 24 inches of crushed rock below box extending a minimum of 12 inches beyond on all sides.
 - e. Permanently and effectively ground metal equipment cases, cable racks, and similar items in pull boxes to site grounding electrode system. Provide grounding conductor in compliance with CEC Article 250.
 - f. Provide 6-inch deep sand base under pull boxes.
 - g. Identify power and signal cables by tagging in manholes and pull boxes. Tie securely to cables with nylon cord.
 - h. Top of steel plate shall provide a minimum coefficient of static friction of 0.5 for either wet or dry locations, when tested for any shoe sole material. Test shall comply with ASTM D 1047 or F 489 or F 609 standards. Submit manufacturer's test results for Architect's review as part of materials and equipment submittals.
 - i. The use of underground extension boxes shall be limited to not more than 1 times the original depth of pull box.
7. Underground utility boxes shall be reinforced concrete with non-setting shoulders to prevent settlement following installation. Boxes shall be furnished with cast iron cover with finger hole, size as indicated on Drawings. Utility boxes shall be as manufactured by Oldcastle, Jensen, Kistner, Western Precast, or equal.

C. 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 Owner.
2. Locks shall be keyed to Corbin No. 60 keys for access to operate equipment and Corbin 70 keys for service access. Special keys and locks shall only be provided where specified.

2.02 RECEPTACLES AND SWITCHES

A. Wireless Controlled Receptacles:

1. The Duplex Controller shall be the Echoflex ERNR Series Split Duplex Controller by Echoflex Solutions, Inc., or equal. (Compatible with the Occupancy sensor Echoflex MOS-21U Series Occupancy Sensor by Echoflex Solutions, Inc., or equal).
 - a) Mechanical
 - 1) The Controller shall mount in a standard single-gang wall box
 - 2) The Controller shall have learn and clear buttons for manual linking of switches and sensors
 - a) The buttons shall be accessible when the Controller is mounted, prior to mounting the faceplate.
 - 3) The Controller shall have two LED indicators to display power and linked device information
 - 4) The Controller shall have LED arrows pointing to controlled side of receptacle so that controlled side is permanently marked and easily visible in dark locations
 - 5) The Controller shall have an embossed icon  so that the controlled side is permanently marked
 - b) Electrical
 - 1) The Controller shall support 120VAC power input
 - 2) The Controller shall provide a single normally open relay contact, fully rated for 15 amps to switch power to the controlled receptacle
 - a) The Controller shall have an auxiliary output controlled from the internal relay for wiring directly to other duplex receptacles
 - 3) The Controller shall use a 902 MHz EnOcean radio. Systems that use other radio frequencies shall not be acceptable
 - 4) The internal radio shall have a range of at least 80 feet through walls (laterally), up to 300 feet in open space

- 5) The Controller shall be ETL listed, conform to UL 508, and certified to CAN/CSA Standard C22.2 No.14
- 6) The Controller shall comply with FCC Part 15.231 and IC RSS-210
- c) Functional
 - 1) The Controller shall provide switching control for an individual load plugged into the controlled receptacle
 - a. The Controller shall support wireless Echoflex switches and sensors for relay control
 - 1) The Controller shall support linking of at least 20 wireless devices in any combination of Echoflex stations and sensors. Systems that do not support at least 20 stations or sensors shall not be acceptable
 - b. The Controller shall provide the option of single or dual-hop wireless signal repeating to other controllers. Systems that do not provide signal repeating shall not be acceptable
 - c. The Controller shall support Central Command functions for use with integrated control systems
 - d. The Controller shall support commissioning and linking through software and/or mechanical means. Controllers that do not support both shall not be acceptable
 - e. The Controller shall provide configuration variables that allow customization of the controllers operation with linked sensors and switches
 - f. The Controller shall provide the option of reporting relay status wirelessly
 - g. The Controller shall save all configuration settings and linked device details in non-volatile memory
 - 1) The Controller shall provide the option of saving user-defined configuration settings as recoverable default settings

B. Receptacles:

- 1. Duplex receptacles shall be heavy-duty specification grade, grounding type. Terminal screws shall be back and side wired 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.

NEMA #

Pass & Seymour

Hubbell

Leviton

(20 amps) NEMA 5-20	PS5362-I	HBL5362-I	5362-I
(15 amps) NEMA 5-15	PS5262-I	HBL5262-I	5262-I

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 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.

<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

4. 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.

<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

5. 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.

C. Switches:

1. Local Switches:

- a. Provide local switches, high strength thermoplastic toggle, specification 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

- b. Provide lock type switches, 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 Owner 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.

	<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

- 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 Owner. Switches shall be rated at 20 amps, 120-277 volt AC. Switch plates shall be of stainless steel, engraved with on and off positions indicated.

	<u>Arrow Hart</u>
Single pole	AH1191N
Double pole	AH1192N
Three way	AH1193N

- 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 long-lasting neon lamps. Pilot light shall light when load is on. Pilot light 120 volt switches

<u>Pass & Seymour</u>	<u>Hubbell</u>	<u>Leviton</u>
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Single pole	PS20AC1-RPL	HBL1221-PL	1221-PLR
Double pole	PS20AC2-RPL	HBL1222-PL	1222-PLR
Three way	PS20AC3-RPL	HBL1223-PL	1223-PLR

Same as above except rated at 20 amps at 277 volts.

	<u>Pass & Seymour</u>	<u>Leviton</u>	<u>Hubbell</u>
Single pole	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

	<u>Pass & Seymour</u>	<u>Hubbell</u>	<u>Leviton</u>
	1251-I	HBL1557-I	1285-I

- 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.

	<u>Pass and Seymour</u>	<u>Hubbell</u>	<u>Leviton</u>
	1225-I	HBL 1385	1285-I

- g. Momentary Contact locking key type switch. 20A 120/277V center off. Key shall be Owner standardized vertically oriented, tamper resistant, forked key with two each 5/16" long forks, 5/32" spacing between forks and 5/16" width overall.

Arrow Hart

AH1995L w/ AH2000 key

- h. Momentary Contact switch low voltage 1 pole 3A 24VAC 3 position center off. Key for locking switch shall be Owner standardized vertically oriented, tamper resistant, forked key with two each 5/16" long forks, 5/31" spacing between forks and 5/16" width overall.

Pass and Seymour

Toggle	1081I
Locking	1081KGRY w/#500 Key

2. Time Switches and Photoelectric Controls for existing construction; use section 26 09 23 for new 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. Contacts rated for 25 amps resistive or inductive, 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. Time switches; Paragon Model EC7000 Series, Tork Model EW 101B series, Intermatic ET7000 series, or equal. Features required for application:

- 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 V.
- 9) 365-day advance scheduling.

b. 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, Tork series 2100, or equal.

3. Emergency Lighting Control Unit

a. The Emergency Lighting control Unit shall provide all required functionality to allow an 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, or 2 amp tungsten loads at 120 VAC, 60Hz.
 - 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. Device shall be WattStopper ELCU-100 Emergency Lighting Control Unit, LVS #EPC-PM Series, Lighting Control Design #GR 2001 series or Equal.
4. Station Main Entrance Intercom Station:
- a. Provide Panasonic video intercom system VL-SV30BX (or equal) . locate per plans and install per manufacturer recommendations.
5. Cords and Caps:
- A. Manufacturers:
 - 1. Rome Cable Corporation
 - 2. Hubbell
 - 3. Or equal

Attachment Plug Construction to Conform to NEMA WD 1 match receptacle configuration to outlet provided for equipment.
 - B. Cord Construction: ANSII/NFPA 70, Type SO multiconductor flexible cord with identified equipment -grounding conductor. Suitable for use in damp locations and Suitable for connected load of equipment, length of cord, and rating of branch circuit overcurrent protection.

2.03 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.

C. Warning Signs:

1. Provide signs of standard manufacture, 18 gage steel, with porcelain enamel finish. Provide red lettering on a white background.

PART 3 - EXECUTION

3.01 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 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, Cooper B-Line 78101140346 or equal nut and a Tomic No. 711-B Adapta-Stud, or 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. Outlet boxes for fire alarm pull stations shall be mounted at 45 inches above finished floor to insure that the operating handle of the initiating device is no higher than 48 inches at finished floor. Under no circumstances shall operating handle of the device exceed 48 inches above finished floor regardless of indicated height on drawing.
2. 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.
3. 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 equal protective covers for devices when required.
4. 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.
5. 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.
6. Install fire alarm strobe lights 80 inches to bottom of light above finished floor.
7. 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.
8. Install power receptacle outlets 15 inches above finished floor.
9. Install panelboards and terminal cabinets 6 feet 6 inches from finish floor to top of cabinet.
10. Install television outlets at a height corresponding to location of television monitor, or a minimum of 15 inches above finished floor.

3.02 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.

3.03 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, 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.

3.04 PROTECTION

- A. Protect Work of this section until Substantial Completion.

3.05 CLEANUP

- A. Remove rubbish, debris, and waste materials and legally dispose of off Project site.

END OF SECTION

SECTION 26 05 19
LOW-VOLTAGE WIRES (600 VOLT AC)

PART 1 - GENERAL

1.01 SUMMARY

- A. Provisions of Division 01 apply to this section.
- B. Section Includes: Low-voltage wire, splices, terminations and installation.

1.02 SUBMITTALS

- A. Provide in accordance with Division 01.

PART 2 - PRODUCTS

2.01 WIRES

- A. Wires shall be single conductor type THHN, THWN or THWN-2 insulated with polyvinyl chloride and covered with a protective sheath of nylon, rated at 600 volts. Wires may be operated at 90 degrees C. maximum continuous conductor temperature in dry locations, 90 degrees C. in wet locations for sizes 8 AWG and larger and 75 degrees C in wet locations for sizes 10 AWG and smaller, and shall be listed by UL Standard 83 for thermoplastic insulated wires, listed by Underwriter's Laboratories (UL) for installation in accordance with Article 310 of the California Electrical Code (CEC). Conductors shall be solid copper for 12 AWG and smaller conductors, and stranded copper for 10 AWG and larger conductors. Conductors shall be insulated with PVC and sheathed with nylon. 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. Wires shall be tested in accordance with the requirements of UL standard for types THWN-2, THWN or THHN.
- B. 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).

2.02 STANDARDS

- A. THWN/THHN and THWN-2/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

3.01 INSTALLATION

- A. Wires shall not be installed until debris and moisture is removed from conduits, boxes, and cabinets. Wires stored at the 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. 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.
- D. At outlets for light, power, and signal equipment, provide pigtail splices with 8-inch circuit conductor leads for connection to fixtures, equipment, and devices.
- E. Pressure cable connectors, pre-insulated 3M Scotchlok, Hubbell Power, O-Z/Gedney or equal, Y, R or B spring-loaded twist-on type, may be furnished in splicing number 8 AWG or smaller wires for wiring systems, except public address and telephone systems.
- F. 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.
- G. Connections to any bussing and high-pressure 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.
- H. 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.
- I. 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.
- J. 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.
- K. Maintain the conductor required bending radius.
- L. 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.
- M. 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.
- N. 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.

3.02 COLOR CODES

A. General Wiring:

1. 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.

2. 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.
- 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:
1. Fire Alarm Systems:
 - a. Notification Devices (Signal Loop Circuits)
Strobes: Red = Positive, Black = Negative
Horns: Red = Positive, Black = Negative
 - b. Initiating Devices (Alarm Loop Circuits):
Pull Stations: Yellow and Blue
Smoke Detectors (Circuit): Orange and Brown
Thermal Detectors (Circuit): Orange and Brown
Air Duct Smoke Det. (Circuit): Purple and Gray
 - c. Initiating Device (Power Circuit): Red = Positive, Black = Negative.
 - d. Interlocks: Red = Positive, Black = Negative
 - e. AC Power: Black and White

All underground wiring to be XHHW insulation rated for wet location.
 2. Program Clock Circuits:
 - a. Clocks: Run Black (Label - CRUN)
Reset Red (Label - CRST)
Common = White (Label - - CC)
 - b. Program Bells: Pink 1st Period (Label - PB1P)
Pink 2nd Period (Label - PB2P)
Pink 3rd Period (Label - PB3P)
Pink 4th Period (Label - PB4P)
Pink = 5th Period (Label - PB5P)

- Pink 6th Period - (Label - PB6P)
Common = White (Label - PBC)
- c. Night Lights: Brown = N.L. On (Label - NLON)
Brown = N.L. Off (Label - NLOFF)
Common White (Label - NLC)
- d. Heat: Purple Heat On (Label - HON)
Purple Heat Off (Label - HOFF)
Common White (Label - HC)
- e. Toilet Flush: Yellow Flush On (Label - TFON)
Common White (Label - TFC)

3. Additional requirements:

- a. All existing outside bells to be identified and labeled on and at each terminal block.
- b. All existing classroom buzzers to be identified and labeled on and at each terminal block.
- c. All existing relays located at the master clock to be identified and labeled as to what it controls. Each relay shall be labeled by the use of a white label and black lettering.
- d. All wires shall be identified and labeled by the use of white shrink wrap, with black lettering on each end of each wire.
- e. All wires shall be placed neatly and tie wrapped into each terminal cabinet, and each terminal block shall be marked as to what circuits it has on it (i.e. Fire Alarm, Clock, program bells, etc.)

3.03 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.

3.04 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.

3.05 TAGGING

- A. General: Install identification markers on ungrounded conductors of all circuits, in switchboards, panel boards, pull, junction and outlet boxes, lighting fixtures, switches, receptacles and other terminating enclosures. Grounded circuit conductors shall have identification markers in switchboards, panel boards, and all enclosures where more than one circuit grounded circuit conductor is installed. Identification shall include switchboard, panel board, or other source and circuit number. Tags shall be 3M Co. "Scotchcode" " write-on tape or shall be premarked with self-adhesive wraparound type EZ Code, Brady.
- B. Tagging: Conductors shall be lagged in each junction box, pull box, wireway or auxiliary gutter and at each device, motor outlet, panel board, switchboard or other conductor termination. Tag shall show feeder number, size. Phase and origin

3.06 MISCELLANEOUS (AS APPLICABLE)

- A. Make all branch circuit and fixture joints for #10 AWG and smaller wire with UL approved connectors, listed for 600 volts. Provide Minnesota Mining and Manufacturing Co. insulated "Scotchlocks," Ideal Co. "Wing-Nut", or T & B Burndy Co. "Piggy" connectors.
- B. Make all branch circuit joints of #8 AWG and larger with screw pressure lugs, and insulate with electrical tape to 150% of the insulating value of the conductor insulation.
- C. Tape all connections made with non-insulated type connectors with half-lapped, rubber-type tape, to 1-1/2 times the thickness of the conductor insulation, then cover with Scotch #33 tape.
- D. Each circuit must correspond to the branch circuit number indicated on the panel schedule shown on the drawings except where departures are approved by the Engineer.
- E. Neatly group or tape together wiring within equipment enclosures.
- F. Where conductors in conduit pass through exterior walls, a sealing compound of moisture-resistant material shall be applied in the ends of the conduits to seal around the conductors.
- G. Megger tests shall be taken on all feeder conductors and on all conductors for motors over 15 HP. Tests shall be made in presence of the District's representative and prior to connection of equipment. Written reports of results shall be submitted to the Engineer. Conductors testing below manufacturers standard shall be replaced at no expense to the owner.

3.07 PROTECTION

- A. Protect the Work of this section until Substantial Completion.

3.08 CLEANUP

- A. Remove rubbish, debris and waste materials and legally dispose of off the Project site.

END OF SECTION

**SECTION 26 05 26
GROUNDING AND BONDING**

PART 1 - GENERAL

1.01 SUMMARY

- A. Section Includes: Provide and install grounding system as indicated or required.
- B. Related Requirements:
 - 1. Refer to related sections for their system grounding requirements.
 - 2. Section 26 05 00: Common Work Results for Electrical.

1.02 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) (Signal).
 - 5. EIA/TIA (Signal and power).
 - 6. Nationally Recognized Testing Laboratory (NRTL) or equal.
 - 7. Motorola R56 Standards.

1.03 SYSTEM DESCRIPTION

- A. Metallic objects on the Project site that enclose electrical conductors, or that are likely to be energized by electrical currents, shall be effectively grounded.
- B. Metal equipment parts, such as enclosures, raceways, and equipment grounding conductors, and earth grounding electrodes shall be solidly joined together into a continuous electrically conductive system.
- C. Metallic systems shall be effectively bonded to the main grounding electrode system.
- D. A separately derived AC source shall be grounded to the equipment grounding conductor, and to separate "made" electrode of building grounding electrode system.
- E. Electrical continuity to ground metal raceways and enclosures, isolated from equipment ground by installation of non-metallic conduit or fittings, shall be provided by a green insulated grounding conductor of required size within each raceway connected to isolated metallic raceways, or enclosures at each end. Each flexible conduit shall be provided with a green insulated grounding conductor of required size.
- F. Cold water, UFER ground or other utility piping systems, shall not be utilized as grounding electrodes due to the installation of insulating couplings and non-metallic pipe in such

installations. 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 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 CAD welded bare copper cable, or be CAD welded directly to the bus. The CAD 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.
 2. Grounding electrodes as specified hereafter in this section.
 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. An external 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 equipment enclosures, signal and power conduits, switchboard and panelboard enclosures, motor frames, equipment cabinets, and metal frames of buildings shall be permanently and effectively grounded. Provide a CEC sized grounding conductor in every raceway.
- H. Metallic or semi-conducting shields and lead sheaths of cables operating at high voltage, 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 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 is installed from switchboard to each individual building. At building, grounding conductor is 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.

1.04 SUBMITTALS

- A. Provide in accordance with Division 01.

PART 2 - PRODUCTS

2.01 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, if necessary to obtain required clearances. Boxes shall be furnished with bolt-down, checkered, cast iron covers and cast iron frames cast into boxes. Yard boxes shall be Jensen Precast, Oldcastle Precast, Western Precast, Kistner, or equal.
- B. "Made" electrodes shall be copper-clad steel ground rods, minimum 3/4 inch diameter by ten feet long.

PART 3 - EXECUTION

3.01 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 grounding resistance requirements.
- F. Ground rods shall be separated from one another by not less than ten feet.
- G. Parallel grounding rods shall be connected together with recognized fittings and grounding conductors in galvanized rigid steel conduit, buried not less than 12 inches below finish grade.

3.02 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 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.

3.03 PROTECTION

- A. Protect the Work of this section until Substantial Completion.

3.04 CLEANUP

- A. Remove rubbish, debris, and waste materials and legally dispose of off the Project site.

END OF SECTION

**SECTION 26 05 33
RACEWAYS, BOXES, FITTINGS, AND SUPPORTS**

PART 1 - GENERAL

1.01 SUMMARY

A. Section Includes:

1. Raceways and wire ways.
2. Conduit installation.
3. Underground requirements.

B. Related Requirements:

1. Section 26 05 00: Common Work Results for Electrical.
2. Section 26 05 13: Basic Electrical Materials and Methods.

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).

1.02 SUBMITTALS

- A. Materials List: Provide in accordance with Division 01.

PART 2 - PRODUCTS

2.01 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

3.01 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. 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.

- D. Slabs on Grade:
1. Unless specifically reviewed by the Architect and DSA, conduits 1 ¼-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.
- E. 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 92 00: Joint Sealants.

3.02 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.

3.03 PROTECTION

- A. Protect the Work of this section until Substantial Completion.

3.04 CLEANUP

- A. Remove rubbish, debris and waste materials and legally dispose of off the Project site.

END OF SECTION

SECTION 26 08 00
ELECTRICAL SYSTEMS COMMISSIONING

PART 1 - GENERAL

1.01 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).

1.02 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 0923: Environmental Control and Energy Management Systems.
- F. Section 23 0813: Environmental Controls and Energy Management System Commissioning.
- G. Section 26 0500: Common Work Results for Electrical.
- H. Section 26 0513: Basic Electrical Materials and Methods.
- I. Section 26 0526: Grounding and Bonding.
- J. Section 26 0519: Low Voltage Wires (600 Volt AC).
- K. Section 26 0586: Motors and Drives.
- L. Section 26 5010: Solid State (LED) Lighting.
- M. Section 26 0923: Lighting Control Systems.

1.03 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.

1.04 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 OWNER.
 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.

1.05 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 (OWNER) 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.

1.06 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

2.01 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

3.01 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.
- 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.

3.02 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.

3.03 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.

3.04 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.

3.05 TRAINING

- A. Provide training and documentation as required in construction documents.

END OF SECTION

**SECTION 26 09 23
LIGHTING CONTROL SYSTEMS**

PART 1 - GENERAL

1.01 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 0533 – Raceways, Boxes, Fittings, and Supports.
 - 6. Section 26 0800 – Electrical Systems Commissioning.
 - 7. Section 26 5000 – Lighting.
 - 8. Section 26 5010 – Solid State (LED) Lighting.

1.02 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.

1.03 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 – Cyber Security Network Connected Systems.
- 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 OWNER 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.

1.04 WARRANTY

- A. Manufacturer shall provide a three-year material warranty.
- B. Installer shall provide a two-year installation warranty.

1.05 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.

1.06 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.

1.07 LIGHTING CONTROL OVERVIEW-BY AREA CONTROLLED

A. Classrooms:

- 1. Classrooms shall be controlled by a combination of vacancy sensors, daylight controllers and dimmers switches.
 - a. The vacancy sensor is to automatically switch lights OFF when the room is not occupied for 15 minutes.
 - b. 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.
 - c. 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.
 - d. 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.
 - e. 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:

- 1. 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.
 - a. Low voltage keyed switches are operable 24 hours a day and are to manually switch lights ON and OFF.
 - b. The central timer is to automatically sweep lights OFF after hours and provide scheduling capability where and when occupancy sensors are not used.
 - c. Interior corridors require occupancy sensors.

C. Custodial, Unsupervised and Equipment Rooms:

- 1. 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:

1. Program exterior wall packs and security lights to be controlled via exterior light sensors, and time switches as indicated on drawings.
 - a. Program lights to ON state when natural lighting is below 5 foot-candles
 - b. Program lights to OFF when natural light level is greater than 5 foot-candles.
- E. Exterior, Non-Security Lights:
 1. 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.
 - a. Program lights to ON state when natural lighting is below 5 foot-candles, and when scheduled time is set to ON.
 - b. 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.

PART 2 - PRODUCTS

2.01 CENTRAL LIGHTING CONTROL PANELS

- A. Central Lighting Control Panels (CLCP) shall be located 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.

2.02 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.

2.03 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.

2.04 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.
 - 1. 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.
 - 2. 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.

2.05 INTERIOR DAYLIGHT SENSORS

- A. Interior daylight sensors shall cause light fixtures to brighten or dim to maintain predetermined 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.

2.06 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.

2.07 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.

2.08 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, or equal.

B. Dual Technology Passive Infrared Wall Switch Sensors with Daylight Controls:

- 1. 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.
- 2. Passive infrared sensor shall utilize a dual-element sensor and a multi-element fresnel lens.
- 3. 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.
- 4. Sensors shall be furnished with convenient bypass provisions, which enable lighting to be turned on in case of failure.
- 5. Time delay range shall be adjustable from 15 seconds to 15 minutes.
- 6. Sensitivity adjustment shall range from 0 (off) to ten (maximum).
- 7. Adjustments and mounting hardware shall be concealed under a removable cover to prevent tampering with adjustments and hardware.
- 8. Each sensor shall cover up to 800 square feet, with a field-of-view of 180 degrees.
- 9. Sensor shall be a completely self-contained control system.
- 10. Power shall be provided via an internal transformer.

11. Switching mechanism shall be a latching dry contact relay.
12. Sensor shall be capable of switching from 30 to 1000 Watts, LED, incandescent or fluorescent light sources.
13. 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.
14. Sensors shall be dual voltage, 120 volt and 277 Volt.
15. Approved products: Watt Stopper No. WI 200, I 300, similar as manufactured by Leviton Sensor Switch, Unenco, or equal.

2.09 LIGHT LEVEL CONTROLERS (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.

2.10 UNIT INVERTERS

- A. Unit Inverters shall be rapid start type consisting of emergency power packs designed to be installed in channels of new lighting fixtures.
- C. Power pack construction shall be of durable polycarbonate housing.
- D. Units shall be furnished with test switches and pilot lights.
- E. Units shall automatically power designated lamp(s) for 90 minutes of emergency service upon failure of utility power.

- F. Upon return of utility power, battery shall automatically recharge.
- G. Batteries shall be field-replaceable, sealed, rechargeable, spill-proof, maintenance-free nickel cadmium.
- H. High efficiency inverter/charger design shall include low-voltage disconnect to prevent deep discharge of battery and dual voltage designed for connection to either 120 or 277 volts. Chargers shall recharge fully discharged batteries to provide 90 minutes operation within 24 hours. Power pack shall not operate if shut off manually.
- I. An unconditional five-year warranty is required.
- J. Approved products: Dual-Lite UFO-5 Series, Bodine, Iota I series, Beghelli Luce, or equal.

2.11 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

3.01 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.

3.02 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.

3.03 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 flush 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.

3.04 PROTECTION

- #### A. Protect all work, equipment and components of the lighting control system until Substantial Completion.

3.05 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.

3.06 SPARE PARTS

- #### A. Provide a minimum of five percent spare parts of each type of relay, sensors, switches, and peripheral devices.

3.07 CLEANUP

- A. Remove rubbish, debris, and waste materials and legally dispose of off the Project site.

END OF SECTION

SECTION 26 24 16
PANELBOARDS AND SIGNAL TERMINAL CABINETS

PART 1 - GENERAL

1.01 SUMMARY

- A. Section Includes: Lighting and power distribution facilities, including panelboards.
- 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 2600: Power Distribution Units.
 - 5. Section 26 5000: Lighting.
 - 6. Division 27: Communications.
 - 7. Division 28: Electronic Safety and Security.

1.02 SUBMITTALS

- A. Provide in accordance with Division 01.
- B. Shop Drawings: Include a front elevation indicating cabinet dimensions, make, location and capacity of equipment, size of gutters, type of mounting, finish, and catalog number of locks. General layout of internal devices, wiring drawings with wire numbers and device connections, vendor cut sheets of devices in enclosure and bill of materials listing description, manufacturer, part number, and quantity of items shall be included.
- C. Installation Instructions: Submit manufacturer's written installation instructions.

1.03 DESIGN REQUIREMENTS

- A. Panelboards:
 - 1. Panelboards shall be wall-mounted, enclosed safety type with 120/240 volt, three-wire solid neutral 277/480 volt, four-wire or 120/208 volt, four-wire solid neutral mains as indicated on Drawings or specified. First panelboard of each building shall be provided with main or sub-feeder circuit breakers where so indicated.
 - 2. Single pole branches shall be molded case, thermal magnetic circuit breakers with inverse time delay, trip free, quick-make, quick-break mechanism and silver alloy contacts. Circuit breakers shall be fully rated, with ampere rating marked on handle and shall indicate on/off and tripped positions. Ground fault interrupters shall be incorporated into circuit breakers where indicated. They shall be listed by UL, or other NRTL as

ground fault devices. Provide appropriate lug kit of sufficient size to accommodate the feeders.

3. Two- and three-pole branches shall be enclosed, and shall be thermal magnetic circuit breakers with inverse time delay, tamper-proof, ambient compensated, single handle, internal common trip, and quick-make, quick-break mechanism with silver alloy contacts. Circuit breakers shall be fully rated or as otherwise indicated on the Drawings.
 4. Main and subfeeder circuit breakers shall be enclosed, thermal magnetic type with inverse time delay, single handle common trip, quick-make, quick-break mechanism, corrosion-resistant bearings and silver alloy contacts. Ampere frame size and trip rating shall be as indicated on Drawings. Breakers over 225 amperes shall be furnished with interchangeable trip units. Handles of main and subfeeder circuit breakers shall be provided cabinet door. Voltage rating shall be as indicated on Drawings.
 5. Circuit breakers shall be fully rated and of one-piece, bolt-on type and shall meet short-circuit interrupting capacity requirements indicated on Drawings. Series rated circuit breaker combinations are not acceptable.
 6. Internal connections shall be fabricated with plated copper bus bars and the busses shall extend for full length of space available for branch circuit breakers. Feeder cable connectors shall be installed at point of feeder entrance. Terminals shall be furnished with copper conductors. Panelboards fed by conductors having over-current protection greater than 200 amperes shall be protected on supply side by over-current devices having a rating not greater than that of panelboards. Copper bussing shall be fully rated. Heat rated bussing is not acceptable.
 7. Except where otherwise indicated, circuit breakers shall be in two vertical rows connected to bus bars in a distributed phase arrangement. Two-pole branches shall be balanced on busses. Single pole branches shall be numbered adjacent to its circuit breaker, with odd numbers on left and even numbers on right.
 8. Specified circuit breaker spaces shall be furnished with hardware required for future installation of circuit breakers.
 9. Provide locking devices for individual circuit breakers. Padlocking devices shall be secured to circuit breakers and by panel dead front plates.
- B. Surge Suppressors: Where indicated on Drawings, provide transient voltage surge suppressors as an integral part of panelboards. Panelboards shall be complete with 200 percent rated copper neutral bus, ground bus and isolated ground bus in addition to requirements of this section. Surge suppressors shall be as follows:
1. Surge Capacity:
 - a. Line-to-neutral for wye systems: 80 KA.
 - b. Line-to-ground: 80 KA.
 - c. Neutral-to-ground: 80 KA, three-phase wye.
 - d. Line-to-neutral plus line-to-ground: 160 KA.

2. UL 1449 2nd Edition Suppressed Voltage Rating for 208/120 Wye System:
 - a. Line-to-neutral: 400 volts.
 - b. Line-to-ground: 400 volts.
 - c. Neutral-to-ground: 400 volts.
 - d. Maximum continuous over-voltage: 150 volts.
3. EMI/RFI High-Frequency Noise Power Filter (Characteristics):
 - a. 100 KHz at 44 dB.
 - b. 100 MHz at 44 dB.
 - c. 10 MHz at 44 dB.
 - d. 100 MHz at 44 dB.
4. MOVs shall be thermally protected for low current faults and shall be fused with surge-rated fuses. The surge-rated surge current passes and clears the circuit safely if the surge capacity is exceeded. Enhanced diagnostics shall continuously monitor the unit's status and shall include LEDs to signal a reduction in surge capacity or the loss of a suppression circuit. An audible alarm, with test and silence features, shall be furnished in diagnostic package.
5. Each phase or the entire unit shall be replaceable and have bolted-on, tin-plated copper connections. Unit to have UL witnessed fault current rating of 65,000 symmetrical amperes.
6. Surge suppression units shall comply with the following:
 - a. UL certified.
 - b. UL 1283.
 - c. UL 1449.
 - d. IEEE C 62.45.
 - e. IEEE C 62.41.
 - f. Nationally Recognized Testing Laboratory (NRTL) or equal.

C. Panelboard Cabinets:

1. Panelboard cabinets shall be code gage galvanized steel or blue steel; fronts, doors, and trims shall be code gage furniture steel. Cabinets shall be furnished with at least six-inch high gutters at top and bottom where feeder cable size exceeds four gage or where feeder cable passes through cabinet vertically. Cabinets shall be furnished with top and bottom gutters sized as required by inspection department having jurisdiction, but never less than six inches where more than one feeder enters top or bottom of

cabinets. Side gutters shall not be less than four inches wide. Width of cabinets shall be 20 inches, unless otherwise indicated on Drawings.

2. Doors shall be cut true, shall accurately fit opening and finish smooth across joints. Rabbets shall be inside. Hinges shall be entirely concealed except for barrels and pins. Hinge flanges shall be welded to door and trim. Doors shall be equipped with flush type, spring-latching, Corbin locks for metal doors, keyed to Corbin No. 60 keys.
 3. Where contactors, time switches, and control devices are specified or indicated to be installed within panelboard cabinets, a separate compartment and door shall be provided at top of cabinet for such devices. Door shall be sized as required to permit removal of contactor and other devices intact. Gutters shall be provided at sides and top of compartment. Doors shall be equipped with flush type, spring-latching, Corbin locks for metal doors keyed to Corbin No. 60 keys.
 4. Provide and install panelboard manufacturer's permanent circuit number kit option.
 5. Panelboards with control devices in compartment shall arrive at the Project site completely assembled with control devices installed and wired.
 6. Outdoor cabinets shall be NEMA Type 3R. Construction shall be formed from code gage galvanized steel with ANSI No. 61 gray enamel finish. Provide heavy-duty, three point latching, vault type door handles with padlocking provisions. Provide stainless steel or galvanized butt hinges on doors. Padlocks shall be furnished, keyed to Corbin No. 60 keys.
 7. Self-tapping screws and bolts not permitted.
- D. Panelboard Schedule: Provide a neatly typewritten schedule with number or name of room or area, or load served by each panelboard circuit. Room numbers or names shall be determined at the Project site and shall not necessarily be those indicated on the Drawings. Schedule shall also indicate panel designation, voltage and phase, building and distribution panel or switchboard from which it is fed. Schedule shall be installed in a frame under transparent plastic 1/32 inch thick on inside of each panelboard cabinet door.
- E. Panelboard nameplate: Provide a nameplate identifying panelboard. Plates shall be black and white plastic nameplate stock, with character cut through black exposing white and shall bare designation of service. Name plate shall be mechanically fastened to switchboard.
- F. Provide additional labeling on dead-front of panelboard. Label shall be a P-Touch or equal with a minimum width of 3/8 inch with black letters on white background. Label shall re-identify panelboard and also identify name and location of power source feeding this panel. Location information shall include building name if located in different building and name or room location. If power source is installed in same room, label should indicate source name and "In this Room"
- G. Panelboard Standards: Panelboards shall be UL, or other NRTL listed and labeled. Panelboards shall meet latest revisions of following standards:
1. California Electric Code, Article 384.
 2. UL 67, Panelboards.
 3. UL 50, Cabinets and Boxes.

4. UL 943, GFCI.
 5. UL 489, Molded Case Circuit Breakers.
 6. NEMA PB1.
 7. Federal Specifications W-P- 115C and WC-375B.
- H. Signal Terminal Cabinets:
1. Signal terminal cabinets shall conform to the Specifications for panelboard cabinets, except as modified herein.
 2. Terminal cabinets shall be flush type, with two-inch trim or surface mounted type, as indicated on Drawings. Terminal cabinets shall be furnished with sections and barriers to separate each system. Sections over 24 inches in width shall be provided with double doors and locks. Terminal cabinets, or sections of terminals housing separate systems, shall measure 12 inches long by 18 inches high by 5 ¾-inch deep, unless otherwise indicated on Drawings. Trims for sectional cabinets shall be of one-piece construction.
 3. Terminal cabinets shall be furnished with ¾ inch thick plywood. Plywood shall be fastened in place with machine screws or factory installed mounting screws.
 4. Flush-mounted terminal cabinets shall be finished as specified for flush-mounted panelboard cabinets. Surface and semi-flush mounted terminal cabinets shall be finished as specified for surface-mounted panelboard cabinets.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

- A. Panelboards shall be manufactured by Siemens, W.A. Benjamin, General Electric, Cutler Hammer, Square D or equal.

PART 3 - EXECUTION

3.01 INSTALLATION

- A. Panelboards shall be located so they are readily accessible and not exposed to physical damage.
- B. Panelboards installed outdoors shall be specifically listed for wet locations and shall be weatherproof in NEMA Type 3R cabinets.
- C. Panelboard locations shall provide sufficient working space around panels to comply with the California Electrical Code.
- D. Panelboards shall be securely fastened to structure and mounted on surface by at least four points.

- E. Unused openings in cabinets shall be effectively closed as required by the manufacturer.
- F. Cabinets shall be grounded as specified in Article 250 of the California Electrical Code.
- G. Conduits shall be installed so as to prevent moisture or water from entering and accumulating within the enclosure.
- H. Lugs shall be suitable and listed for installation with the conductor being connected.
- I. 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.
- J. Maintain the required bending radius of conductors inside the cabinet.
- K. Clean the cabinet of foreign material such as cement, plaster, and paint.
- L. Distribute and arrange conductors neatly in the wiring gutters.
- M. Use the manufacturer's torque values to tighten lugs.
- N. Before energizing panelboards, the following steps shall be taken:
 - 1. Retighten connections to the manufacturer's torque specifications. Verify that required connections have been provided.
 - 2. Remove shipping blocks from component devices and panelboard interiors.
 - 3. Manually exercise circuit breakers to verify they operate freely.
 - 4. Remove debris from panelboard interior.
- O. Follow manufacturer's instructions for installation.
- P. Do not install in highly corrosive environments, unless rated for the application.

3.02 PROTECTION

- A. Protect the Work of this section until Substantial Completion.

3.03 CLEANUP

- A. Remove rubbish, debris, and waste materials and legally dispose of off the Project site.

END OF SECTION

SECTION 26 50 10
SOLID STATE (LED) LIGHTING

PART 1 - GENERAL

1.01 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.

1.02 REFERENCES

- 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.

1.03 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.

1.04 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 substantiating reasons and benefits to OWNER.
 - 2. OWNER'S approval shall be obtained for any equipment or materials substitutions.
 - 3. 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. Substitutions: Submittals must comply with contract general provisions.

1.05 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.

1.06 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 is not acceptable.

PART 2 - PRODUCTS

2.01 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 be in compliance with 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.

2.02 DRIVERS and LED MODULES

A. Drivers:

1. Approved Drivers Manufacturers:
 - a. Osram – Optotronic.
 - b. Philips – Advance and Xitanium.
 - c. Universal Lighting Technologies – Everline.
 - d. General Electric – Ligttech.
 - 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:

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° C
13	Minimum Starting Temperature	-20° C
14	Storage Temperature	No less than 70° 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° C
19	Dimming, Motion Sensors and Daylight Sensors Controllability	0-10V

B. LEDs:

1. Approved Manufacturers:

- a. General Electric.
- b. Philips.
- 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 50° 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 with a minimum of 6000 hours testing.
- e. LM-79 reported CCT and CRI in compliance with articles 2.01.D.11 and 14.

2.03 LUMINAIRES

A. Refer to appendix A for list of approved luminaires.

B. Luminaires types and minimum requirements:

1. Ceiling Surface-Mounted with wraparound diffusers:

APPLICATION – CORRIDORS AND CLASSROOMS (REPLACEMENT PROJECTS ONLY)

- 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 sufficient 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: Per Plans, or OWNER approved equal.

2. Linear Suspended Direct/Indirect:

APPLICATION – CLASSROOMS, WORKROOMS, MULTI-PURPOSE

- a. Luminaire shall be minimum 20 gage CRS with die-cast end cap mechanically attached with no exposed fasteners.
- b. Housing shall come in three styles perforated, pierced or solid with a clear acrylic dust cover.
- c. Cable suspension canopy shall be a minimum of 3 ½-inch diameter with 1/16 inches diameter stainless steel aircraft cable adjustable up to 36 inches.
- d. Reflector shall be semi-specular aluminum.
- e. Furnish luminaires with LED strips as indicated on drawings.
- f. Approved luminaires: Per Plans, or OWNER approved equal.

3. Linear Suspended Direct/Indirect:

APPLICATION – LIBRARY / MULTI-PURPOSE.

- a. Luminaire shall be minimum 20 gage steel, cast aluminum end caps. No exposed fasteners or hardware.
- b. Cable suspension shall be minimum 3 ½-inch diameter canopy with 1/16 inch diameter stainless steel aircraft cable adjustable up to 36, inches unless otherwise specified.
- c. Housing shall be supplied with a clear acrylic dust cover.
- d. Reflector shall be highly reflective aluminum.
- e. Furnish luminaires with LED strips as indicated on drawings.
- f. Approved luminaires: Per Plans, or OWNER approved equal.

4. Ceiling Recessed Troffer Luminaires:

APPLICATION – CLASSROOMS AND WORKROOMS WITH 9- FOOT CEILING HEIGHTS.

- a. Luminaire shall be 20 gage cold rolled steel housing with no exposed fasteners or hardware.
- b. Approximately 4 ½-inch maximum depth housing with full length die-formed stiffeners, and contoured ballast wireway cover.
- c. Positive cam action steel latches and safety lock T-hinges to allow hinging and latching on either side.
- d. Baked white enamel finish.
- e. Trim shall be painted to match ceiling color.
- f. Reflector reflectance shall equal or exceed 89 percent.
- g. Flat non-glare acrylic panel.
- h. Minimum lens thickness 0.187 inch.
- i. Furnish luminaires with LED strips as indicated on drawings. Mounting shall be compatible with standard or slot T-grid systems.
- j. Furnish mounting frames on recessed luminaires in plaster and tile surfaces.
- k. Approved luminaires: Per Plans, or OWNER approved equal.

5. Ceiling Recessed Troffer-Retrofit Luminaires:

APPLICATION – USE RETROFIT LUMINAIRES IN MODERNIZATION PROJECTS ONLY IF LIGHTING CONTROLS ARE BEING UPDATED. REMOVE TYPE ADR IF NOT APPLICABLE TO PROJECT.

- a. Retrofit kits shall comply with all requirements sets forth in parts 2.01 and 2.02
- b. Provide proof of even distribution on lighting with max/min foot-candle ratios of 2.5.
- c. Approved luminaires: Per Plans, or OWNER approved equal.

6. Linear Suspended 100 percent Direct:

APPLICATION – BACK OF STAGE WITH HIGH CEILINGS.

- a. Luminaire shall be minimum 20 gage steel housing with steel ends.
- b. Luminaire shall have a top reflector for 100 percent down light.
- c. Lens shall be high impact vandal resistant acrylic hinging from either side of housing.
- d. Approved luminaires: Per Plans, or OWNER approved equal.

7. Recessed Linear Wall Washer:

APPLICATION – CLASSROOM TEACHER WALL.

- a. Luminaire shall be minimum 20 gage steel with integral adjustable hanger clamps.
- b. High performance luminaire with low iridescent specular aluminum reflector.
- c. One piece body with integral hangers.
- d. Approved luminaires: Per Plans, or OWNER approved equal.

8. Linear Suspended or Wall Mounted Wall Washer:

APPLICATION – CLASSROOM TEACHER WALL.

- a. Luminaire shall be 20 gage die formed steel.
- b. Reflector shall be die-formed white and/or semi specular.
- c. Luminaire shall be an asymmetric distribution.
- d. Luminaire shall come with the option for prismatic lens or louver.
- e. Luminaire shall have an option to be wall mounted or suspended.
- f. Approved luminaires: Per Plans, or OWNER approved equal.

9. Ceiling Surface-mounted or Recessed Troffer Luminaires:

APPLICATION – KITCHEN, FACILITY DINING, CORRIDORS, OFFICES WITH LOW VISUAL DISPLAY TERMINAL (VDT).

- a. 22 gage extruded aluminum doorframes, white baked enamel finish. Spring loaded and half recessed with flush latches and T-handle hinge, accessible from bottom to drivers and wiring. Clear prismatic 100 percent pure virgin acrylic Pattern 12.
- b. Recessed Troffer Housing minimum depth shall be 4 ½-inch to eliminate lamp images in lens.
- c. Minimum lens thickness 0.187 inch.
- d. Furnish mounting frames on recessed luminaires in plaster and tile surfaces.
- e. Manufacturers and catalog numbers: Modify catalog numbers for mounting in gypsum drywall ceilings, as required.
- f. Approved luminaires: Per Plans, or OWNER approved equal.

10. Recessed Indirect Luminaire:

APPLICATION – OFFICES, WORKROOMS.

- a. Housing shall be made of die-formed 20 gage steel with a minimum depth of 5 ½-inch.
- b. Lamp shield shall be made of 22 gage perforated mesh with white acrylic overlay.

- c. Approved luminaires: Per Plans, or OWNER approved equal.
- d. Luminaire shall provide the option to be hinged from either side.

11. Wall-Mounted Luminaires:

APPLICATION – STAIRS (EXISTING CONSTRUCTION ONLY).

- a. Fully enclosed, with high impact white acrylic diffuser.
- b. Die-formed, prime quality 20 gage steel body, 48 inches long.
- c. Approved luminaires: Per Plans, or OWNER approved equal.

12. Surface-Mounted Industrial Luminaires:

APPLICATION – ELECTRICAL AND MECHANICAL EQUIPMENT ROOMS, STORAGE ROOMS, AND NON-LECTURE SEATING AREA OF INDUSTRIAL SHOP.

- a. Approximately 48-inch or 96-inch long by 16-inch wide by 7 ½-inch deep.
- b. Provide couplings, clips and end caps for continuous row installation.
- c. Furnish luminaires with screw-on wire guards. Design guards to accommodate luminaire, provided by same manufacturer as luminaire.
- d. Exposed LED strips are not allowed.
- e. Housing shall be made of die formed 20 gage cold rolled steel.
- f. Approved luminaires: Per plans, or OWNER approved equal.

13. Recessed two-foot by four-foot Static Troffer Luminaires with Parabolic Louvers:

APPLICATION – OFFICES (EXISTING CONSTRUCTION ONLY).

- a. Approximately 5 ½-inch maximum depth housing fabricated of 22 gage, prime cold-rolled steel, with full length die-formed stiffeners. Contoured driver wireway cover.
- b. Provide positive cam action steel latches and safety lock T-hinges to allow hinging and latching on either side.
- c. Baked white enamel finish. Trim shall be painted white to match ceiling color.
- d. Louvers shall be three inches deep, die-formed of semi-specular anodized aluminum with anodic oxide coating. Parabolic cells shall be fastened with interlocking feature. Provide 12-cell louvers for two-lamp luminaires and 18-cell louvers for three-lamp luminaires.
- e. Voltage shall be as indicated on Drawings.
- f. Approved luminaires: Per Plans, or OWNER approved equal.

14. Surface Mounted Strip Light:

APPLICATION – COVE LIGHTING.

- a. Luminaire shall be made of 20 gage die formed steel and have the ability for continuous row mounting.
- b. Furnish luminaires with LED strips as indicated on drawings. Luminaire shall have the option to have narrow or wider housing channels depending on the application.
- c. Approved luminaires: Per Plans, or OWNER approved equal.

15. Surface/Pendant Mounted:

APPLICATION – GYMNASIUMS.

- a. Luminaire shall be 20 gage cold rolled steel precision formed housing.
- b. Luminaire shall be supplied with diffuser lens and 11 gage wire guard.
- c. Furnish luminaires with LED strips as indicated on drawings.
- d. Luminaires shall be glare free.
- e. Approved luminaires: Per Plans, or OWNER approved equal.

16. Surface Mounted Hazardous Luminaire:

APPLICATION – HAZARDOUS LOCATIONS.

- a. Luminaire shall be non-corrosive fiberglass reinforced polyester composite body.
- b. 16 gage stainless steel door with 3/16 inch tempered glass lens.
- c. Stainless steel toggle clamps to secure lens and door frame.
- d. Luminaire shall have a one-piece silicone gasket.
- e. Luminaire shall meet Class I Division 2, Groups A, B, C and D locations.
- f. Luminaire shall meet Class II, Division 1 and 2, Groups F and G and Class III, Division 1 and 2 locations.
- g. Luminaire shall be listed for wet locations.
- h. Approved luminaires: Per Plans, or OWNER approved equal.

17. Enclosed and Vandal Resistant Luminaires:

APPLICATION – STUDENT RESTROOMS, SHOWERS, LOCKER ROOMS, EXTERIOR FACILITY DINING AREAS AND EXTERIOR CANOPIES.

- a. Luminaire shall be 20 gage extruded aluminum with die cast end caps.
- b. Luminaire shall have opal polycarbonate lens.

- c. Furnish luminaires with LED strips as indicated on drawings. Luminaire shall have tamper resistant hardware.
- d. Luminaire shall have the ability to be in continuous rows with seamless appearance.
- e. Luminaire shall be listed for wet location.
- f. Approved luminaires: Per Plans, or OWNER approved equal.

18. Enclosed, Gasketed Luminaire:

APPLICATION – GARAGES AND MISCELLANEOUS DAMP/ WET LOCATIONS.

- a. Luminaire shall be 20 gage steel.
- b. Lens enclosure shall be heavy duty vapor tight enclosed gasketed with closed-cell foam gasketing permanently attached to luminaire housing.
- c. Luminaire shall have tamperproof latches.
- d. Luminaire shall be furnished with minimum one watertight hub kit for top or end conduit entry.
- e. Luminaire shall have option for cable mount and safety strap
- f. Wet Location listed.
- g. Approved luminaires: Per Plans, or OWNER approved equal.

19. Surface, Wall or Recess Mounted fixtures

APPLICATION – STAFF RESTROOMS.

- a. Luminaire shall be 20 gage extruded aluminum with die cast end caps.
- b. Opal polycarbonate lens.
- c. Furnish luminaires with LED strips as indicated on drawings.
- d. Luminaire mounting as indicated on drawings.
- e. Luminaire shall be listed for damp and wet location.
- f. Approved luminaires: Per Plans, or OWNER approved equal.

20. Display Case/Under Counter Luminaires:

APPLICATION – TASK LIGHTING, UNDER COUNTERS, DISPLAY CASES.

- a. Ribbed, white opal acrylic lens.
- b. Chassis parts shall be die-formed cold rolled steel.
- c. Finish shall be white baked enamel.

- d. Furnish luminaires with LED strips as indicated on drawings. .
- e. Luminaire shall be supplied without switches or receptacles.
- f. Approved luminaires: Per Plans, or OWNER approved equal.

21. Down Lights:

APPLICATION – OFFICES, CONFERENCE ROOMS, LOBBIES

- a. 4 to 6 inch round LED downlight.
- b. Color trim as specified in construction drawings.
- c. Trim attachment to frame-in kit via push-in connector on frame.
- d. Removable cover for access.
- e. Complete luminaire including all peripheral devices including frame-in kit, light engine, trim kit, etc. shall be provided.
- f. Approved luminaires: Per Plans, or OWNER approved equal.

22. High Abuse Surface Luminaires:

APPLICATION – STUDENT RESTROOMS, SHOWERS

- a. Lens shall be extruded polycarbonate, clear prismatic refractor, nominal thickness 0.125 inch, UV stabilized.
- b. Base-plate shall be 18 gage prime cold-rolled steel with corrosion-resistant, 92 percent reflective, white polymer finish.
- c. End caps shall be 16 gage prime cold roll steel with corrosion-resistant, white polymer finish and shall be spot welded to the base-plate.
- d. Lens/housing shall be furnished with a minimum of two large or four small stainless steel fasteners to secure lens/housing to base plate.
- e. Listed for wet and damp locations.
- f. Approved luminaires: Per Plans, or OWNER approved equal.

23. Wall Mounted Vaportite Luminaire:

APPLICATION – SMALL EQUIPMENT AND CUSTODIAL ROOMS.

- a. Luminaire housing shall be die cast aluminum with corrosion resistant polyester powder coated finish.
- b. Luminaire shall be heat and shock resistant, with prismatic glass optical chamber with neoprene gasketing.
- c. Luminaire shall be 15 or 20 watt LED; LEDs and drivers as indicated on drawings.

- d. Luminaire shall be equipped with lens guard.
- e. Approved luminaires: Per Plans or OWNER approved equal.

24. Ceiling-Mounted Luminaires:

APPLICATION – EXTERIOR CANOPY, CORRIDORS, RESTROOMS

- a. Separate ceiling and reflector pans with foil-backed fiberglass between pans and 1/8 inch thick neoprene gasketing between ceiling pan and ceiling.
- b. White polyester finished 18 gage cold-rolled steel back-plate with clear prismatic injection molded polycarbonate lens, UV stabilized heavy gage aluminum back-plate and four tamper-proof screws.
- c. Provide luminaire wattage as indicated on drawings.
- d. Luminaire shall be listed for damp locations.
- e. Approved luminaires: Per Plans, or OWNER approved equal.

25. Ceiling Mounted Luminaires:

APPLICATION – EXTERIOR CANOPIES, EXTERIOR CORRIDORS

- a. Luminaire shall be die-cast aluminum.
- b. Luminaire shall have reinforced four-point mounting system construction to resist breakage from impact and prying.
- c. Luminaire finish shall be as indicated on drawings.
- d. Lens shall be Injection molded UV stabilized, high impact resistant opal polycarbonate.
- e. Luminaire shall have option trim ring to fit between housing and inside lip of trim ring for a smooth transitional look.
- f. Provide luminaire with input watts as indicated on drawings.
- g. Ceiling luminaires shall be supplied without eye lid option, wall mounted luminaires shall be supplied with eye lid option.
- h. Approved luminaires: Per Plans, or OWNER approved equal.

26. Recessed Interior/Exterior Vandal Resistant Luminaires (Square):

- a. Housing/door shall be fabricated from 16 gage cold-rolled steel, and polyester powder coated after fabrication.
- b. Fully gasketed for exterior installation.
- c. 0.187 inch clear polycarbonate UV stabilized safety lens.
- d. Provide luminaire wattage as indicated on drawings.

e. Approved luminaires: Per Plans, or OWNER approved equal.

27. Recessed Interior/ Exterior Vandal Resistant Downlight Luminaire :

APPLICATION – EXTERIOR CANOPY, CORRIDORS, LOBBY, RESTROOMS.

- a. Luminaire shall have a die cast aluminum mounting frame suitable for dry or wet plaster ceilings of a minimum thickness of 1 1/8 inches.
- b. Luminaire shall be UL listed for damp locations.
- c. Lens shall be vandal resistant acrylic with flat or drop diffuser. (Refer to luminaire schedule in drawings for type of diffuser).
- d. Die formed aluminum reflector.
- e. Luminaire shall be provided with input wattage as indicated on drawings.
- f. Approve luminaires: Per Plans, or OWNER approved equal.

28. Outdoor Wall-Mounted Luminaires (Vandal Resistant):

- a. Seamless, one-piece, injection molded polycarbonate lens/housing, 0.187 inch, UV stabilized polycarbonate lens. The wraparound lens design encloses and protects the interior of unit.
- b. Die cast aluminum mounting plate.
- c. One-piece, full size, closed cell neoprene rubber gasket.
- d. One stainless steel tamper-proof screw.
- e. Luminaire shall be UL listed for wet locations.
- f. Luminaires shall be provided with input watts as indicated on drawings.
- g. Approved luminaires: Per Plans, or OWNER approved equal.

29. Wall Mounted Full Cutoff Exterior Wall.

Luminaire shall be mounted at no less than nine feet above finished grade, or as indicated in drawings.

- a. Housing shall be made of 20 gage die cast aluminum, and be equipped with hinged doors.
- b. Luminaire shall have Stainless steel tamperproof hardware.
- c. Luminaire shall be provided with input watts as indicated on drawings. Luminaire Optics shall be full 90 degree horizontal cutoff on all distributions. Reflector shall be specular aluminum. Luminaire shall have tempered glass lens with optional wire guard.
- d. Approved luminaires: Per Plans, or OWNER approved equal.

30. Recessed Low Level Light:

- a. Housing shall be die cast aluminum with captive stainless steel hardware.
- b. Luminaire shall be gasketed with a single piece of molded silicone.
- c. Lens shall be Louver and completely sealed to prevent water, dust and insect infiltration.
- d. Luminaire shall be equipped with drivers and LED strips wattage as indicated in drawings.
- e. Approved luminaires: Per Plans, or OWNER approved equal.

31. Explosion-Proof Luminaires:

- a. Designed for Class I, group CD location, ceiling-mounted.
- b. Per Plans, or OWNER approved equal.

32. Safe Light Luminaires:

APPLICATION – DARK ROOMS/PHOTO LABS.

- a. Twenty gage steel luminaire with satin stainless steel trim, recessed-mounted, with plaster frame.
- b. Two separate light-tight compartments shall accommodate both white and safe lights.
- c. Provide drivers, lens and LED strips in each compartment as indicated on drawings.
- d. Approved manufacturers: Per Plans, or OWNER approved equal.

33. Step Lighting:

- a. Recessed aisle die cast aluminum lights 1/8 inch minimum wall thickness. Luminaire shall be provided with tamper-proof screws.
- b. Silicon gasket to exclude moisture, insects and contaminants.
- c. Ribbed guard face plate design as specified in construction drawings.
- d. Manufacturer: Per Plans, or OWNER approved equal.

34. Wall-Mounted Luminaires (Vandal Resistant):

APPLICATION – EXTERIOR WALLS, GENERAL AREA LIGHTING, PERIMETER LIGHTING, SECURITY LIGHTING.

- a. One-piece prismatic refractor held by cast metal door, hinged to die-cast anodized aluminum weatherproof housing with visor to limit light pollution.
- b. Die-cast aluminum housing of 1/8 inch minimum wall thickness. Luminaire shall be provided with tamper-proof screws.
- c. High impact resistant, UV stabilized injection molded polycarbonate lens.

- d. High power LEDs.
- e. Approved manufacturers: Per Plans, or OWNER approved equal.

35. Wall Mounted Full Cutoff – Luminaires:

APPLICATION – EXTERIOR WALLS.

- a. Luminaire shall be injection molded, impact resistant polycarbonate lens, with optional wire guard.
- a. Luminaire shall have Tamperproof hardware.
- b. Reflector shall be hydro-formed anodized aluminum.
- c. Lens shall be injection molded UV stabilized high impact acrylic.
- d. Drivers and LED strips as indicated on drawings.
- e. Housing shall be 20 gage die cast aluminum with hinged doors.
- f. Luminaire Optics shall be full 90 degree horizontal cutoff on all distributions.
- g. Approved Luminaires: Per Plans or OWNER approved equal.

36. Pendant/Surface Mounted Indoor Luminaires:

APPLICATION – GYMNASIUM LIGHTING.

- a. Luminaire shall be constructed to withstand moisture, dust, and chemical contact.
- b. Rugged die-cast aluminum housing designed for heat dissipation and corrosion resistance.
- c. Luminaire shall be equipped with precast wire guard attachment points, and wire guard standard option.
- d. Luminaire shall have a glass reflector made of prismatic borosilicate glass with captive screws and safety cable option for hand free relamping.
- e. Luminaire shall be dimmable and operate with motion and daylight sensors.
- f. Approved products: Per Plans, or OWNER approved equal.

37. Ceiling-Mounted Outdoor Luminaires:

APPLICATION – PARKING GARAGES

- a. Pendant or Junction box mounted as indicated in construction drawings.
- b. Heavy-duty, cast aluminum housing, copper-free, coated with electrostatically deposited and thermally set powdered polyester paint.
- c. Luminaires shall have a wire guard option.

- d. LEDs shall not be visible.
- e. Luminaire shall be UL listed for outdoor use and labeled "suitable for wet locations".
- f. Capable of operating in 40 centigrade ambient temperatures.
- g. Approved products: Per Plans, or OWNER approved equal.

38. Floodlight Luminaires:

APPLICATION: FLOOD LIGHTING OFFICE BUILDINGS, MONUMENTS, FACADES.

- a. Narrow, medium, rectangular and wide light distributions.
- b. Housing shall be marine-grade die-cast aluminum, dust-tight and 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.
- c. High impact UV stabilized acrylic lens.
- d. Visor option for lighting control.
- e. Photocells and motion control capabilities.
- f. Listed for wet locations.
- 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. Lens shall be acrylic tempered glass to withstand thermal and physical shock.
- j. Finish color shall be as selected by Architect from manufacturer's standard colors.
- k. Approved products: Per Plans, or OWNER approved equal.

2.04 EXIT ILLUMINATION

A. :

- 1. Ceiling or wall-mounted, vandal-resistant type, LED EXIT, consisting of:
 - a. LED board, green exit lettering and directional arrows as indicated on drawings.
 - b. Face plate and polycarbonate shield.
 - c. Number of faces, voltage, and emergency power source shall conform to design requirements indicated on drawings.
 - d. Area of refuge listing is required when luminaires are used in such locations.

- e. Utilize a flag mount luminary with additional support from the ceiling or wall for canopy or pendant mounted exit signs. This option shall be exercised only if a wall is not available.
 - f. Approved Products: Per Plans, or OWNER approved equal.
- B. :
- 1. Low Level Exit Signs:
 - a. Approved products: Evenlite DCG Series, Per Plans or OWNER approved equal.
 - b. Luminaires shall be:
 - 1) L.E.D. boards, green lettering, or as indicated on drawings.
 - 2) Die cast aluminum body and face plate with white finish.
 - 3) Polycarbonate shields.
 - 4) Area of refuge listing is required when luminaires are used in such locations.
 - c. Emergency battery pack operation shall be as indicated on Drawings.

2.05 LIGHT POLES (STANDARDS)

- A. Standards shall be 25 feet high, tapered galvanized steel.
 - a. Starting at the base, a minimum of 12 inches of the light standards interior and exterior surfaces shall be treated with water repellent or barrier coatings to prevent moisture contact with galvanized surface.
- B. Aluminum poles are not acceptable.
- C. Pole shaft shall conform to ASTM A595 Grade A and be 11 gage thickness, unless otherwise indicated on Drawings. Shaft shall be one piece construction with a full length longitudinal high frequency resistance weld.
- D. The anchor base shall be constructed from structural quality hot rolled carbon steel plate conforming to ASTM A36.
- E. Anchor bolts shall be fabricated from commercial quality hot rolled carbon steel bar with minimum yield strength of 55,000 PSI. Bolts shall have an L bend on one end and threaded on the opposite end. Anchor bolts shall be hot dipped galvanized with a minimum length of 12 inches on the threaded end. Four properly sized bolts furnished with two hex nuts, and flat washers, shall be provided for each pole. Contractor to obtain manufacturer required base bolt pattern prior to concrete installation.
- F. A two piece base cover shall completely seal the entire base plate and be securely fastened.
- G. Each pole shall have a three-inch by five-inch handle. A nut holder shall be provided near the hand-hole and shall include a ½ inch – 13 UNC HE by Head bolt and nut for grounding. The hand-hole shall be welded in the pole shaft and shall include a steel cover with attachment screws. The hand-hole shall be located 18 inches above the base of the pole.
- H. Finish of pole and accessories shall be electrostatically applied, and thermally cured polyester powder coat. Color shall be selected by Architect.

- I. All structural fasteners shall be galvanized high strength carbon steel.
- J. Poles shall be designed to withstand wind velocity of 80 MPH and 100 MPH gusts. Concrete base shall be a monolithic concrete pour when installed.
- K. Standards shall be installed plumb and straight on concrete footings. Grout and dry-pack after leveling. Concrete, grout and drypack requirements and procedures are as specified in Division 02.
 - a. Standards footings shall be provided with a moisture release channel to keep the interior of the standards dry and free from rain, dew or condensation. Refer to District's Standards Footing Detail. Engage a California Registered structural engineer to design the base.
- L. Provide in line fuse assembly in hand-hole of each light standard with breakaway receptacle Bussmann HEY series, or OWNER approved equal. Fuse assembly shall easily disconnect power to light standard. Fuse type and rating shall be as required by each application.
- M. Provide all required fixture mounting accessories.
- N. Standards shall be as manufactured by Gardco, Alcastco, Lytepole, or OWNER approved equal.

PART 3 - EXECUTION

3.01 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.

3.02 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.

3.03 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.

3.04 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.

3.05 PROTECTION

- A. Protect the Work of this section until Substantial Completion.

3.06 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

**SECTION 28 31 00
FIRE DETECTION AND ALARM**

PART 1 - GENERAL

1.01 SUMMARY

A. Section Includes:

1. Fire alarm system shall consist of fire alarm control panel or networked nodes, of the same make and CSFM (California State Fire Marshall) listed for the application.
2. Labor, equipment, materials, connections, testing, and performance of operations in the installation of fire alarm system.

B. Related Requirements:

1. Division 01 General Requirements.
2. Section 23 09 23: Environmental Controls Energy Management Systems.
3. Section 23 80 00: Heating, Ventilating, and Air Conditioning Equipment.
4. Section 26 05 00: Common Work Results for Electrical.
5. Section 26 05 13: Basic Electrical Materials and Methods.
6. Section 26 05 19: Low-Voltage Wire (600 Volt AC).
7. Section 26 05 26: Grounding and Bonding.
8. Section 26 05 33: Raceways, Boxes, Fittings, and Supports.

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1.02 SYSTEM REQUIREMENTS

A. Fire detection system shall continually supervise and monitor the following initiating, signaling, and monitoring circuits:

1. Manual fire-pull stations.
2. Smoke and heat detectors, duct detectors, including those installed under other sections.
3. Fire sprinkler flow and tamper switches. In existing installations also include PIV tamper switches.
4. Alarm signaling circuits including alarm bells, horns and visual alarm units.
5. Annunciators.
6. Power supplies and batteries.

7. Interconnection with Central and Autonomous Public Address systems, telephone network system, Clock System-Classroom or Program schedule change, HVAC system where applicable.
- B. System controls shall be UL listed for power limited applications in accordance with California Electrical Code.
- C. The fire alarm devices and equipment shall be listed for installation for the fire alarm control panel to which they are being connected.
- D. Complete installation shall conform to the version of NFPA 72, California Fire Code, California Building Code (CBC), and California Electrical Code (CEC) as approved by DSA on stamped drawings.
- E. System labels and devices programming addresses shall be based on final signage and building labeling submittals. For existing facilities contractor shall obtain from Owner Authorized Representative a copy of the current site layout and building labeling designations.

1.03 CERTIFICATION

- A. Certification: Installation of fire alarm system shall not begin until Shop Drawings, including State Fire Marshal listing numbers of fire alarm components, are submitted and reviewed by the Architect. Written certification by fire alarm equipment distributor or manufacturer shall be submitted to the Architect stating that system and its component parts are as approved and listed by the State Fire Marshal, and that the design conforms to requirements set forth in CBC.

1.04 PERFORMANCE

- A. System shall be fully programmable, configurable, and expandable in the field without special tools or PROM programmers and shall not require replacement of memory ICs. Installer shall provide a CD of system installed software, site specific system programming and information and tools required to re-program or modify the system.

1.05 SYSTEM FUNCTIONAL OPERATION

- A. When a fire alarm condition is detected by one of the system alarm initiating devices, the following functions shall occur:
 1. System alarm LED shall flash.
 2. Local sounding device in panel shall be activated.
 3. The LCD display shall indicate type of device, custom label location label and point status alarm condition.
 4. Appropriate change of status message shall be transmitted to remote annunciator(s).
 5. Automatic programs assigned to alarm point shall be executed and associated indicating devices and relays activated.
 6. In the event of a fire alarm control panel activation, manual and automatic electronic tone or electromechanical bell class passing signals shall be disabled.

7. In the event of a fire alarm condition the Central and Autonomous Public Address System shall be overridden.
 8. UDACT (Universal Digital Alarm Communicator Transmitter) shall activate.
 9. Provide necessary hardware and labor for a complete and tested interfacing of the fire alarm system with the lighting controls systems in Auditoriums, Multi-Purpose rooms, and Gymnasiums; lighting in these areas shall be brought to full brightness in the event of a fire alarm.
- B. Trouble and Supervisory Conditions.
1. When any trouble condition is detected the following functions shall occur:
 - a. System trouble LED shall flash.
 - b. Local sounding device in panel shall be activated.
 - c. The LCD display shall indicate the type of trouble and custom label location associated with the trouble condition and its location. Unacknowledged alarm messages shall have priority over trouble messages. If such an alarm is displayed, then trouble messages shall not be displayed.
 - d. Appropriate message shall be transmitted to remote annunciators.
 - e. UDACT shall activate.
- C. When any supervisory condition occurs such as a sprinkler valve tamper, the following function shall occur:
1. System supervisory LED shall flash.
 2. Local sounding device in panel shall be activated.
 3. Appropriate message shall be transmitted to remote annunciators.
 4. UDACT shall activate.
- D. Activation of control panel ACKNOWLEDGE switch in response to a single new alarm, trouble or supervisory condition shall silence panel sounding device and change system alarm, trouble, or supervisory LED from flashing to steady-ON. If additional new alarm, trouble, or supervisory conditions exist in the system; activation of this switch shall advance display to next alarm, trouble, or supervisory condition that exists, and shall not silence local audible device or change LED to steady until new conditions have been so acknowledged. New alarm conditions shall always be displayed before new trouble conditions. Occurrence of a new alarm, trouble, or supervisory condition shall cause panel to resound, and sequences as described above, shall repeat.
- E. Activation of the signal silence switch shall cause appropriate notification (indicating) appliances and relays to return to normal condition. Selection of notification appliance circuits and relays silenced by this switch shall be fully programmable.
- F. Activation of system reset switch shall cause electronically latched initiating devices or zones, as well as associated output devices and circuits, to return to normal condition after sixty seconds of alarm. If alarm conditions exist in system after system reset switch activation, system shall then re-sound alarm conditions as indicated hereafter.

- G. Activation of lamp test switch shall turn on LED indicators, LCD display, and local sounding device in panel, and then return to previous condition.
- H. Fire alarm indicating appliances may be silenced or extinguished, after one minute, by operating signal silence switch at the FACP or by use of key supervised alarm silence switch at remote annunciators. A subsequent zone alarm shall reactivate signals. Audible indicating appliances shall be automatically silenced after no less than five nor more than ten minutes of operation. Visual indicating appliances shall be extinguished at system reset, or automatically after no less than five nor more than ten minutes of operation. Fire sprinkler flow alarm bells shall not silence until the contacts in the fire sprinkler flow switch return to the normal non-alarm state. Appropriate signage must be installed on or next to the sprinkler alarm bell.
- I. System's circuits including but not limited to initiation, indicating, and equipment interfacing shall be monitored for open or short circuit and ground fault conditions, these conditions shall be indicated on the Fire Alarm Control Panel and Annunciator displays while remaining circuits continue to operate normally.
- J. Notification appliance circuits shall be silenceable for testing purposes by authorized persons. Protected pass-codes, keys, or another secure method that does not require entering into the system programming shall be used.

1.06 POWER REQUIREMENTS

- A. The fire alarm control panel and remote power supply shall receive 120 VAC power, 60 Hz, through a dedicated 20 amps circuit. Circuit breaker protection for the dedicated fire alarm power circuits shall be equipped with a handle lock-on device; the breaker handle shall be colored red and labeled "FIRE ALARM". Clearly label the Electrical panel name, location and circuit number on the inside of the fire alarm control panel and remote power supplies using a p-touch style labeling system. Transient voltage surge suppression shall be provided at the 120VAC input terminal.
- B. System shall be provided with sufficient battery capacity to operate entire system upon loss of normal 120 VAC power, in a normal quiescent mode, for a period of 24 hours with five minutes of alarm indication at end of this period. System shall automatically transfer to standby batteries upon power failure. Battery charging and recharging operations shall be automatic. Batteries, once discharged, shall recharge at a rate to provide a minimum of 70 percent capacity in 12 hours.
- C. Circuits requiring system operating power shall be 24 VDC and shall be individually protected at control panel.

1.07 SUBMITTALS

- A. Provide in accordance with Division 01.
- B. Component Plan Submittal: Availability and listing for its application shall be verified for system components before presentation of the submittal. Include the following information and details as applicable:
 - 1. Installer name, address, telephone number.
 - 2. List of system components, equipment and devices, including manufacturer model numbers, quantity and California State Fire Marshal listing numbers, mounting heights, and symbols per OUHSD symbol list.

3. Copies of manufacturer specification sheets for equipment and devices indicated. Highlight or identify the specific components on Catalog cut sheets.
 4. Voltage Drop Calculations: Include the following information for the worst case:
 - a. Point-to-point or Ohms law calculations.
 - b. Zone used in calculations.
 - c. Voltage drop percent. Voltage drop shall not exceed manufacturer's requirements. If voltage drop exceeds ten percent, indicate manufacturer listed operating voltage ranges for equipment and devices.
 5. Battery types, amp hours, and load calculations including the following:
 - a. Normal operation: 100 percent of applicable devices for 24 hours to equal control panel amps plus list of amps per device that draw power from the panel during standby power condition including, but not limited to, zone modules, detectors and devices as identified.
 - b. Alarm condition: 100 percent of applicable devices for five minutes to equal control panel amps plus list of amps per device that draw power from panel during alarm condition including, but not limited to, the following:
 - 1) Zone modules.
 - 2) Signal modules.
 - 3) Detectors.
 - 4) Signal devises.
 - 5) Annunciator.
 - 6) Other devices as identified.
 - c. Normal operation plus alarm operation load calculation shall include total amp hours required and total amp hours provided.
 6. Provide one copy of testing procedures.
- C. Shop Drawings: Provide Shop Drawings, in the same size as the design Drawings, include the following:
1. Provide drawing scale, elevations of system enclosures, and actual layout of the Fire Alarm Control Panel, power supply, annunciator, and main system components.
 2. Site Plan indicating PIV and related fire sprinkler system devices and equipment to be monitored or supervised; such as water flow valves, and main equipment such as control panels, power supplies, annunciators, and components such as outdoor wall-mounted horns, sprinkler bells, pull boxes, underground pull boxes , wiring routes on buildings exterior and underground locations. In each conduit or raceway run indicate conduit sizes, and quantities and type of wires.

- a. In existing facilities make a distinction between existing and new installation.
3. Complete battery calculations, and voltage drop calculation shall be included; these calculations shall be based on the devices maximum UL current rating.
4. One line drawing for the entire system network indicating system components and wiring. The one line diagram shall show but not be limited to panel to panel interconnections, conductors gage and quantity, conduit size and type (designation) and specific function.
5. System panel one-line drawings indicating the quantity and type (designation) of conductors entering and exiting the fire alarm terminal cabinet in each building (enclosure) for initiating, notification, or other command control functions required for complete system operation:
 - a. Individual floor or building plan view drawings indicating device locations including end of line resistors "EOLR" in accordance with the legend provided.
 - b. Individual point addresses for initiation and notification devices.
 - c. Device "typical" wiring diagrams. These drawings shall indicate specific termination details for peripheral equipment and interface devices.
6. Provide interfacing with equipment furnished by others including voltages, and other required coordination items. Refer to 3.01-B.
7. Each of the pictorial diagrams included shall appear identical to the products they are intended to depict, in order to speed installation of the system, and to enhance the accuracy of the installation Work. Typical wiring diagrams or catalog sheets are not permitted.
8. Background Drawings with device locations of DSA approved drawings are available in electronic format and may be obtained from the Owner Authorized Representative (OWNER). Contractor is solely responsible for the accuracy and completeness of shop drawings. Buildings that are not part of the contract shall be clearly identified "NOT IN CONTRACT". Shop Drawings shall be prepared in the latest version of AutoCAD with three – CD ROM electronic copies submitted along with full sized Shop Drawings.
9. Other installation and coordination drawings specifically related to this section shall be included as follows:
 - a. Size A (8 ½ by 11) and size B (11 by 17) shall be bound into the manual.
 - b. Larger drawings shall be folded and inserted into transparent envelopes and bound into the manual.
10. Installation and coordination drawings for items in other sections shall be included with submittal of Shop Drawings. Submit blue line copies and one reproducible copy of installation and coordination drawings.
11. Samples: Provide Samples of material and equipment as required by the Architect. If Samples are requested, they shall be submitted within ten days from date of request.

- D. In addition to the above requirements, provide submittals to meet any additional requirements of DSA.
- E. Submittal of Equivalent Systems:
 - 1. In addition to the submittal requirements of this section, if an equivalent system listed in Section 2.01A is submitted in lieu of the designed system shown on DSA approved drawings, the Contractor shall also submit a letter stating that the system is equivalent, and that device locations and quantities of devices are unchanged. Attached to this letter shall be a copy of the revised equipment schedule with corresponding CSFM numbers and a cut sheet for each item.
- F. Modifications or additions to existing fire alarm systems shall be compatible and of the same manufacturer as the existing system. Contractor shall be solely responsible for engineering, plan check and any fees resulting from an installation that deviates from this requirement.
- G. Prior to Substantial Completion submit to the Architect or Engineer of Record and to Owner Authorized Representative a complete updated set of the Shop Drawings showing changes made to the Fire Alarm System during construction. These drawings will become the System As-Built Drawing set for the Fire Alarm System Owner's Manual.

1.08 QUALITY ASSURANCE

- A. Installer shall have successfully completed at least five projects of equal scope in the past five years, and have been in business of furnishing and installing fire alarm systems of this type for at least five years.
- B. Installer shall be a factory authorized distributor and service provider for the brand of equipment offered and shall provide documentation to the Architect upon request.
- C. Installer shall maintain a fully equipped service organization capable of furnishing repair service to the equipment and shall maintain a spare set of major parts for the system at all times.
- D. Installer shall furnish a letter from manufacturer of equipment certifying equipment has been installed according to factory standards and that system is operating properly.
- E. Certifications: Installer shall submit certification from the equipment manufacturer indicating that installer is an authorized representative of the equipment manufacturer and is trained on network applications.
- F. Materials and equipment installed shall be new.
- G. Equipment in this specification shall be furnished and installed by the Authorized Factory Distributor of the equipment. Furnish a letter from the manufacturer of major equipment, which certifies that the installer is an authorized distributor and that the equipment has been installed according to factory intended practices. Furnish a written guarantee from the manufacturer that they will have a service representative assigned to this area for the life of the equipment.
- H. Installer shall be Underwriters Laboratory (UL) listed company under the UUJS classification, and shall certify that the installation has been made in accordance with UL requirements.

- I. The fire alarm contractor shall have a NICET II Certified Technician on staff in their facility directly involved with this project to ensure technical expertise to this project and adherence with these specifications.
- J. Contractor or Installer's Electricians and fire and life safety technicians shall be certified in accordance with Labor Code sections 3099, and 3099.2, and section 209.0 of the California Code of Regulations.
- K. System startup and testing shall be performed under the direct observation of the Project Inspector and OWNER. Provide a legible half size reproduction of the original completed fire alarm red-line drawings (this copy will be retained by the Owner), an accurate copy of the fire alarm system points list, and a copy of the construction drawings on CD in AutoCad format.
- L. At the time of installation the most current software package available shall be provided.
- M. Provide at the time of Owner Acceptance of the installation, equipment, and updated software which is to include the appropriate operating system, pass-codes, electronic keys and program disks, manuals and cables employed in the installation of the system. These components shall be delivered to the OWNER.
- N. Provide a backup copy of the most current software revision, in disk format. This copy shall be delivered to the OWNER
- O. A software license agreement shall be made available for the responsible Owner representative to sign at the time of training.

1.09 WARRANTY

- A. The Fire Alarm Equipment Manufacturer shall provide a three year material warranty. Installer shall provide a three year labor warranty. Products shown defective in workmanship or material during the warranty period shall be repaired, replaced or adjusted at no cost to Owner.
- B. Complete maintenance and repair service for the fire alarm system shall be available from a factory trained authorized representative of the manufacturer for a period of five years after expiration of the warranty.
- C. Owner personnel will conduct annual City of Camarillo Fire Department Regulation 4 Tests. Defects noted during these tests shall be corrected by the Contractor during the warranty period specified.

PART 2 - PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS

- A. Fire alarm equipment shall be standard products of Gamewell-FCI, to match existing system.
- B. Catalog and model numbers listed are intended to establish type and quality of equipment and system design as well as operating features required. Deviations from intended functions of specified system are not permitted. Equipment shall not be ordered or installed until such equipment has been reviewed and approved by the Architect.
- C. Products specified below are based on Gamewell-FCI system components.

2.02 FIRE ALARM CONTROL PANEL (FACP) OR NETWORK NODES (EXISTING)

- A. Existing control panel is Gamewell-FCI Model No. E3 (CSFM 7165-1703:0125) Fire Alarm Control Panel as indicated on drawings.

2.03 POWER SUPPLIES (EXISTING)

- A. Remote Notification Appliance Circuit (NAC) extender power supplies is Gamewell-FCI No. SNAC-4 (CSFM 7300-0694:0194) .
- B. Remote Notification Appliance Circuit (NAC) extender power supplies to be Gamewell-FCI No. HPF24S6 (CSFM 7315-1637:0102).

2.04 PERIPHERAL DEVICES AND EQUIPMENT

- A. (EXISTING) Manual Stations: Interior Use: Station is Gamewell-FCI, Model No. FCI-MS-2 (CSFM 7150-1703:0100).
- B. Smoke Detectors: Smoke Detectors shall be Gamewell-FCI Model No. ASD-PT2LF (CSFM 7272-1703:0121).
- C. Heat Detectors: Heat Detectors shall be Gamewell-FCI Model No. ATD-HL2F (CSFM 7270-1703:0115)
- D. Projected Beam Infrared Type Smoke Detectors shall be Gamewell-FCI Model No. ABD-RT2F (CSFM 7260-1703:0120), or equal, and shall consist of a transmitter / receiver unit and reflector to be used in accordance with manufacturers recommendations. Each detector shall include six user-selectable sensitivity levels. Alignment shall be achieved with a signal strength meter incorporated into the beam detector. The detector shall feature automatic detection and adjustment to the optimum level for the specific environment. Provide remote test stations with key lock for detectors, System Sensor Model RTS-451KEY, or equal, located below ceiling.
- E. Multi-Criteria Fire Detectors shall be Gamewell-FCI Model MCS-COF (CSFM 7275-1703:0175) or equal.
 - 1. Multi-Criteria Fire Detectors shall be used on performing stages and surrounding areas of the performing stage where the use of special effect smoke is to be used.
 - 2. Multi-Criteria Fire Detector shall combine four separate sensing elements into one unit:
 - a. Photoelectric chamber shall sense airborne particulate for smoke detection.
 - b. Electrochemical cell technology shall monitor carbon monoxide.
 - c. Infrared sensing shall measure ambient light levels and flame signatures.
 - d. Thermal detection shall monitor temperature.
 - 3. Multi-Criteria Detector shall be capable of generating only one alarm signal from at least two sensors of the four when positively confirming a fire. The sensor output shall be mathematically evaluated to determine when a signal is warranted.

4. Twin LED indicators shall provide 360 degree visibility.
5. Provide B200S sounder base for Temporal 4 Code notification.

F. Monitor Modules:

1. Monitor module shall be Gamewell-FCI Model No. AMM-2 (CSFM 7300-1703:0102), or equal. Module shall connect a supervised zone of conventional initiating devices, N.O. dry contact devices, including four-wire smoke detectors, to one of SLC loops. Monitor module shall install in a four-inch square by 2 1/8-inch deep electrical box. The module shall have its loop number, electronic address, and function label on the front cover using a P-Touch type or equal labeling system.
2. Monitor module shall provide address-setting means using rotary decimal switches and shall store an internal type of device. An LED shall be provided which shall flash under normal conditions indicating that monitor module is operational and in regular communication with control panel.

G. Control Modules:

1. Provide Air Products MR-101 Relay Model (CSFM 7300-1004:0101) or equal power supervision relay to monitor 24 volt DC power.
2. Control module shall provide address-setting means using rotary decimal switches and shall store an internal identifying code which control panel shall use to identify type of device. An LED shall be provided which shall flash under normal conditions, indicating that control module is operational and in regular communication with control panel.

H. Relay Modules:

1. Relay Module shall be Gamewell-FCI Model No. AOM-2 (CSFM 7300-1703:0102) the module shall provide as a minimum one set of form "C" dry contacts and have its loop number, electronic address, and function labeled on the front cover using a P-Touch type labeling system.
2. Provide a buffer relay that is part of the control system if controlled circuit(s) exceeds the voltage or current rating of the relay module.
3. Relays used to interface control of other systems shall be electrically supervised and shall only be wired in a fail-safe mode of function during a power failure.

I. Notification: Existing Horns and strobes are compatible with existing fire alarm control panel and power supplies. Low Frequency notification appliances provided for Gymnasium CO detection.

1. (Existing) Strobe indicating appliances are Gentex Model No. GXS Series (CSFM 7125-0569:0114).
2. (Existing) Exterior Horn indicating appliances are Gamewell-FCI Model No. GX-93 (CSFM 7135-0569:0126).
3. Low Frequency Sounder for Temporal 4 code notification appliances shall be System Sensor Model No. HWL-LF (CSFM 7135-1653:0516).

4. Low Frequency Sounder/Strobe for Temporal 4 code notification appliances shall be System Sensor Model No. P2WL-LF (CSFM 7125-1653:0517).
- J. Voice Evacuation System:
1. The Voice Evacuation Control (EVAC) digital audio amplifier shall be Gamewell-FCI Model No. AM-50 (CSFM 7165-1703:0125).
 2. Ceiling Mounted EVAC Speakers shall be System Sensor No. SPCW (CSFM 7320-1653:0201). The 8 inch speaker shall have an impedance of 8 ohms, minimum 9.5 ounce magnet and an attached 25 volt audio line matching transformer with 1/8, 1/4, 1/2, 1, 2, 4 and 8 watt tap settings and DC blocking capacitor. Wattage shall be selectable by the use of a jumper or shunt. Audio levels shall be 75, 78, 81, 87, 90 or 93 dba at ten feet. Input or output terminals that will accommodate 12 to 18 AWG wire shall be provided. Speakers orientated in the same direction shall be connected in phase with each other. Multiple speakers in areas such as Auditoriums or Gymnasiums shall be divided into two circuits in a checker board pattern and connected separately to the two audio output circuits.
 3. Wall Mount four Inch EVAC Speakers shall be System Sensor Model No. SPW (CSFM 7320-1653:0201) to be mounted on a manufacture recommended outlet box. The four inch speaker shall have an attached 25 volt audio line matching transformer with 1/4, 1/2, 1 and 2 watt tap settings and a DC blocking capacitor. Wattage shall be selectable by the use of a jumper or shunt. Audio levels shall be 80, 84, 86 or 89 dba at ten feet. Input or Output terminals that will accommodate 12 to 18 AWG wire shall be provided. Speakers orientated in the same direction shall be connected in phase with each other; but when installed facing opposite directions they shall be connected out of phase.
 4. Ceiling Mounted EVAC Speaker/Strobes shall be System Sensor No. SPSCW (CSFM 7320-1653:0201).
 5. Wall Mount four Inch EVAC Speaker/Strobes shall be System Sensor Model No. SPSW (CSFM 7320-1653:0201)
- K. Network Cables or SLC or Annunciator Data or Audio Output Cables: The construction and physical characteristics such as aqua-seal water block, wire gage, insulation and jacket types, etc. shall not be altered. Equivalent cables must be specifically approved and recommended by the manufacturer of the fire alarm system equipment. Substitutions will require review from the Architect or Engineer of Record.
- L. The cable types listed below are based and specified on the recommendations of Gamewell-FCI. If the submitted fire alarm system requires a different cable configuration with additional conductors, multi-conductor versus twisted pairs, etcetera than is specified above, request a substitution to supply and install the configuration of cables by the make and model of the fire alarm system that is to be installed.
1. Indoor Network and EVAC System Audio Output Circuit(s) applications shall be in conduit or in surface mounted raceway as indicated on drawings: West Penn No. D980, one pair 18 gage solid copper, unshielded, Copolene II insulated and PVC jacketed, or equal.
 2. Indoor SLC applications in conduit or in surface mounted raceway where it is indicated on drawings: West Penn No. D990, one pair 16 gage solid copper, unshielded, Copolene II insulated and PVC jacketed, or equal.
 3. Indoor Annunciator applications in conduit or in surface mounted raceway where it is indicated on drawings: West Penn No. D975, one pair 18 gage solid copper, shielded, Copolene II insulated and PVC jacketed, or equal.

4. Outdoor or Underground Network Applications: West Penn AQ224, two-conductor 18 gage stranded copper, unshielded, water-blocked construction and PVC insulated, or equal.
5. Outdoor or Underground SLC applications: West Penn AQ225, 2-conductor 16 gage, AQ226, 2 conductor 14 gage, or AQ227, 2 conductor 12 gage stranded copper, unshielded water-blocked construction and PVC insulated, or equal.
6. Outdoor or Underground Annunciator applications: West Penn AQ293, 2 conductors, 18 gage stranded copper, shielded water-blocked construction and PVC insulated, or equal.

M. Protective Covers

1. Provide protective covers for pull stations, smoke and heat detectors, and audible and visual devices located in areas occupied by students that can be subjected to vandalism such as gyms, restrooms, locker and shower rooms, and all hallways and corridors associated with these spaces. Installation of cover must not protrude over current ADA limitations.

PART 3 - EXECUTION

3.01 GENERAL

- A. Fire alarm system shall not be used for any purpose other than fire alarm functions.
- B. Fire alarm shall be interconnected but not limited to the following systems:
 1. Systems required by code to be connected to the fire alarm systems shall be connected.
 2. Public address system for disabling the manual and automatic bell or tone class passing signals. Manual and automatic class passing signals shall not be operable during alarm conditions.
 3. Ventilation systems where required for the purpose of fan shutdown
 4. Damper control or smoke management systems.
 5. Water based fire sprinkler systems.
 6. Chemical fire extinguisher systems.
 7. Central and Autonomous PA system(s).
 8. Theatrical lighting control system.
 9. Fire pump controller for required signaling and trouble supervision.
- C. Fire alarm system shall not be interconnected to any of the following:
 1. Sump warning systems,
 2. Carbon monoxide detection systems.
 3. Methane gas detection systems.

4. Elevator car alarm bell circuit.
5. Other unrelated system.

3.02 SYSTEM INSTALLATION

- A. Install required conductors to devices indicated on Drawings. Provide required conductor terminations to devices for a complete system to function as specified and indicated on Drawings. Refer to Section 26 05 19: Low-Voltage Wire (600 Volt AC), for installation and color coding requirements.
- B. Splices are not allowed in junction boxes. Terminations shall be in terminal cabinets or on equipment terminals.
- C. Conductors shall be installed within conduits, boxes, and terminal cabinets in a totally enclosed installation. Furnish and install conductors required to connect incoming and outgoing circuits, including spare conductors, to terminal strips within terminal cabinets.
- D. Wiring within equipment and terminal cabinets shall be installed to conform to contract documentation and NFPA 72 standards, and shall be terminated on terminal blocks having terminals for required connections. Wiring shall be cabled, laced, and securely fastened in place so that no weight is imposed on equipment or terminals.
- E. Install required terminal blocks within terminal cabinets. Terminal blocks shall be installed on inside back of cabinets only, not on side. Incoming wiring shall be terminated on the left side of terminal blocks; outgoing wiring shall be terminated on the right side of the terminal blocks.
- F. Conductors shall be color-coded per specification section 26 05 19 Low Voltage wires and tagged with code markers at terminal cabinets, and equipment. A wire index shall be typed and installed on terminal cabinet doors. Index shall be covered with clear plastic adhesive covers. Wiring shall be identified as to building and location of devices in the index.
- G. Wiring within equipment and terminal cabinets shall be carefully strapped, and shall be formed in rectangular configuration. Wires shall be properly numbered in numerical order and shall maintain same number throughout the Project site.
- H. Complete installation shall comply with local building codes and applicable provisions of the California Electrical Code, California Fire Code and the NFPA 72 National Fire Alarm Code.
- I. Location of outlet boxes and equipment on Drawings is approximate, unless dimensions are indicated. Do not scale Drawings to determine locations and routing of conduits 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 the start of Work.
- J. Drawings generally indicate Work to be provided, but do not indicate all 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 furnish and install required fittings.
- K. Provide P-touch label of approximately one inch wide with red lettering for each initiating device that is hidden from view. Tags shall indicate the name and type of device: Heat Detector, or Duct Smoke Detector. Tags shall be permanently attached on access panel or t-bar grid which is used to access a hidden device.

3.03 SYSTEM PROGRAMMING

- A. Programming shall be performed in accordance with District requirements set forth in this section – the local authority having jurisdiction and applicable codes. If a conflict arises or a clarification is required, the contractor through the project's OWNER shall contact the Districts Fire Life Systems Testing Group (FLSTG) for clarification
- B. As part of the 50 percent construction completion label devices and locations in the manner indicted in the attached guidelines on a separate copy of the shop drawings. Request a meeting with OWNER, Project Inspector, and representative of FLSTG to review, finalize and obtain approval of the proposed device, equipment and location descriptors that will be programmed into the system. The District may at time of substantial completion request minor changes to program descriptors if needed to conform to site conditions.
- C. The following functions and features as required by the site or system configuration and installed peripheral equipment and systems shall be programmed into OUHSD fire alarm systems. The definition of programming shall include but not be limited to the use of a built in keyboard, the use of a connected PC with the appropriate software, dip or rotary switches, wiring or installable or removable jumpers as required or provided in the fire alarm equipment.
 - 1. Signal Silence Switch Inhibit: The audible signal silence switch located on the remote fire alarm annunciator(s) or any fire alarm control panel(s) shall be programmed to not silence the audible or extinguish the visual alarm circuits during the first minute (60 seconds) of the fire alarm horn or strobe activation. Activation of this switch after the initial 60 seconds signaling shall silence only the audible signals. Enabling or disabling this feature shall be allowed only by authorized District maintenance personnel and shall be protected by a maintenance level password.
 - 2. Audible and Visual Signal Auto Silencing Extinguishing: Audible coded signals and visual signals throughout the site, unless silenced by the above switch, shall be programmed to automatically self-silence or extinguish in no less than 5 minutes (300 seconds) and no more than 10 minutes (600 seconds). This feature shall not apply to the fire sprinkler water flow audible appliance.
 - 3. Fire Sprinkler Water Flow Audible Appliance: The fire sprinkler water flow appliance (bell) shall not require any programming because of our requirement for this appliance to be directly controlled by a set of dry contacts within the associated sprinkler water flow switch(s). The 24 volt DC auxiliary power for the sprinkler water flow audible appliances shall be supplied by an FACP or a remote power supply. This audible appliance shall operate continuously during the detection of fire sprinkler water flow and shall not be coded in any manner nor silenced automatically by any FACP or manually by any user controls at any FACP or remote annunciator.
 - 4. Fire Sprinkler Water Flow Switch: Fire sprinkler water flow switches shall be programmed in a manner that shall prevent the above Signal Silence Switch from silencing the audible coded signals or visual signals after the initiation of an alarm by a fire sprinkler flow switch.
 - 5. Audible Notification Appliance Circuits: Audible notification appliance circuits shall be programmed to emulate the temporal code (ANSI S 3.41) from fire alarm audible appliances (horns). This coding shall originate and be controlled by a single coder residing within the FACP(s). The use of coders within remote power supplies either mounted adjacent to an FACP or at a remote location or directly

by an audible notification appliance will not be permitted. Programmable audible notification appliances shall be configured to emulate a steady tone at approximately 1000 Hz. Audible notification appliance circuits shall be programmed to be silenced as described above. Notification appliance circuits throughout the site shall be activated by any alarm initiating device. Coded audible signals shall be controlled by a single synchronized FACP.

6. Visual Notification Appliance Circuits: Visual notification appliance circuits shall be programmed to provide steady non-coded power to the visual appliances (strobes). As required by code and the system configuration, a synchronization signal shall be superimposed onto the NAC by the FACP, a remote power supply or an add-on synchronization module. Visual notification appliance circuits shall be programmed to be extinguished as described above. Visual notification appliance circuits throughout the site shall be activated by any alarm initiating device.
7. System Reset Button: The system reset button located on FACPs and remote annunciators in addition to resetting the fire alarm system and silencing or extinguishing notification appliances except for the sprinkler water flow appliances shall be programmed to reset analog and addressable smoke detectors, duct detectors, beam detectors and relays, addressable control modules and addressable relay modules used to interface to other systems and equipment. Each installed system reset button shall be programmed to operate as a "single point of reset" for the complete system.
8. HVAC Shutdown: Relays and addressable relay modules used to interface to HVAC equipment dampers, and supply and exhaust fan motors shall be programmed to shut down this equipment only within the same building where the detection of smoke, heat or fire sprinkler water flow has taken place. Manual pull stations within any building shall not effect the operation of the HVAC equipment. These relays shall return to normal only after the system is reset.
9. Smoke Detector Maintenance Alert: Addressable smoke detectors shall be programmed with the capability of initiating a maintenance alert when any one detector becomes obscured by dust or any other contaminates at approximately 10 percent below the level of obstruction that would initiate an alarm.
10. Disabling Class Passing Signals: The relay or addressable relay module shall be programmed to disable the class passing signals during any alarm condition at the site. This relay or addressable module shall return to normal only after the system is reset.
11. Disabling Audio of a Public Address System: The relay or addressable relay module shall be programmed to mute the audio output of the associated public address system during any activation of an audible notification appliance circuit or a voice evacuation announcement. This or these relays shall automatically restore to normal upon the silencing of the audible NACs and the voice evacuation announcement.
12. UDACT: The FACP and the associated Universal Digital Alarm Communication Transmitter shall be programmed to transmit to the central monitoring station separate indications for General Alarm, Fire Sprinkler Water Flow Alarm, System Trouble and Supervisory Conditions. These indications shall be in addition to any indications initiated by the UDACT itself.

13. Power Failure Reporting Time Delay: Main and remote NAC power supplies shall be programmed to delay the reporting of a site AC power failure for a minimum of 6 hours.

D. Device Descriptors:

1. Descriptors shall enable responding personnel to identify the location of a fire quickly and accurately, and shall indicate the status of emergency equipment or fire safety functions that might affect the safety of occupants. The minimum required information for devices intended to report smoke, fire, or fire sprinklers water flow include, but may not be limited to: Building, floor (if multiple floors exist in the building), room or space description, and device type and digital address (Smoke detector, Heat detector, Fire sprinkler water flow switch, etc).
 - a. Building: The building must always be included in the descriptor, even if there is only one building on the site. Additional building(s) may be added at a later date creating the possibility of confusion by similar designated spaces, such as "Work room" or "Staff restroom" if more than one building has these similar designated spaces. The building designation in the descriptor must be what the site-based personnel call the building. The building should be provided with signage to aid fire department personnel in the identification of the building.
 - b. Floor: In multi-floor buildings the floor designation (1st, 2nd, etc) must be included in the descriptor.
 - c. Room Description: The room or space description must be unique. Using the same designation for multiple spaces, such as "Workroom", "Counselor's Office", or "Men's restroom", etc. is not acceptable. If, during a project, the room numbers or the use of the room changes then the room or space descriptor must be changed to agree with the change. Proper signage should be provided for each space to aid fire department personnel in the identification of the room or space.
 - d. Device Type, Address and Compass Designations: The device type and digital address must be included with the descriptor, such as smoke detector or heat detector, etc. Some systems provide this information automatically in the descriptor. Compass designations, (N, S, E, and W) are required in spaces such as corridors where there are multiple detectors and this information would be helpful to responding fire department personnel in locating the device reporting alarm. It is not necessary to include compass designations in smaller spaces where there are multiple detectors located in close proximity to each other.

E. ACCEPTABLE ABBREVIATIONS

Rm.- Room	Bldg.- Building	Smk. - Smoke
Corr.- Corridor	Lby- Lobby	Asst. - Assistant
Eng.- English	N – North	Nrs. - Nurse
Flr.- Floor	S – South	Cnclr - Counselor
Ht.- Heat	E – East	Off. - Office

Lib.- Library	W – West	PE – Physical Education
Lkr. – Locker	Kit- Kitchen	RR- Rest Room
Stu Str – Student Store	Sci - Science	By = near
Stor Rm – Store Room	Café - Cafeteria	PM – Plant Manager
1 st - First	2 nd - Second	3 rd - Third
Hopr Rm – Hopper Room	Det - Detector	Elev - Elevator
Prin – Principal	Blr Rm – Boiler Room	Conf – Conference
Park – Parking	Bsmt –Basement	MPR.- Multi-Purpose room

3.04 SYSTEM OPERATION

- A. Unless otherwise specified, but not limited to actuation of manual stations, smoke detectors, heat detectors, linear heat or smoke detectors, or water-flow switches shall cause the following operations to occur, refer to Attachment B:
1. Activate audible circuits.
 2. Actuate strobe units until the panel is reset or strobe circuit time-out.
 3. Release magnetic door holders to doors to adjacent zones on the floor from which the alarm was initiated.
 4. UL listed central station shall be notified via – Universal Digital Alarm Communicator Transmitter (UDACT).

3.05 TESTING

- A. A 48 hour notice shall be provided to the Project Inspector before final testing.
- B. Testing of fire detection system shall be as required by the State Fire Marshal and local authorities having jurisdiction. Installer is responsible for identifying required testing, coordinating, scheduling, and conducting tests before Substantial Completion. Tests shall include the following:
1. Operation of signal-initiating devices (smoke detectors, heat detectors, pull stations etc.).
 2. Operation of indicating devices (alarm horns, alarm bells and alarm strobes).
 3. Operation of system features under normal operation.
 4. Operation of system supervisory features.
 5. Operation of system features on standby power, with primary power turned off.
 6. Before energizing the cables and wires, check for correct connections and test for short circuits, ground faults, continuity, and insulation.

7. Close sprinkler system flow valves and verify proper supervisory alarm at the FACP.
 8. Verify activation of flow switches.
 9. Open initiating device circuits and verify that trouble signal actuates.
 10. Open signaling line circuits and verify that trouble signal actuates.
 11. Open and short notification appliance circuits and verify that trouble signal actuates.
 12. Open and short (wire only) network communications and verify that trouble signals are received at network annunciators or reporting terminals.
 13. Ground initiating device circuits and verify response of trouble signals.
 14. Ground signaling line circuit and verify response of trouble signals.
 15. Ground notification appliance circuit and verify response of trouble signals.
 16. Check alert tone to alarm notification devices.
 17. Check installation, supervision, and operation of intelligent smoke detectors.
 18. Alarm conditions that the system is required to detect shall be introduced on the system. Verify the proper receipt and the proper processing of the signal at the FACP and the correct activation of the control points.
 19. When the system is equipped with optional features, consult the manufacturer manual to determine proper testing procedures.
 20. Theatrical lighting house light control override.
 21. Central and Autonomous PA systems for muting during the sounding of the audible notification appliances and voice evacuation announcements.
 22. Disabling electronic tone or electromechanical bell class passing signals until system reset.
- C. Upon completion of installation of fire alarm equipment, provide to the OWNER a signed, written statement confirming that fire alarm equipment was installed in accordance with the Specifications, Shop Drawings, instructions and directions provided by the manufacturer.
- D. Demonstrate in presence of the Project Inspector that circuit and wiring tests are free of shorts and grounds and that installation performs as specified herein and within manufacturer's guidelines.
- E. Software Modifications:
1. Provide the services of a factory trained and authorized technician to perform system software modification, upgrades or changes. Response time of the technician to the Project site shall not exceed 24 hours.

2. Provide hardware, software, programming tools, and documentation necessary to modify the fire alarm network on the Project site. Modification includes: addition and deletion of devices, circuits, zones and changes to system operation and custom label changes for devices or zones. The system structure and software shall place no limit on the type or extent of software modification on-site. Modification of software shall not require power-down of the system or loss of system fire protection while modifications are being provided.
- F. Complete the inspection and testing form as required by NFPA 72, and submit one copy of the completed form to the Architect and Project Inspector.

3.06 SERVICE MANUALS

- A. Deliver to OWNER, three copies of the service manuals. Each manual shall include the following:
1. Installation manuals, programming manuals and user manual if applicable for every control panel, control panel power supply, FACP input or output or relay or control module, auxiliary power supply, UDACT, remote NAC extender power supply, door holder power supplies, installed annunciators, initiating and indicating devices and addressable monitor, relay and control modules. Catalog cut sheets are not acceptable.
 2. A printed copy of the system configuration as programmed, including system labeling codes, and passwords.
 3. An electronic copy on compact disk of the system configuration program
 4. Final test report.
 5. Detailed explanation of the operation of the system.
 6. Instructions for routine maintenance.
 7. Detailed wiring diagram for the connection of relays, addressable monitor, and control or relay modules as applied in the interfacing of peripheral systems or equipment to the fire alarm system. Updated shop drawings shall include revisions made in the field via plan changes, RFIs, Field Change Directives, and any other construction change documents including interface details with ancillary systems.
 8. An electronic copy (CD) of the posted site or fire alarm map in Auto-Cad and pdf formats.
 9. Provide a CD ROM electronic copy of the updated system As-Built Drawings to the OWNER, prepare this copy in the latest version of AutoCAD; along with the electronic copy provide a full size bond copy. Include one CD-ROM of the updated As-Built Drawings into each of the Service Manuals. CD and folded drawings shall be secured and inserted into the Service Manuals via a three-hole punched protective CD case and protective envelopes for the drawings.
 10. Provide codes and passwords for fire alarm system at testing.

3.07 SPARE PARTS

- A. The following new spare parts shall be furnished in unopened boxes:

1. Five percent spare pull stations including the associated monitor module (minimum one spare pull station per type).
2. Five percent spare smoke and heat detectors (minimum one spare smoke and heat detector per type).
3. Five percent spare audible devices (minimum one spare audible device per type).
4. Five percent spare strobe devices (minimum one spare strobe device per type).

3.08

SYSTEM USER AND MAINTENANCE PERSONNEL TRAINING

- A. Before Substantial Completion, provide one instruction period for the Project site based Owner operators and system users. The instruction period shall be scheduled and coordinated by the OWNER.
- B. Training materials and required deliverables shall be submitted to the OWNER.
 1. Prior to beginning the operational demonstration, notify Central monitoring Station that an instructional activity is beginning; inform them that it includes setting and resetting the system in test mode. After the demonstration is completed and the system restored, notify the Central Monitoring Station that the system has been restored and it is back on line for continuous monitoring.
- C. User Instruction and Training
 1. Before substantial completion and with a fully functional fire alarm system installed at the site, the contractor shall provide a minimum of four hours of user training for site based staff. The date and time for this training shall be coordinated by the project OWNER.
- D. Instruction period training for site based staff shall consist of the following:
 1. Overview:
 - a. Explain the fire system is “addressable” which means every device-smoke detector, heat detector, sprinkler water flow switch, manual pull station, etc. has a unique address or identity. This makes it possible to positively identify the exact device causing an alarm, trouble or supervisory condition.
 - b. Explain the fire alarm control panel also controls the horns and strobes throughout the campus or building.
 - c. Explain that the fire alarm system is interconnected to various other systems and equipment through out the site such as:
 - 1) Heating and air conditioning equipment to turn off fans and close dampers to stop the spread of smoke through out a building.
 - 2) The class passing signaling system to disable the bells or tones to not accidentally signal students and staff to return to the buildings.
 - 3) Magnetically held doors to close them to stop the spread of smoke.

- 4) To turn up house lighting in an occupied Auditorium or Multi-Purpose room to provide adequate egress lighting.
 - 5) The Central and Autonomous PA systems to mute them during the sounding of the alarm signal.
- d. Explain the fire system has a battery backup in case of power failure and that it will continue to function for a minimum of 24 hours after a total power failure.
 - e. Explain that the fire alarm system components and wiring are monitored to report a malfunction, damage or vandalism. When this occurs, a trouble indication will appear on the fire alarm annunciator and FACP and this indication will be transmitted to the central monitoring station.
 - f. Explain that other equipment and systems are monitored for abnormal conditions such as the fire sprinkler water being turned off. When this occurs, a supervisory condition is created. A supervisory indication will appear on the fire alarm annunciator and FACP and this indication will be transmitted to the central monitoring station.
 - g. Explain that the fire system in addition to notifying the occupants of a possible fire condition also transmits an alarm indication to the central monitoring station that will in turn notify and dispatch the local fire department to your site.
2. Basic:
- a. Hand out the SYSTEM OPERATION instructions to attendees.
 - b. Point out the Fire Alarm Control Panel and have them observe the normal LED status (one green LED only should be on):
 - 1) GREEN = Normal.
 - 2) YELLOW = Trouble.
 - 3) RED = ALARM.
 - c. Have the attendees observe the LCD display that should be indicating a SYSTEM NORMAL message.
 - d. Point out the Fire Alarm System Annunciator and have attendees observe the LCD display that should be indicating a SYSTEM NORMAL message.
3. Operation and Demonstration:
- a. After putting the system or having someone put the system central station monitoring into the test mode demonstrate the following:
 - b. Activate a Manual Pull Station to demonstrate ALARM.
 - 1) Demonstrate audible and visual notification appliances and if installed the voice evacuation signal announcement.
 - 2) Demonstrate panel or annunciator sounder tone for ALARM.

- 3) Have staff SILENCE system.
 - 4) Show LCD display and LED of alarm.
 - 5) Demonstrate and have staff reset the manual pull station.
 - 6) Have staff RESET fire system.
- c. Activate Smoke Detector with canned smoke to demonstrate address identification:
- 1) Have staff SILENCE system.
 - 2) Show LCD and display LED of ALARM.
 - 3) Have staff RESET fire system.
- d. Remove Smoke Detector to demonstrate SYSTEM TROUBLE.
- 1) Demonstrate panel or annunciator sounder tone for TROUBLE.
 - 2) Have staff SILENCE system.
 - 3) Show LCD display and LED of TROUBLE.
 - 4) Replace the smoke detector.
 - 5) Have staff RESET fire system.
- e. Remove power to demonstrate function during power failure.
- 1) Have staff SILENCE system.
 - 2) Show LCD display and LED of TROUBLE.
 - 3) Activate Manual Pull station to demonstrate audible or visual functions in power failure mode.
 - 4) Reset manual pull station.
 - 5) Reset fire system.
 - 6) If applicable, point out sprinkler riser and shut off valves.
 - 7) Show location of a water flow switch.
 - 8) Show location of a valve tamper switch.
 - 9) Point out valves must always be OPEN or fully counter clock wise.
 - 10) Point out PIV (Post Indicator Valves) if applicable.
 - 11) Have water flow through the inspectors test valve and point out the ringing water flow bell.

- 12) After the horns are silenced by an assistant, show that the water flow bell is ringing continuously indicating water flow.
- 13) Have the assistant turn off the inspectors test valve to show that water flow alarm bell turns off.
- 14) Reset system.
- 15) Unlock and turn off a PIV or riser valve to show a supervisory condition.
- 16) Turn valve back on, lock the valve open and demonstrate the end of the indication of a supervisory condition.

4. Training documentation.

- a. Insure fire panel is reset and indicates normal and central station monitoring is taken off of the test mode.
- b. Have staff attendees sign off training sheet and provide a copy to the PROJECT INSPECTOR.

3.09 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 Project site.

END OF SECTION

**SECTION 31 10 00
SITE CLEARING**

PART 1 - GENERAL

1.01 SUMMARY

- A. Contractor shall furnish all labor, materials, services, testing, transportation and equipment necessary for the completion of all site clearing work as required and as indicated on drawings and specified herein. Work materials and equipment not indicated or specified which is necessary for the complete and proper operation of the work of this Section in accordance with the true intent and meaning of the contract documents shall be provided and incorporated at no additional cost to the Owner.
- B. Removal of surface debris; removal of paving and curbs; removal of trees, shrubs, and other plant life; topsoil excavation; and repair of damaged vegetation and/or irrigation systems/system components.
- C. Removal of concrete and bituminous surfacing where applicable.

1.02 RELATED SECTIONS

- A. Section 02 41 19 - Demolition.

1.03 REFERENCE STANDARDS

- A. The work provided herein shall conform to and be in accordance with the Contract Plans, General Conditions/Specifications and Special Provisions, as well as the Standard Specifications for Public Works Construction ("GREENBOOK"), 2018 Edition, adopted by the Southern California Chapter, American Public Works Association; herein referred to as the "Standard Specifications". In case of conflict between the "Standard Specifications", the General Conditions/Specifications and these Special Provisions, the General Conditions/Specifications and these Special Provisions shall have precedence.

1.04 REGULATORY REQUIREMENTS

- A. The Contractor shall obtain all necessary permits, licenses, or agreements required by any legally constituted agency, pay for all fees and give all necessary notices required for the construction of the work. The College of the Desert shall reimburse the contractor for all necessary permits or inspection fees by any legally constituted agency.
- B. Perform all work of this Section in strict accordance with applicable Government Codes and Regulations especially meeting all safety standards and requirements of CAL/OSHA, County of Los Angeles and the City of Los Angeles. Provide additional measures, added materials and devices as may be needed as directed by the District Representative at no added cost to the District.
- C. Comply strictly to Rule 1404, South Coast Air Quality Management District.
- D. Coordinate clearing Work with utility companies.

PART 2 - PRODUCTS

2.01 Satisfactory Soil Materials: Requirements for satisfactory soil materials are specified in Section 02 41 19 – Demolition.

- A. Obtain approved borrow soil materials off-site when satisfactory soil materials are not available on-site.

PART 3 - EXECUTION

3.01 PREPARATION

- A. Verify that existing plant life designated to remain is tagged or identified.
- B. Identify a waste area for placing removed materials.

3.02 PROTECTION

- A. Protect existing structures and site improvements indicated to remain, from damage by approved methods and/or as authorized by the *District Representative*. Removal of all protections shall be when work of this Section is completed or when so authorized by the District Representative.
- B. Protect Existing Utilities indicated or made known to remain traversing the job-site and serving existing adjacent facilities.
- C. Protect Existing Trees and Shrubs indicated to remain by providing temporary surrounding fencing so located a sufficient distance away so that trees and shrubs will not be damaged by site-clearing operations.
 - 1. Protection Barrier: A protection barrier shall be installed around the shrubs or trees to be preserved. The barrier shall be constructed of a durable fencing material, such as plastic construction fencing, snow fence, or chain link. The barrier shall be placed at or beyond the drip line. "Drip line" as referred to herein means a line which may be drawn on the ground around the tree directly under its outermost branch tips and which identifies that location where rainwater tends to drip from the tree. Placement of barrier to be approved by District Representative (Grounds Supervisor). If barrier is placed inside the drip line, then 3/4 inch plywood must be placed over the root zone up to the drip line. The fencing shall be maintained in good repair throughout the duration of the project, and shall not be removed, relocated, or encroached upon without permission of the District Representative (Grounds Supervisor).
 - 2. Storage of Materials: There shall be NO storage of materials or supplies of any kind within the area of the protection barriers. Concrete, cement, asphalt materials, block, stone, sand and soil shall not be placed within the drip line of the tree(s).
 - 3. Fuel Storage: Fuel storage shall NOT be permitted within 150 feet of any tree to be preserved. Refueling, servicing and maintenance of equipment and machinery shall NOT be permitted within 150 feet of protected trees.
 - 4. Vehicles/equipment: NO parking or driving of vehicles or storage of equipment shall be permitted within the drip line of any tree to be preserved.
 - 5. Debris and Waste Materials: Debris and waste from construction or other activities shall NOT be permitted within protected areas. Wash down of Concrete, cement or asphalt handling equipment, in particular shall NOT be permitted within 150 feet of protected areas.
 - 6. Grade Changes: Grade changes can be particularly damaging to trees. Any grade changes should be approved by the District Representative (Grounds

Supervisor) before construction begins and precautions taken to mitigate potential injuries.

7. Damages: Any damages or injuries to the preserved trees (including pruning or cutting of such trees not in conformity with the International Society of Arboricultural Pruning Guidelines and ANSI A300 Pruning Standards) shall be reported immediately to the District Representative (Grounds Supervisor). Severed roots shall be pruned cleanly to healthy tissue, using proper pruning tools. Broken branches/limbs shall be pruned according to International Society of Arboricultural Pruning Guidelines and ANSI A300 Pruning Standards. In the event that any damage, injury, improper pruning or cutting of a protected tree is deemed to be so substantial as to require its replacement (such determination to be made in the sole discretion of the District Representative), Contractor shall replace such tree with the same species and variety of tree, up to a box size of 48 inches, or if no such replacement is available, with a substitute species or variety as determined in the sole discretion of the District Representative. Any replacement tree shall be approved in advance by the District Representative. The value of the tree to be replaced shall be determined by a Certified Arborist selected by Contractor from the District's approved list of Registered Consulting Arborists. To the extent that the value of the replaced tree as determined by the Certified Arborist exceeds the cost of the replacement tree, Contractor shall be liable to District for such difference in value in addition to all costs associated with replacement of the damaged tree.
8. Removal of Existing Tree or Shrub: Prior to removing or cutting any trees designated for removal, the contractor shall coordinate with the District's Ground Supervisor. In the event that Contractor, a Subcontractor, Sub-Subcontractor, material supplier or anyone else performing the Work of the Contract willfully, negligently or mistakenly removes any tree or shrub not designated for removal, Contractor shall immediately report such removal to the District Representative (Grounds Supervisor). Contractor shall replace such tree with the same species and variety of tree, up to a box size of 48 inches, or if no such replacement is available, with a substitute species or variety as determined in the sole discretion of the District Representative. Any replacement tree shall be approved in advance by the District Representative. The value of the tree to be replaced shall be determined by a Certified Arborist selected by Contractor from the District's approved list of Registered Consulting Arborists. To the extent that the value of the replaced tree as determined by the Certified Arborist exceeds the cost of the replacement tree, Contractor shall be liable to District for such difference in value in addition to all costs associated with replacement of the damaged tree.
9. Unauthorized Tree Removal or Injury: Criminal Penalties: Reference is made to California Penal Code §384a which provides that any person who willfully or negligently cuts, destroys, mutilates or removes any tree or shrub or portion thereof growing on public land without a written permit from the owner of said public land is guilty of a misdemeanor, subject to a fine of up to \$1,000, imprisonment in county jail for up to 6 months, or both. Contractor is advised that, in addition to all remedies provided herein and in the Contract Documents, the District shall cooperate with appropriate authorities in prosecuting and enforcing Penal Code §384a and other criminal sanctions as appropriate concerning trees and shrubs located on District property.
10. Preventive Measures: Before construction begins fertilization of the affected areas to be applied at a rate to be determined by the District Representative (Grounds Supervisor).

- D. Protect bench marks, survey control points, and existing structures from damage or displacement.
- E. Protection of Persons and Property (existing structures and site improvements):
 - 1. Provide barricades, warning signs at open depressions and holes on adjacent property and public accesses.
 - 2. Provide operating warning lights during hours from dusk to dawn each day or as otherwise required.
 - 3. Protect existing remaining structures, utilities, sidewalks, pavements other facilities from damage as caused by settlement, undermining, washout or other hazards created by site-clearing operations of this Section.
- F. Use means necessary to prevent dust from becoming a nuisance to the public, to neighbors and to others performing work on or near the job-site.
- G. Maintain access to the job-site at all times.

3.03 CLEARING

- A. Clear areas required for access to site and execution of Work.
- B. Remove all rubbish and debris existing and resulting from work operations of this Section as soon as possible, do not allow to pile up. Do not burn rubbish and debris on the job-site.
- C. Where active utility lines need to be capped or plugged, perform such work in accordance with requirements of the Utility Company.

3.04 REMOVAL

- A. Remove debris, rock, and extracted plant life from site.
- B. Excavate and remove associated plumbing piping.
- C. Prior to demolition work, the Contractor shall notify the District Representative to identify the existing items for salvage purposes. The materials identified for salvage shall be returned to the District in a timely manner agreed upon by the District Representative.

3.05 CONCRETE AND BITUMINOUS SURFACE REMOVAL

- A. Where noted on the construction drawings, break up and completely remove all existing concrete surfacing, curbs, gutters, walks and bituminous surfacing to limits indicated to be removed. All cutting shall be done to a neat and even line with proper tools or a concrete cutting saw. Minimum depth of cut shall be 1-1/2", unless otherwise specified. Remove any concrete broken beyond the indicated limits to the nearest joint or score line and replace with new concrete to match the existing.
- B. Removed concrete and bituminous materials shall be disposed of off-site unless otherwise noted on the construction drawings. All such items to be removed shall be disposed of off the property in a legal manner.
- C. Bituminous pavement saw cutting shall conform to the provisions of Section 300-1.3.2 (a) of the Standard Specifications. The residue resulting from the saw cutting operations shall not be permitted to flow beyond the specific work location and shall be removed the same day.

- D. Removal of concrete curb / curb & gutter covered by this section shall include saw-cutting and removal of a twelve (12") inch wide section of the adjacent bituminous pavement.
- E. When saw cutting concrete curb / curb & gutter, the cuttings shall be continuously wet vacuumed to prevent the materials from entering catch basins, storm water conveyances, or waters of the State. Vacuumed cuttings shall be disposed of according to applicable regulations.
- F. Concrete curb and concrete curb and gutter shall be removed to the lines, grades and locations shown on the plans in accordance with Section 300-1.3.2 of the Standard Specifications.
- G. Concrete removal in sidewalk and driveway areas shall extend to existing score lines unless specifically indicated otherwise on the Plans or in the Project Special Provisions, or unless otherwise approved by the Engineer.
- H. Reinforcing or other steel may be encountered in portions of concrete to be removed. No additional compensation will be allowed for the removal of concrete containing reinforcing or other steel.
- I. In those areas where existing bituminous surfacing is removed to make way for new planting or lawn areas, remove soil 6" below existing exposed soil surface. Removed soil may be used only as fill under buildings or other areas to be paved, only if approved by the District Inspector. Legally dispose of off site, if material is not approved as fill material.

3.06 REPAIRS

- A. During demolition and construction, ensure that trees, shrubs and other plant material and vegetation are protected inside and outside of the work zone and that the vegetation is being watered, maintaining the proper moisture content according to the season. Failed vegetation, including sod, due to lack of water, and/or plant material destroyed during construction period are to be replaced to equal or better size and condition at no additional cost to the District.
- B. If the irrigation system is damaged or modified during construction, it shall be repaired to the Districts standards, and shall be in equal or better condition than prior to damage or modification. All repairs shall be, inspected and approved by the District Representative (Grounds Supervisor) prior to backfilling or covering of said repairs. The District representative requires forty-eight hours prior notice, when contractor requests inspection of completed repairs. All repairs shall be made so as to ensure proper operation prior to the close of the contract at no additional cost to the District.
- C. Controller Wires: If damaged, cut or removed, repair by splicing, soldering and silicone sealing. To ensure proper operation, reconnect the wires to the valve to correspond with the map on the controller to the correct station.
- D. Hydraulic Tubes: If damaged/cut or removed, repair by replacing the tubing using equal or better material.
- E. Valves: If damaged, repair/replace with equal or better material. All valves are to be flushed/cleaned thoroughly.
- F. Mainlines: If damaged, repair/replace with equal or better material. All lines are to be flushed/cleaned thoroughly.
- G. Lateral Lines: If damaged, repair/replace with equal or better material. All lines are to be flushed/cleaned thoroughly.

- H. Irrigation Heads: If damaged, repair/replace with equal or better material. All heads are to be flushed and filters cleaned thoroughly.
- I. Controllers: If damaged repair/replace with equal or better material.
- J. Backflow Prevention Devices: If damaged, repair/replace with equal or better material.
- K. Gate/Ball/Quick Coupler Valves: If damaged repair/replace with equal or better material.
- L. Valve Boxes: If damaged, repair/replace with equal or better material. Concrete boxes and concrete lids with the appropriate markings for identification shall be used. The top of the box shall be buried below finish grade, equal to existing depth or deeper. The top of the valve stems shall be 6" below the underside of the top of the box.
- M. Construction in grass areas: Sod shall be removed by sod cutting at a soil depth of 2", stored on site, and watered on a daily basis. Upon completion of work, stored sod shall be reinstalled over the areas disrupted due to construction. An option may be to bypass cutting the sod, however at the completion of the project, finish grading and installation of new Hybrid Bermuda GN -1 sod over the areas disrupted by construction shall be required.

3.07 EXCESS MATERIALS DISPOSAL

- A. Remove surplus soil material, unsuitable topsoil, obstructions, demolished materials, and waste materials, including trash and debris, and legally dispose of them off Owner's property.

3.08 SITE CLEANUP

- A. Cleanup of branches, limbs, logs, or any other debris resulting from any operations shall be promptly and properly accomplished. The work area shall be kept safe at all times until all operations are completed. Under no circumstances shall the accumulation of brush, limbs, logs, or other debris be allowed in such a manner as to result in a hazard to the public. All debris shall be cleaned up each day before the work crew leaves the site, unless permission is given by the Owner to do otherwise. All lawn areas shall be raked, all streets and sidewalks shall be swept, and all brush, branches, rocks or other debris shall be removed from the site. Areas are to be left in a condition equal to or better than that which existed prior to the commencement of operations.

END OF SECTION

**SECTION 31 20 00
EARTHWORK**

PART 1 - GENERAL

1.01 SUMMARY

- A. The work of this section shall include excavation, unclassified cut, unclassified fill, removing existing unsatisfactory material, preparing areas to be filled, spreading and compacting of fill in the areas to be filled, and all other work necessary to complete the grading of the site. It shall be the Contractor's responsibility to place, spread, moisten or dry, and compact the fill in strict accordance with these specifications to the lines and grades indicated on project plans or as directed in writing by the Geotechnical Engineer. Included with this Work are the following:
1. General exterior grading, cutting and filling, including grading for building area, paving, planting areas, banks and hillsides.
 2. Excavating, filling, backfilling, and compacting for Project site pavement, planting areas, buildings, and other structures.
 3. Subbase course for walks and pavements.
 4. Subsurface drainage backfill for walls and trenches.
 5. Excavating and backfilling trenches within buildings lines.
 6. Excavating and backfilling for underground mechanical and electrical utilities and appurtenances.
 7. Shoring plan guidelines.
- B. Related Sections: The following Sections contain requirements that relate to this Section.
1. Section 32 12 16 – Bituminous Surfacing.
 2. Section 32 13 13 - Site Concrete.

1.02 DEFINITIONS

- A. Excavation consists of the removal of material encountered to subgrade elevations and the reuse or disposal of materials removed.
- B. Subgrade: The uppermost surface of an excavation or the top surface of a fill or backfill immediately below subbase, drainage fill, or topsoil materials.
- C. Borrow: Soil material obtained off site when sufficient approved soil material is not available from excavations.
- D. Base Course: The layer placed between the subgrade and surface pavement in a paving system.
- E. Drainage Fill: Course of washed granular material supporting slab on grade placed to cut off upward capillary flow of pore water.
- F. Permeable Backfill: Provide permeable backfill material behind retaining structures consisting of gravel, crushed gravel, crushed rock, natural sands, manufactured sand, or combinations.

- G. Unauthorized excavation consists of removing materials beyond indicated subgrade elevations or dimensions without direction by the Architect. Unauthorized excavation, as well as remedial work directed by the Architect, shall be at the Contractor's expense.
- H. Structures: Buildings, footings, foundations, retaining walls, slabs, tanks, curbs, mechanical and electrical appurtenances, or other man made stationary features constructed above or below ground surface.
- I. Utilities include underground pipes, conduits, ducts, and cables, as well as underground services within building lines.

1.03 SUBMITTALS TO CONSTRUCTION MANAGER

- A. General: Submit the following according to the Conditions of the Contract and Division 1 Specification Sections.
- B. Product data for the following:
 - 1. Each type of plastic warning tape.
 - 2. Filter fabric.
- C. Samples of the following:
 - 1. 20 lb sample, sealed in air tight container, of proposed drainage fill materials.
 - 2. 12 by 12 inch sample of filter fabric.
- D. Test Reports: In addition to test reports required under field quality control, submit the following:
 - 1. One optimum moisture-maximum density curve for each soil sample.
 - 2. Laboratory analysis of each soil material proposed for fill or backfill from borrow sources.
- E. Excavation support & protection (shoring) shop drawings for informational purposes: Prepared by or under the supervision of a qualified professional engineer for excavation support and protection systems.

1.04 QUALITY ASSURANCE

- A. Codes and Standards:
 - 1. 2010 California Building Code, Title 24, Part 2, Volume 2 of 2, Appendix J, Grading.
 - 2. ASTM D422 - Method for Particle Size Analysis of Soils
 - 3. ASTM D1556 - Test Method for Density of Soil in Place by the Sand-Cone Method.
 - 4. ASTM D1557 - Test Methods for Moisture-Density Relations of Soils and Soil-Aggregate Mixtures Using 10-lb (4.54 kg) and 18-inch (457-mm) Drop.
 - 5. ASTM D2216 - Method for Laboratory Determination of Water (Moisture) Content of Soil, Rock, and Soil Aggregate Mixtures.
 - 6. ASTM D2922 - Test Method for Density of Soil and Soil-Aggregate in Place by Nuclear Methods (Shallow Depths).

7. ASTM D3017 - Test Method for Moisture Content of Soil and Soil-Aggregate in Place by Nuclear Methods (Shallow Depths).
 8. ASTM D4318 - Test Method for Liquid Limit, Plastic Limit and Plasticity Index of Soils.
 9. AASHTO T217 - Determination of Moisture in Soils by Means of a Calcium Carbide Gas Pressure Meter.
 10. ASTM D4829 - Expansion Index Test.
- B. For off-site work, conform to all requirements of City of Pasadena and any other agencies having jurisdiction. Coordinate and obtain all required permits and inspections.
 - C. The work provided herein shall conform to and be in accordance with the Contract Plans, General Conditions/Specifications and Special Provisions, as well as the Standard Specifications for Public Works Construction ("GREENBOOK"), 2009 Edition, adopted by the Southern California Chapter, American Public Works Association; herein referred to as the "Standard Specifications". In case of conflict between the "Standard Specifications", the General Conditions/Specifications and these Special Provisions, the General Conditions/Specifications and these Special Provisions shall have precedence.
 - D. Comply with all requirements of permit for export of soil from site. Permit is to be obtained and paid for by Contractor. Furnish copies of all permits and licenses required by the City of Pasadena to Owner's representative.
 - E. Professional Observation: A soils engineer will be retained by the Owner for purposes of inspection, testing and approval of all work under this section. Perform work of this Section under inspection and approval of the soils engineer. Give soils engineer not less than 48 hours advance notice of readiness for inspection.
 - F. The soils engineer will have the authority over all filling, grading, and compaction operations, including interruption of work if deemed necessary due to improper work
 - G. Pre-Grading Conference: Conduct conference at Project site to comply with requirements of Division 1 Section "Project Meetings."
 1. Before commencing earthwork operations, meet with representatives of the governing authorities, Owner, Architect, consultants, Geotechnical Engineer, independent testing agency, and other concerned entities. Review earthwork procedures and responsibilities including testing and inspection procedures and requirements. Notify participants at least 3 working days prior to convening conference. Record discussions and agreements and furnish a copy to each participant.

1.05 CONSTRUCTION MONITORING

- A. All earthwork and foundation construction should be monitored by a qualified engineer/technician under the supervision of a Geotechnical Engineer, including;
 1. Observation of all site preparations;
 2. Observation of shoring installation, if needed;
 3. Observation of all site excavations;
 4. Test and approval of all import soil;
 5. Observation of placement of all compacted fills and backfills;

6. Observation of all surface and subsurface drainage systems;
 7. Observation of all foundation and pile excavations;
 8. Observation of subgrade preparation for paved and building areas.
- B. The Geotechnical Engineer of Record should be notified at least three (3) days in advance of the start of construction. A joint meeting between the Contractor and Geotechnical Engineer is recommended prior to the start of construction to discuss specific procedures and scheduling. The Geotechnical Engineer should be present to observe the soil conditions encountered during construction, to evaluate the applicability of the recommendations presented in the Soils Report to the soil conditions encountered, and to recommend appropriate changes in design or construction if conditions differ from those described herein. The Geotechnical Engineer of Record should inspect and approval all imported backfill material prior to its placement as backfill, approve the subgrade beneath all fills, fill placement and bottom of all foundation excavations before concrete or steel is placed.
- C. The Geotechnical Engineer shall submit compaction reports to the Construction Manager and the Civil Engineer at the completion of the work, including test results and plot plans indicating the locations from which the tested samples of fill were taken. The Geotechnical Engineer shall keep the Construction Manager informed on the progress of the grading work.

1.06 IMPORT AND EXPORT OF EARTH MATERIALS

- A. Fees: Pay as required by government authority having jurisdiction over the area.
- B. Bonds: Post as required by government authority having jurisdiction over the area.
- C. Hauling Routes and Restrictions: Comply with requirements of authorities having jurisdiction over the area.

1.07 TRUCK HAUL ROUTE

- A. A proposed truck haul route is to be submitted to the City of Pasadena Public Works Department for review and approval. Upon approval, an approved copy shall be returned to the Contractor. The Contractor shall post an approved copy on the job site. All trucks working that project shall also carry a copy. If a truck(s) is found not to be carrying an approved copy, the Contractor shall be subject to a Notice of Noncompliance (stop work order)
- B. All trucks must cover their dirt with an acceptable tarp during transport for dust containment. Provisions for street sweeping and watering will also be required unless an active wheel washing facility proves that they are un-necessary to the satisfaction of the Engineer.
- C. All truck haul routes, as approved, are good only for the project time period, and trucks shall have to comply with the approved route only. If during the progress of the project an alternate route is needed, the Contractor shall submit a new plan. The haul route application shall contain the following information:
 1. Map showing the proposed route
 2. Project name
 3. Grading Contractor's name, address and phone number
 4. Type of material being hauled

5. Encroachment or construction permit number

1.08 DIG ALERT NOTIFICATION

- A. Before any excavation in or near the public right-of-way, the Contractor must contact the Underground Service Alert of Southern California (Dig Alert) at 811 for information on buried utilities and pipelines.
- B. Delineation of the proposed excavation site is mandatory. Mark the area to be excavated with water soluble or chalk based white paint on paved surfaces or with other suitable markings such as flags or stakes on unpaved areas.
- C. Call at least Two (2) full working days prior to digging.
- D. If the members (utility companies) have facilities within the work area, they will mark them prior to the start of your excavation and if not, they will let you know there is no conflict. A different color is used for each utility type (electricity is marked in red, gas in yellow, water in blue, sewer in green, telephone and cable TV in orange).
- E. The Law requires you to hand expose to the point of no conflict 24" (inches) on either side of the underground facility, so you know its exact location before using power equipment.
- F. If caught digging without a Dig Alert ticket you can be fined as much as \$50,000 per California government code 4216.

1.09 PROJECT CONDITIONS

- A. Data: Maps, boring logs, geotechnical and foundation investigation reports, and like reference data, not included in Contract Documents but made available to Contractor by Architect or Owner are for information only, and the Architect and Owner assume no responsibility for any conclusions Contractor may draw from such information. Should questions or issues arise, contact Architect or Owner for clarification.
- B. Contractor shall determine existing conditions under which the Contractor will operate in performing the Work
- C. A geotechnical investigation report prepared by Hydrologue, Inc. (Project No. 4027-00), dated October 25, 2011 has been prepared. Prior to bidding or performing the work of this project, contractor shall obtain a copy of this report, and shall thoroughly familiarize himself/herself with its contents. Any information obtained from such report, or any information given on any drawings as to subsurface soil conditions or to elevations of existing elevations or elevations of underlying rock, is approximate only, is not guaranteed, and does not form a part of the contract, unless specifically referenced in the Contract Documents. The Contractor is required to make a visual inspection of the Project Premises and must (and is permitted to) make whatever tests the Contractor deems appropriate to determine and assess the underground condition of the soil. No claims for allowances or damages because of the Contractor's negligence or failure in acquainting itself with the conditions of the Project Premises as described herein will be recognized by the District.
- D. WARNING: DISTRICT DOES NOT WARRANT THE SOILS AT THE PROJECT SITE. SOILS INVESTIGATION REPORT IS PROVIDED FOR CONTRACTORS INFORMATION ONLY. CONTRACTOR HAS CONDUCTED AN INDEPENDENT INVESTIGATION OF THE PROJECT SITE AND THE SOILS CONDITIONS OF THE SITE. DISTRICT DOES NOT WARRANT THE SOILS CONDITIONS OF THE SITE AND CONTRACTOR IS FULLY RESPONSIBLE TO ASCERTAIN SITE CONDITIONS FOR THE PURPOSES OF DETERMINING CONSTRUCTION MEANS AND METHODS

PRIOR TO COMMENCING CONSTRUCTION. THE SOILS INVESTIGATION REPORT IS NOT A CONTRACT DOCUMENT.

- E. Information on Drawings does not constitute a guarantee of accuracy or uniformity of soil conditions over the Project site.
- F. Existing utilities: Locate existing underground utilities in all areas of work prior to excavation or commencement of work. If utilities are to remain in place provide adequate means of protection during earthwork operations.
 - 1. Should uncharted, or incorrectly charted piping or other utilities be encountered during excavation, consult Utility Owner immediately for direction. Cooperate with Owner and Utility companies in keeping respective services and facilities in operation. Repair damaged utilities to the satisfaction of Utility Company.
 - 2. Do not interrupt existing utilities serving facilities occupied or used by Owner, or others, except when permitted in writing by Owner's Representative, and then only after acceptable temporary services have been provided.
 - 3. Demolish and completely remove from site existing underground utilities indicated to be removed. Coordinate with utility companies for shut off of services if lines are active.
- G. Noise and Dust Abatement: Exercise all reasonable and necessary means to abate dust, dirt rising and undue noise. Perform necessary sprinkling and wetting of construction site to allay dust as required by applicable codes and ordinances.
- H. Water for Grading: Contractor shall obtain and pay for all water required for his grading operation. This may include, but is not limited to, payment of deposits to utility for construction meter, and payment of all monthly service and water charges. Construction meter shall be in place throughout construction period unless alternative arrangements are made with the Water Department to provide construction water for all purposes. Contractor shall be aware of water moratoriums and restrictions, and shall immediately advise Owner of effects on construction schedules.
- I. Existing Conditions: Prior to commencing work at site, verify agreement of existing conditions with indicated conditions. Notify Owner's Representative in writing of discrepancies found. Start of work without notification constitutes acceptance of conditions, without cause for extra compensation.
- J. Field obstructions, grade differences or differences in dimensions may exist that might not have been considered or observed during design of this project. Contractor shall promptly notify the Engineer and the Agency having jurisdiction by telephone and in writing upon discovery of and before disturbing, any physical conditions differing from those represented by approved plans and specifications. In the event this notification is not performed, the Contractor shall assume full responsibility for necessary revisions.

PART 2 - PRODUCTS

2.01 SOIL MATERIALS

- A. General: All soils materials to be used throughout the site shall be approved for use by the Geotechnical testing engineer. Provide approved borrow soil materials from off site when sufficient approved soil materials are not available from excavations.
- B. No earthwork analysis has been completed with respect to the volumes of soils to be excavated, placed, or imported in order to provide the finished grades shown on the plans. The Contractor is solely responsible for verifying the earthwork quantities necessary to complete the project.

- C. For earthwork volume estimating purposes, an average shrinkage volume of 10 to 15 percent and subsidence of 0.1 to 0.2 foot may be assumed for the surficial soils. See page 13 of the project Geotechnical Investigation Report.
- D. Satisfactory Soil Materials: Soils approved by the testing geotechnical engineer and free of rock or gravel larger than 3 inches in any dimension, debris, waste, vegetation and other deleterious matter and as approved by the Geotechnical Engineer. Rocks or hard lumps larger than approximately 3 inches in diameter should be broken into smaller pieces or should be removed from the site. It is anticipated that most of the on-site soils may be reusable as engineered fill after any vegetation, construction debris, oversized material and deleterious material is removed from the site.
- E. Borrow / Imported Fill Material: Soil excavated from site or imported conforming to requirements for fill material.
 - 1. Materials for the fill shall be free from vegetable matter and other deleterious substances, shall not contain rocks or lumps of a greater dimension than is recommended by the geotechnical consultant, and shall be approved by the geotechnical consultant.
 - 2. Imported materials should have a Plasticity Index (PI) not less than 12 nor greater than 15, as determined by ASTM D 4318; and expansion index not exceeding 35, as determined by ASTM D 4829; and have 100% passing a two inch sieve, 60% to 100% passing a #4 sieve, no more than 20% passing a #200 sieve.
- F. Backfill & Native Fill Materials: The on-site soils may be reused as compacted engineered fill provided they comply to the requirements of "Satisfactory Soil Materials", as described above.
- G. Base Course Material For Use Under Asphalt Pavement: Crushed base material shall consist of materials that meet the provisions listed below.
 - 1. Crushed Aggregate Base (CAB) per Section 200-2.2, 3/4" maximum of the Standard Specifications for Public Works Construction (Green Book).
 - 2. Crushed Miscellaneous Base (CMB) per Section 200-2.4, fine sieve, of the Standard Specifications for Public Works Construction (Green Book).
 - 3. 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 the Owner's Construction Manager prior to importing the material. A statement on company letterhead from the 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 does not mine ultramafic materials, a source of natural occurring asbestos shall be included in the submittal to Owner's Construction Manager.
 - 4. Prior to import, Contractor shall submit written certification to the Owner's Construction Manager that Crushed Miscellaneous Base (CMB) does not contain Polychlorinated biphenyls (PCB) above laboratory detection limits when tested in accordance with EPA Method 8082.
- H. Engineered Fill: Satisfactory Soil Materials / Borrow Fill Material, as described above, placed in lifts no greater than 3 inches thick (loose measurements) unless approved by

the Geotechnical Engineer, and compacted to a minimum of 95% in accordance with ASM D1557. See page 12 of the approved soils report for this project.

I. Bedding Material for Trenches:

1. Bedding sand shall be as defined by Standard Specifications, Section 200-1.5, and shall be free of expansive material and organic matter. Bedding material for utility lines outside the property lines shall be as required by the agency having jurisdiction. On-site soils are not considered suitable for bedding or shading of utilities.
2. 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. All of the sand bedding shall be compacted to 90 percent of maximum density as indicated in the Contract Documents by mechanical means. Flooding and jetting shall not be permitted without prior written approval from the Geotechnical Engineer. Pipe bedding material shall be placed in horizontal layers not exceeding (8) eight inches.

J. Backfill Material for Trenches:

1. The on-site soils may be used for backfilling utility trenches from 6 inches above the top of pipe to the surface, provided the material is free of organic matter and deleterious substances. Any soft and/or loose materials or fill encountered at pipe invert should be removed and replaced with properly compacted fill or adequate bedding material. Also, rocks larger than 6 inches and boulders should not be used as backfill.
2. Where Construction Documents indicate areas of backfill requiring cement-sand slurry, the material requirements in Section 32 13 13: Site Concrete shall be followed.

K. Gravel Fill Material: Shall be from an approved source, having the following gradation: 90-100% passing a 3/4" sieve, 0% to 10% passing a No. 4 sieve, and 0% to 3% passing a No. 100 sieve.

L. Filter Fabric: Manufacturer's standard nonwoven geotextile fabric of polypropylene geotextiles, "Mirafi 140N" or approved equal

1. Provide filter fabrics that meet or exceed the listed minimum physical properties determined according to ASTM D 4759 and the referenced standard test method in parentheses:
 - a. Grab Tensile Strength (ASTM D 4632): 100 lb.
 - b. Apparent Opening Size (ASTM D 4751): #70 U.S. Standard sieve.
 - c. Permeability (ASTM D 4491): 135 gallons per minute per sq. ft.

2.02 ACCESSORIES

A. Detectable Warning Tape: Acid and alkali-resistant polyethylene film metallic warning tape manufactured for marking and identifying underground utilities, 6 inches wide and 4 mils thick minimum, continuously inscribed with a description of the utility, with metallic core encased in a protective jacket for corrosion protection, detectable by metal detector when tape is buried up to 30 inches deep.

1. Tape Colors: Provide tape colors to utilities as follows:

- a. Red: Electric.
 - b. Yellow: Gas, oil, steam, and dangerous materials.
 - c. Orange: Telephone and other communications.
 - d. Blue: Water systems, with "Caution: Water Line Below."
 - e. Green: Sewer systems, with "Caution: Sewer Line Below."
 - f. Green: Storm systems, with "Caution; Storm Drain Line Below."
- B. Filter Fabric: Manufacturer's standard nonwoven geotextile fabric of polypropylene geotextiles, "Mirafi 140N" or approved equal.
- 1. Provide filter fabrics that meet or exceed the listed minimum physical properties determined according to ASTM D 4759 and the referenced standard test method in parentheses:
 - a. Grab Tensile Strength (ASTM D 4632): 100 lb.
 - b. Apparent Opening Size (ASTM D 4751): #70 U.S. Standard sieve.
 - c. Permeability (ASTM D 4491): 135 gallons per minute per sq. ft.

2.03 EXCAVATION SUPPORT & PROTECTION – SHORING PLAN

- A. The CONTRACTOR shall have at the Worksite, copies or suitable extracts of: Construction Safety Orders, Tunnel Safety Orders and General Industry Safety Orders issued by the State Division of Industrial Safety. The CONTRACTOR shall comply with provisions of these and all other applicable laws, ordinances, and regulations.
- B. Before excavating any trench 1.5m (5 feet) or more in depth, the CONTRACTOR shall submit a detailed plan to the Owner showing the design of shoring, bracing, sloping, or other revisions to be made for the Workers' protection from the hazard of caving ground during the excavation of such trench. If the plan varies from the shoring system standards, the plan shall be prepared by a registered Civil Engineer. No excavation shall start until the OWNER has accepted the plan and the CONTRACTOR has obtained a permit from the State Division of Industrial Safety. A copy of the permit shall be submitted to the OWNER.
- C. The INSPECTOR will provide a competent person trench/excavation certification form to the CONTRACTOR. It shall be completely filled out before any worker has access to trench or excavation and returned to the INSPECTOR before the end of the first working day. The CONTRACTOR shall certify by this form the name of the competent person administering the Work, the soil classification, and the type of excavation protective system provided and/or installed.
- D. The CONTRACTOR shall completely fence all excavations to provided protection against anyone falling into the excavation and to the satisfaction of the INSPECTOR. The fencing shall be in place at all times except when workers are present and actual construction operations are in progress.
- E. The fencing material shall be chain link fabric or welded wire fabric (6x6-W9xW9 minimum) and 1.5 m (5 feet) high, constructed according to one of the following:
 - 1. Tensioned fencing material and have top and bottom tension wires securely fastened to driven steel posts or other equally rigid elements at a maximum spacing of 3.6m (12 feet); or

2. Untensioned fencing materials securely fastened to extended trench shoring elements at a maximum spacing of 2.4m (8 feet) and fastened to continuous top and bottom rails constructed of nominal 50mm x 100mm (2 in x 4 in) lumber or equally rigid material. Framed panels with suitable supporting elements fastened together to form a continuous fence may also be used.
- F. Payment for performing all work necessary to provide safety measures shall be included in the prices bid for other items of work except where separate bid items for excavation safety are provided, or required by law.

PART 3 - EXECUTION

3.01 PREPARATION

- A. Protect adjacent property and existing improvements and structures as necessary to prevent undermining, caving of cuts, and miscellaneous damage.
- B. Provide cribbing, sheeting, and shoring necessary to safely retain the earth banks and protect excavations and adjoining grades from caving and other damage resulting from excavating together with suitable forms of protection against bodily injury to personnel employed on the work and the general public. Be responsible for the design, installation, and maintenance of required cribbing and shoring and shall meet the approval of the State Division of Industrial Safety and local governing agencies requirements.
- C. Utility lines and structures shown shall be protected and treated as indicated. Where work not shown is encountered, report it to the Architect before proceeding with excavation. Encase active lines in sleeves where they pass through concrete; remove inactive lines as directed, and plug the remaining ends. Bear the costs for repairs to damaged or broken utilities and any damages related thereto.
- D. Protect existing improvements and adjacent properties from storm damage and flood hazard originating on this project until final acceptance by the Owner. Prevent silt run-off from the limits of work in accordance with governmental requirements.
- E. An 8 foot high, temporary chain link fence with visual screen and gates, (pair 26' wide, minimum) shall be erected prior to any grading operations at the construction limits perimeter. Coordinate the exact location with Architect and District.

3.02 DEWATERING

- A. Prevent surface water and subsurface or ground water from entering excavations, from ponding on prepared subgrades, and from flooding Project site and surrounding area. Any water entering an excavation shall be immediately pumped out and the exposed excavation allowed to dry.
- B. Protect subgrades and foundation soils from softening and damage by rain or water accumulation.

3.03 GRADE STAKES

- A. The Contractor's Surveyor will set grade stakes. The Surveyor shall be a California registered land surveyor or licensed Civil Engineer. The Surveyor shall be hired and paid by the Contractor, and shall be subject to the approval of the Owner. Contractor shall notify the Owner at least 48 hours before staking is to be started. The Owner will determine if work is ready for staking.
- B. All work shall conform to the lines, elevations, and grades shown on the Construction Plans. Three consecutive points set on the same slope shall be used together so that any variation from a straight grade can be detected. Any such variation shall be reported

to the Engineer. In the absence of such report, the Contractor shall be responsible for any error in the grade of the finished work.

- C. Protect and maintain stakes in place until their removal is approved by the Owner. Grade or location stakes lost or disturbed by Contractor, shall be reset by the Surveyor at the expense of Contractor.
- D. Grades for underground conduits will be set at the surface of the ground. The Contractor shall transfer them to the bottom of the trench.

3.04 EXCAVATION

- A. All undocumented fill soil encountered during site grading in the areas of building and other improvements, as well as any native soils disturbed during demolition and clearing operations, should be excavated full depth under the observation and confirmation by the Geotechnical Consultant. Lateral extent of overexcavation beyond building perimeter, where possible, should be to a minimum distance equal to the depth of undocumented fill/disturbed soil encountered or five (5) feet, whichever is greater.
- B. It is recommended that the existing on-site soil within the footprint of the building pad be overexcavated and removed uniformly to a minimum depth of three (3) feet below existing or finish grade, or five (5) feet below the bottom of the lowest footing, whichever is lower, and replaced with properly compacted fill such that the building foundations and slabs are supported on a re-engineered, compacted general fill layer.
- C. In preparation for grading, the construction areas should be cleared of surface vegetation, concrete, pavement and any loose surficial soils. Any unsuitable material encountered should be properly disposed of and not incorporated into any new fill.
- D. Excavate to the depths, lines and grades indicated on the approved Grading Plan. Excavate sufficiently over-size to permit installation and removal of concrete forms and other required work. Should soil of inadequate density and bearing capability be encountered at the elevations indicated on the drawings, or where new fill is to be placed upon existing loose fill material exposed by excavation, the excavation shall be carried to the depth required to attain soil of bearing quality as determined by the Geotechnical Engineer.
- E. A California Licensed Surveyor (LS) must provide grade stakes and elevations for the Geotechnical Engineer to verify that the over-excavation depths, shown on the construction drawings for asphalt concrete pavement and concrete pavement structural sections, have been achieved prior to re-compaction.
- F. Should footing excavations exceed required dimensions or should sloughing occur, fill such extra space with concrete at no additional cost to the contract. If unsuitable material is found at the indicated depths, immediately notify the Inspector.
- G. Notify the Inspector 48 hours before foundation excavations are ready for inspection.
- H. The bottoms of footings shall be free of loose material, debris, and water before concrete is placed.
- I. Cut banks shall be neatly trimmed to the required finish surface as the cut progresses, or the Contractor shall have the option of leaving the cuts full and finish grading by mechanical equipment which shall produce the finish surfaces as shown on the Drawings.
- J. Surplus earth not needed for filling and grading shall be disposed of in a legal manner off the site.

- K. All applicable requirements of the California Construction and General Industry Safety Orders, the Occupational Safety and Health Act of 1970, and the Construction Safety Act should also be followed.

3.05 HAZARDOUS MATERIALS

- A. All import fill material shall be characterized, handled, and documented in accordance with applicable US EPA and State of California hazardous waste and hazardous materials regulations.
- B. "Contaminated" shall mean any soil or geotechnical material at a concentration, which would require disposal at a regulated facility (i.e., California hazardous or RCRA hazardous).
- C. Owner's Authorized Representative (OAR) must be notified at least 72 hours prior to the disposal of any hazardous waste or hazardous material. No material disposal or reuse can take place without prior written approval of the OAR.
- D. Replacement of earth material, that has been removed due to hazardous waste reasons, shall be placed back to meet the requirements of Section 2.1, F – Engineered Fill.

3.06 EXCAVATION FOR ASPHALT PAVING AND SITEWORK CONCRETE

- A. Refer to Site Concrete Specification 32 13 13 section 3.01 requirements.
- B. Refer to Asphalt Paving Specification 32 12 16 section 3.2 requirements:
- C. The compacted surface shall be firm, hard and unyielding. The term "firm, hard and unyielding" as used in the Standard Specifications Section 301-1.3 shall mean that when the heaviest construction and hauling equipment used on the project drives over the subgrade, no permanent deformation shall occur either before or during pavement construction. On areas where the underlying material appears to be wet or soft, or where it deflects under wheel loads, the Contractor shall employ excavation and work techniques which do not worsen the subgrade condition.
- D. The above subgrade preparation recommendations are based on the assumption that soils encountered during field exploration are representative of soils throughout the site. However, there can be unforeseen and unanticipated variations in soils between points of subsurface exploration. For this reason, the actual scarification and over-excavation depths will have to be determined on the basis of in-grading observations and testing performed by representatives of the Owner's geotechnical consultant.
- E. Whenever batch trucks or other paving equipment cause rutting of the subgrade or subbase in asphalt or concrete placement areas, inspectors shall immediately stop construction. Construction shall not be allowed to resume until distorted subgrade or subbase is repaired. Contractors and inspectors should locate by proof rolling, any questionable unstable areas in advance to avoid distortion under equipment. Wet, unstable areas must be dried out or replaced before starting placement of asphalt. Locating wet or soft areas in advance can be accomplished by testing finished subgrade or subbase with a loaded truck. Construction of asphalt or concrete pavement should not proceed unless testing gives a reasonable indication that distortions will not occur during construction of overlying pavement. When repair, aeration, and recompaction are required to correct damage from Contractor's operation, all necessary repair will be done at Contractor's expense. However, if the Engineer determines that additional depth of aeration and recompaction are needed, that should be paid by change order.
- F. A California Licensed Surveyor (LS) must provide grade stakes and elevations for the Geotechnical Engineer to verify that the over-excavation depths, shown on the

construction drawings for asphalt concrete pavement and sitework concrete structural sections, have been achieved prior to re-compaction.

- G. Subgrade tolerances: Subgrade for pavement shall not vary more than 0.02' from the specified grade and cross section established by the Engineer. Subgrade for base material shall not vary more than 0.04' from the specified grade and cross section. Variations within the above specified tolerances shall be compensating so that the average grade and cross section specified are met.

3.07 EXCAVATION, BACKFILL & COMPACTION FOR UTILITIES

- A. Field conditions may require deviations from information indicated on Drawings. Such changes in work shall be covered by a Change Order, indicating an increase or decrease in the Contract sum.
- B. Before excavation, Contractor shall contact the "Underground Service Alert of Southern California" (USASC) for information on buried utilities and pipelines.
- C. When connections are to be made to any existing pipe, conduit, or other appurtenances, the actual elevation or position of which cannot be determined without excavation, the Contractor shall excavate for, and expose, the existing improvement before laying any pipe or conduit. The Engineer shall be given the opportunity to inspect the existing pipe or conduit before connection is made. Any adjustments in line or grade which may be necessary to accomplish the intent of the plans will be made, and the Contractor will be paid for any additional work resulting from such change in line or grade.
- D. Trenches, ditches, pits, sumps, and similar items which are outside the barricaded working area shall be barricaded to conform to Cal OSHA standards.
- E. Trenches over 5'-0" in depth shall conform to the Construction Safety Orders of the California Division of Industrial Safety, see Section 2.3 EXCAVATION SUPPORT & PROTECTION – SHORING PLAN.
- F. Safe and suitable ladders which project 2 feet above the top of the trench shall be provided for all trenches over 4 feet in depth. One ladder shall be provided for each 50 feet of open trench, or fraction thereof, and be so located that workers in the trench need not move more than 25 feet to a ladder.
- G. Where indicated and/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. All trenches should be backfilled with approved fill material compacted to relative compaction of not less than 90 percent of maximum density determined in accordance with ASTM D 1557. Backfill shall be placed in layers not exceeding 8" (inches) in thickness.
- I. 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.
- J. Do not excavate trenches parallel to footings closer than 18" from the face of the footing or below a plane having a downward slope of 2 horizontal to one vertical, from a line 9" above bottom of footings.
- K. If soft, spongy, unstable, or other unsuitable material is encountered upon which the bedding material or pipe is to be placed, this material shall be removed to a depth

ordered by the Engineer and replaced with bedding material suitably densified. Additional bedding so ordered, over the amount required by the Plans or Specifications, will be paid for as provided in the Bid. If the necessity for such additional bedding material has been caused by an act of failure on the part of the Contractor or is required for control of groundwater, the Contractor shall bear the expense of the additional excavation and bedding.

- L. Unless indicated otherwise on the plans are within this specification, 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. Maximum allowances at the sides for trenching shall be 12 inches. Grade bottom of trenches to a uniform smooth surface. Remove loose soil from the excavation before installing sand bedding or concrete encasement.
- M. Where portions of existing structures, walks, paving, etc. must be removed or cut for pipe or conduit installation, replace the material with equal quality, finished to match adjacent work.
- N. Provide a minimum clear dimension of 6 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/or tanks.
- O. DO NOT place backfill until the bedding and pipe work installed has been inspected, tested and approved by the Inspector. Remove excavated rocky material unsuitable for backfill from the site prior to final backfilling.
- P. Backfill shall be placed in layers not exceeding 8" (inches) in thickness and compacted to 95% for sand and silts and 90% for clayey soils, unless otherwise directed by the Geotechnical Engineer.
- Q. If materials excavated from the Project site are not permitted for trench backfill in paved areas or as specified in Contract Documents, backfill trenches with a one sack cement-sand slurry mix. Install backfill to an elevation of the existing undisturbed grade plus one inch.
- R. Bedding zone shall be defined as the area containing the material specified that is supporting, surrounding, and extending to 12" (inches) above the top of pipe. Compaction requirements in this area must meet 90%.
- S. Bedding material shall first be placed on a firm and unyielding subgrade so that the pipe is supported for the full length of the barrel. There shall be 6" (inch) minimum of bedding below the pipe barrel and 1" (inch) clearance below a projecting bell for sewer, storm drain and water pipe. The material in the bedding zone shall be placed and densified by mechanical compaction only.
- T. Mechanically compacted backfill shall comply with section 306-1.3.2 of the Standard Specifications for Public Works Construction.
- U. Concrete backfill trenches that carry below or pass under footings and that are excavated within 18 inches of footings. Place concrete to level of bottom of footings.
- V. Fill voids with approved backfill materials as shoring bracing and sheeting is removed.

3.08 INSPECTION & TESTING AT TRENCHES

- A. Pipe will be inspected in the field before and after laying. If any cause for rejection is discovered in a pipe after it has been laid, it shall be subject to rejection. Any corrective work shall be approved by the Engineer and shall be at NO cost to the Owner.

- B. The Inspector or Geotechnical Engineer will inspect all subgrades and excavations prior to placing bedding & backfill materials.
- C. DO NOT place backfill until the bedding and pipe work installed has been inspected, tested and approved by the Inspector. Remove excavated rocky material unsuitable for backfill from the site prior to final backfilling.
- D. Utility backfill compaction test shall be performed in accordance with ASTM D1557, method "C".
- E. Utility backfill in place density test per ASTM D 1556 (sand cone) or other test method as considered appropriate by the Geotechnical Engineer.
- F. Hydrostatic pressure tests shall be done only after backfill has been placed and final compaction has been achieved.

3.09 APPROVAL OF SUBGRADE

- A. Notify Geotechnical Engineer when excavations have reached required over-excavation subgrade.
- B. When Geotechnical Engineer determines that unforeseen unsatisfactory soil is present, continue work only after receiving direction from the Contracting Officer.
- C. Reconstruct subgrades damaged by rain, accumulated water or construction activities as directed by the Soils Engineer.

3.10 UNAUTHORIZED EXCAVATION

- A. Fill of unauthorized excavation below bottoms of foundations or wall footings will be engineered fill.
- B. Fill unauthorized excavations under other construction as directed by the Soils Engineer.
- C. Where indicated widths of utility trenches are exceeded, provide stronger pipe, or special installation procedures, as required by the Geotechnical Engineer.

3.11 STORAGE OF SOIL MATERIALS

- A. After the site has been stripped of all debris, vegetation and organic materials, excavated on site soils may be reused as engineered fill provided they meet the satisfactory soils material conditions in Section 2.1, part B. High in-site moisture contents will require aeration prior to placement as engineered fill.
- B. Stockpile excavated materials acceptable for backfill and fill soil materials, including acceptable borrow materials. Stockpile soil materials without intermixing. Place, grade, and shape stockpiles to drain surface water. Stockpile soil materials away from edge of excavations. Do not store within drip line of remaining trees. Cover to prevent wind-blown dust.

3.12 PLACEMENT OF ENGINEERED FILL

- A. Preparation of the bottom of the excavation:
 - 1. Where structural foundations, slab on grade construction, asphalt pavement and concrete flatwork engineered fill is to be placed, the upper 6" (inches) of native soil must be scarified, moisture conditioned and re-compacted to a minimum of 90 percent of the maximum dry unit weight as determined by the ASTM Test Method D1557.

B. Spreading and Compacting Fill Material:

1. It is anticipated that most of the on-site soils may be reusable as engineered fill after any vegetation, construction debris, oversized material and deleterious material is removed from the site. Engineered fill should have no particles greater than 3 inches in diameter, be placed in lifts no greater than 8 inches thick (loose measurements) and re-compacted to a minimum 95% of the maximum density obtainable by ASTM D1557.
2. After each layer has been placed, mixed, and spread evenly, it shall be thoroughly compacted by the Contractor to the specified density. Compaction shall be accomplished by sheepfoot rollers; vibratory rollers; multiple-wheel, pneumatic-tired rollers; or other types of acceptable compacting equipment. Equipment shall be of such design that it will be able to compact the fill to the specified density. Compaction shall be continuous over the entire area, and the equipment shall make sufficient passes to obtain the desired density uniformly. Jetting, puddling and hydroconcolitation techniques shall not be used.
3. When backfilling and compacting behind retaining walls and flexible retaining structures, the Contractor shall use lightweight compaction equipment such as hand-operated equipment, shoring, or other means to avoid over-stressing structural walls. When using lightweight compaction equipment, the fill materials shall be spread in horizontal layers not greater than 6 inches thick, measured before compaction.

C. Compaction Testing:

1. The Geotechnical Engineer's representative shall observe the excavation, filling, and compacting operations and shall make density tests in the fill material so that he can state his opinion as to whether or not the fill was constructed in accordance with the specifications. If the surface is disturbed, the density tests shall be made in the compacted materials below the disturbed zone. When these tests indicate that the density or moisture content of any layer of fill or portion thereof does not meet the specified density or moisture content, the particular layer or portions shall be reworked until the specified density and moisture content have been obtained.
2. Sampling and testing of materials for determination of compliance with the specified compaction requirements will be conducted by the Geotechnical Engineer's representative at any location and time as the Owner may determine.
3. The Contractor shall be responsible for excavation of the test pits and for providing and installing any shoring, ladders, or other equipment necessary to protect the testing personnel. The Contractor shall also suspend operations as necessary and at no cost to the owner for the purpose of conducting such testing.
4. Test pits shall be excavated in the backfill by the Contractor as directed by the Engineer for the purpose of testing the backfill compaction. At the option of Engineer, density tests may be taken on a lift of compacted backfill immediately before placing the next lift.
5. Any settlement noted in backfill, fill, or in structures built over the backfill or fill within the one-year warranty period will be considered to be caused by improper compaction methods and shall be corrected at the Contractor's expense. Structures damaged by settlement shall be restored to their original condition by the Contractor at the Contractor's expense.

6. When initial compaction testing performed by the Engineer indicates the required density has not been obtained, the Contractor shall re-compact or replace the backfill as necessary to meet the specified minimum density.
7. The Contractor shall be responsible for rescheduling compaction testing with the Engineer and shall bear all costs for subsequent retesting in the areas of noncompliance. Costs associated with retesting and scheduling delays shall be the sole responsibility of the Contractor. The Engineer will deduct the costs for testing of materials and work found to be unacceptable, as determined by the tests performed by the Owner and the costs for testing of material sources identified by the Contractor which are not used for the work, from moneys due or to become due to the Contractor. The amount deducted will be determined by the Engineer.

3.13 BACKFILL - GENERAL

- A. Backfill excavations promptly, but not before completing the following:
 1. Acceptance of construction below finish grade including, where applicable, dampproofing, waterproofing, and perimeter insulation.
 2. Surveying locations of underground utilities for record documents.
 3. Testing, inspecting, and approval of underground utilities.
 4. Concrete formwork removal.
 5. Removal of trash and debris from excavation.
 6. Removal of temporary shoring and bracing, and sheeting.
 7. Installing permanent or temporary horizontal bracing on horizontally supported walls.

3.14 GRADING

- A. Rough & Fine Grading: Rough grade area sufficiently high to require cutting by fine grading.
- B. General: Uniformly grade areas to a smooth surface, free from irregular surface changes. Comply with compaction requirements and grade to cross sections, lines, and elevations indicated.
 1. Provide a smooth transition between existing adjacent grades and new grades.
 2. Cut out soft spots, fill low spots, and trim high spots to conform to required surface tolerances.
 3. Grade area for paving to a depth below finish grades indicated, equal to base and pavement thickness to be constructed.
 4. Cut banks neatly to required finish grades as cut progresses, or leave cuts full and finish grading by mechanical equipment, which will produce finish grades indicated on Drawings.
 5. Grade filled banks full and compact beyond grade of finish bank so that when trimmed to finish grades, soil is compacted to density specified for final slope face.
 6. Bring areas to be graded to approximate finish grades and then scarify, moisten and roll to obtain required density. Scarify, moisten and roll resulting high and low areas to obtain required finish grades by cutting and filling.

7. Grade future planting areas so that, upon cultivation and fertilization, they will conform to finish grades indicated for planting areas.
 8. Protect all utilities.
- C. Site Grading: Slope grades to direct water away from buildings and to prevent ponding. Finish subgrades to required elevations within the following tolerances:
1. Building pad tolerance plus or minus ½ inch (0.05-foot).
 2. Lawn or Unpaved Areas: Plus or minus (0.10-foot).
 3. Walks: Plus or minus (0.04-foot).
 4. Pavements: Plus or minus (0.04-foot).
- D. Grading Inside Building Lines: Finish subgrade to a tolerance of ½ inch when tested with a 10-foot straightedge.

3.15 FIELD QUALITY CONTROL

- A. A Geotechnical Engineer, designated by the Owner, will be engaged to perform continuous inspection of the placing and compacting of all fills and backfills within the limits of grading of this project. All work shall be done in accordance with the approved plans and these specifications and as recommended and approved by the Geotechnical Engineer. Revised recommendations relating to conditions differing from the approved soils engineering and engineering geology reports shall be submitted to the owner, inspector, architect and the civil engineer. Costs for all such inspections and tests shall be paid by the Owner. The Contractor shall be responsible for notifying the Geotechnical Engineer in advance so that he may be present to perform his services as needed.
- B. The Geotechnical Engineer shall submit compaction reports to the Construction Manager and the Architect at the completion of the work, including test results and plot plans indicating the locations from which the tested samples of fill were taken. The Geotechnical Engineer shall keep the Construction Manager informed on the progress of the grading work.
- C. Testing Agency Services: Allow testing agency to inspect and test each subgrade and each fill or backfill layer. Do not proceed until test results for previously completed work verify compliance with requirements.
1. Perform field in-place density tests according to ASTM D 1556 (sand cone method) or other test method as considered appropriate by Geotechnical Engineer.
 - a. Field in place density tests may also be performed by the nuclear method according to ASTM D 2922, provided that calibration curves are periodically checked and adjusted to correlate to tests performed using ASTM D 1556. With each density calibration check, check the calibration curves furnished with the moisture gages according to ASTM D 3017.
 - b. When field in place density tests are performed using nuclear methods, make calibration checks of both density and moisture gages at beginning of work, on each different type of material encountered, and at intervals as directed by the Architect.
 2. Paved and Building Slab Areas: At subgrade and at each compacted fill and backfill layer, perform at least one field in-place density test for every 2,000 sq. ft. or less of paved area or building slab, but in no case fewer than three tests.

3. Foundation Wall Backfill: In each compacted backfill layer, perform at least one field in place density test for each 100 feet or less of wall length, but no fewer than two tests along a wall face.
 4. Trench Backfill: In each compacted initial and final backfill layer, perform at least one field in place density test for each 150 feet or less of trench, but no fewer than two tests.
- D. When testing agency reports that subgrades, fills, or backfills are below specified density, scarify and moisten or aerate, or remove and replace soil to the depth required, recompact and retest until required density is obtained.
- E. Owner's inspector will inspect foundation excavations when completed and ready for forms, after forms are in place, and before first placement of concrete.

3.16 PROTECTION

- A. Protecting Graded Areas: Protect newly graded areas from traffic, freezing, and erosion. Keep free of trash and debris.
- B. Repair and re establish grades to specified tolerances where completed or partially completed surfaces become eroded, rutted, settled, or lose compaction due to subsequent construction operations or weather conditions.
1. Scarify or remove and replace material to depth directed by the Architect; reshape and recompact at optimum moisture content to the required density.
- C. Settling: Where settling occurs during the Project correction period, remove finished surfacing, backfill with additional approved material, compact, and reconstruct surfacing.
1. Restore appearance, quality, and condition of finished surfacing to match adjacent work, and eliminate evidence of restoration to the greatest extent possible.

3.17 MAINTENANCE

- A. Install and maintain all erosion control devices, including sandbag and gravel bag dikes, silt fences, de-silting basins, inlet barricades, vehicle wash traps, and other features called for per Specification Section 01 50 00.
- B. Reconditioning Compacted Areas: Where completed compacted areas are disturbed by subsequent construction operations or adverse weather, scarify surface, re-shape to required tolerances, and compact to required density prior to further construction.

3.18 DISPOSAL OF SURPLUS AND WASTE MATERIALS

- A. Disposal: Remove surplus satisfactory soil and waste material, including unsatisfactory soil, trash, and debris, and legally dispose of it off the Owner's property.

END OF SECTION

**SECTION 32 12 16
BITUMINOUS SURFACING**

PART 1 - GENERAL

1.01 SUMMARY

- A. Provisions of Division 01 apply to this section.
- B. Section Includes:
 - 1. Paving for playground, parking areas, areas between buildings, synthetic track surfacing adjacent to planting and turf areas as indicated.
 - 2. Parking and existing non-concrete walk areas.
- C. Related Sections:
 - 1. Division 31: Site Clearing
 - 2. Division 31: Earthwork
 - 3. Division 32: Pavement Marking

1.02 SUBMITTALS

- A. Shop Drawings: Submit site plan indicating extent of paving and accessories.
- B. Product Data: Manufacturer's technical data for materials and products.

1.03 QUALITY ASSURANCE

- A. Comply with the following as a minimum requirement: Standard Specifications for Public Works Construction.

1.04 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.
- B. A copy of the soils report is available for examination in the office of the Architect during regular office hours of the Architect.

PART 2 - PRODUCTS

2.01 BITUMINOUS MATERIALS

- A. Provide materials of the class, grade, or type indicated on the Drawings, conforming to relevant provisions of Section 203 - Bituminous Materials of the Standard Specifications for Public Works Construction.

2.02 HEADERS AND STAKES

- A. Concrete: Per specification Division 03.

PART 3 - EXECUTION

3.01 HEADERS

- A. Install headers along edge of bituminous surfacing abutting turf, earth, or planting area, unless indicated otherwise.
- B. Install headers so the bottom surface has continuous bearing on solid grade. Where excavation for headers is undercut, thoroughly tamp soil under the header. Compact backfill on both sides of header to the density of adjacent undisturbed earth.
- C. Remove existing headers where new surfacing is installed adjacent to existing surfacing.
- D. Install temporary headers at transverse joints of paving where continuous paving operations are not maintained.

3.02 CONSTRUCTION OF ASPHALT CONCRETE PAVEMENT

- A. Thickness of Surfacing: Unless otherwise indicated on Drawings or specified, install bituminous surfacing to a compacted thickness of 2 inches.
- B. Provide surfacing material over base course.
- C. Surfaces of walls, concrete, masonry, or existing bituminous surfacing indicated to be in direct contact with installed bituminous surfacing shall be cleaned, dried and uniformly coated with an asphaltic emulsion film.
- D. Thicken edges of bituminous surfacing that do not abut walls, concrete, or masonry, and edges joining existing bituminous surfaces. Remove headers at existing bituminous surfacing where new bituminous surfacing is to be installed. Thicken edges an additional 2 inches and taper to the indicated or specified thickness 6 inches back from such edges.
- E. At stairways, join surfacing to first tread or riser below first tread, at an elevation below first riser equal to height of risers of stairway.
- F. Provide adequate protection for concrete, planting areas, and other finish Work adjacent to areas indicated to receive bituminous surfacing.
- G. Placing:
 - 1. Do not install bituminous surfacing when atmospheric temperature is below 40 degrees F; or when fog or other unsuitable weather conditions are present. Temperature of mixture at time of installation shall not be lower than 260 degrees F in warm weather or higher than 320 degrees F in cold weather.

2. Where 2-inch or 3-inch thick surfacing is indicated or specified, install surfacing in one course. Where surfacing is indicated or specified 4 inches or more in thickness, except for thickened edges, install bituminous surfacing in courses of approximately equal thickness, each course not exceeding 2-1/2 inches in thickness unless otherwise required by the Architect.
- H. Stakes or Screeds: Provide grade or screed stakes spaced not more than 15 feet apart in flow lines with grades of less than one percent. Continuous screeds may be provided instead of stakes.
- I. Spreading: Install bituminous surfacing in a manner to cause least possible handling of mixture. In open areas and wherever practicable, install by mechanical means with a self-propelled mechanical spreader. In confined or restricted areas, install mixture with hot shovels and rakes, and smooth with lutes.
- J. Joints: Provide vertical joints between successive runs. Install joints true to line, grade, and cross section. Lapped joints are not permitted.
- K. Rolling:
1. Finish roll with a self-propelled tandem roller weighing at least 8 tons. Break down roll with a self-propelled roller weighing between 1-1/2 tons and 8 tons.
 2. Roll in a manner that preserves flow lines and the established finished grades. Break down roll in areas adjacent to flow lines parallel to flow lines. Break down roll after bituminous surfacing is installed without shoving or cracking of mixture under roller. Continue finish rolling until surfacing is unyielding, true to grade, and meets requirements for specified smoothness. Areas inaccessible to finish roller may be finish rolled with breakdown roller or tamped with hot tamping irons and smoothed with hot smoothing irons or hand roller.
 3. Where bituminous surfacing abuts concrete, masonry, walks or paving, tamp joint smooth, if necessary, as described above to obtain a uniformly even joint, true to line and grade. Tamp and smooth to properly compact.
 4. Compacted bituminous surfacing shall be provided with a bulk specific gravity of at least 2.31 when tested in accordance with ASTM D 1188.

3.03 TOLERANCE

- A. Smoothness: Surface of bituminous surfacing after rolling, shall be even, smooth and uniform in texture with no voids or rock pockets, free of roller marks or other irregularities, and not varying by more than 0.03 foot, except at local depressions or raised areas as indicated, when a 10 foot straightedge is placed on surface.
- B. Grade: Finished grade shall not vary more than 0.02 foot above or below required grade. Variations within prescribed tolerance shall be compensating so that average grade and cross-section are provided.
- C. Premium paving tolerances and requirements for synthetic track:

1. General: Test in-place asphalt concrete courses for compliance with requirements or thickness and surface smoothness. Repair or remove and replace unacceptable paving as directed by Owner's representative.
2. Thickness: Tolerances for thickness shall be ¼ inch, plus or minus.
3. Planarity: The asphalt substrate shall not vary from the planned cross slope by more than +/-0.1%. The finished asphalt shall not vary, plus or minus, under a 10 feet straight edge greater than 1/8". It is the responsibility of the paving contractor to flood test the surface with the use of a water truck. If, after 30 minutes on a 70 degree F day, "bird bath" are evident in a depth more than 1/8" the paving contractor, track surfacing contractor and the Owner's representative will determine the best method of correction.
4. Corrective Measures: It is the general contractor's responsibility to determine if the planarity, cross slopes, and general specifications have been met. If all of the conditions have been met the general contractor must notify the Owner in writing of the acceptance of the asphalt paving. This notification must include the acceptance of the paving by the track surfacing contractor.
5. No slurry or fog seals are to be applied to areas of asphalt paving that are to receive synthetic track surfacing. Problems with adhesion of synthetic surface are likely over seal coatings and warranty of the synthetic surfacing delaminating from the asphalt base will be voided.

3.04 TESTING

- A. After first coat of surface seal has been installed and after a 24 hour period, the flood test shall be completed of the bituminous surfacing in presence of the IOR. Repair areas of standing water or puddles and flood test locally; install surface seal and retest as necessary.

3.05 SURFACE SEALING

- A. After bituminous surfacing has passed flood test, clear and allow to dry and provide one more coat of surface seal.
- B. Where indicated, provide multiple coats of surface seal to existing bituminous surfacing.
- C. Where new bituminous surfacing joins existing bituminous surfacing, overlap surface seal a minimum of 12 inches onto existing bituminous surfacing.

3.06 PROTECTION

- A. Protect the Work of this section until Substantial Completion.

3.07 CLEANUP

- A. Remove rubbish, debris and waste materials and legally dispose of off the Project site.

END OF SECTION

**SECTION 32 12 36
SEAL FOR BITUMINOUS SURFACING**

PART 1 – GENERAL

1.01 SUMMARY

- A. Section Includes:
 - 1. Surface sealer over bituminous surfacing.
- B. Related Requirements:
 - 1. Division 01 - General Requirements.
 - 2. Section 32 0117 - Pavement Repair.
 - 3. Section 32 1216 - Asphalt Paving.
 - 4. Section 32 1723 - Pavement Marking.

1.02 SUBMITTALS

- A. Product Data: Submit manufacturer's product information and application procedures for bituminous surfacing.

1.03 QUALITY ASSURANCE

- A. Comply with the Standard Specifications For Public Works Construction, current edition.
- B. Agitate bulk materials during transport.

1.04 MAINTENANCE

- A. Extra Materials: Provide 10 gallons in unopened containers.

PART 2 – PRODUCTS

2.01 MATERIALS

- A. Provide one of the following surface seals:

	<u>Product Name</u>	<u>Manufacturer</u>
1.	Guard-Top	CALMAT / Industrial Asphalt
2.	Over Kote	Diversified Asphalt Product
3.	Park Top	Western Colloid Products
4.	Sure Seal	Asphalt Coating Engineering
5.	Super Drive Top.	SAF– T Seal. Inc.
6.	Equal.	

PART 3 – EXECUTION

3.01 SURFACE PREPARATION

- A. Thoroughly wash surfaces with water to remove dirt, debris, excessive oil and grease, or other foreign matter.

3.02 APPLICATION

- A. Install seal coat in strict accordance with manufacturer's written directions and recommendations.
- B. Install two coats of surface seal to new bituminous surfacing. First coat shall be installed before flood testing. Clean surface and allow to dry before installing second coat. Second coat shall be installed after bituminous surfacing has passed flood test.
- C. Where new bituminous surfacing is installed adjacent to existing bituminous surfacing, overlap surface seal a minimum of 12 inches onto existing bituminous surfacing.
- D. Where existing bituminous surfacing is indicated to be patched and sealed, install two coats of surface seal after patching. Refer to Section 32 1216 - Asphalt Paving.

3.03 PROTECTION OF SURFACES

- A. Protect sealed and unsealed surfaces from damage and traffic during performance of the Work of this section and until surface seal has thoroughly set and cured. Do not permit traffic of any kind for at least 24 hours after completion of installation.
- B. Protect the Work of this section until Substantial Completion.

3.04 TESTING

- A. Owner reserves the right to obtain samples, perform tests to ensure compliance with the Specifications, and to review weight slips and invoices of materials delivered to the Project site.

3.05 CLEAN UP

- A. Remove rubbish, debris, and waste materials and legally dispose of off the Project site.

END OF SECTION

**SECTION 32 13 15
PAVEMENT MARKING**

PART 1 - GENERAL

1.01. REFERENCE:

- A. Requirements in Addenda, Alternates, Conditions, and Division 1 collectively apply to this work.
- B. Related Sections:
 - 1. Division 31:
 - 2. Division 32:

1.02 DESCRIPTION:

- A. Principal Work Items Are:
 - 1. Painted lines, lettering, and symbols at parking areas.
 - 2. Painted stripes at exterior stairs.
 - 3. Painted lines for sport courts.
 - 4. Fire Lane "No Parking."
 - 5. Curb marking and red curbs.

1.03 JOB CONDITIONS:

- A. Proceed with pavement marking only on clean, dry surfaces and at a minimum ambient or surface temperature of 40 deg F for oil-based materials, 50 deg F for water-based materials, and not exceeding 95 deg F.
- B. Sequencing, Scheduling: Coordinate with paving work. Verify that paint type is compatible with asphalt paving surfaces seal coats.
- C. Protection: Do not apply pavement markings for seven days after application of asphalt surface seal coat. After application, protect from traffic until thoroughly dry.

PART 2 - PRODUCTS

2.01 MATERIALS:

- A. Traffic Paint:
 - 1. Type: Water base, roadway traffic lane marking type; colors as selected.
 - 2. Acceptable Manufacturers:
 - a. Dunn-Edwards, Vin-L-Stripe No. W-801, vinyl-epoxy as a standard of quality.
 - b. J. E. Bauer latex base Formula No. 1030A9 White, No. 1056A9 Yellow, No. 1865A9 Blue, No. 1118A9 Green, and No. 1854A9 Red.

- c. Sinclair No. 160 Vinyl Traffic Line Paint, water base.
- d. Pervo Paint Company.

PART 3 - EXECUTION

3.01 PREPARATION:

- A. Layout: Accurately measure and layout work. Use stencils for all work; snap lines for straight work.
- B. Prior to application of paint, allow the pavement to properly cure. Clean and prepare in accordance with paint manufacturer's written recommendations.
- B. Provide mechanical equipment to install paint in a uniform, straight or curved pattern, without holidays and other defects.
- C. Do not permit traffic until paint has completely cured.
- D. Install 2 coats in thickness recommended by manufacturer.

3.02 APPLICATION:

- A. Painted Lines, Lettering, and Symbols At Parking Areas:
 - 1. Parking Stall Lines: 4 inches wide, color white.
 - 2. Wheelchair accessible parking stalls, stripes and letters: As indicated.
 - 3. Color: White, for all work except blue at wheelchair accessible parking stalls and red to indicate "No Parking".
 - 4. Specific areas designated as fire lanes must be marked with red curbs using OSAH safety red paint. "FIRE LANE – NO PARKING" shall be painted on the top of curb in 3" white lettering at a spacing of 30' on center or portion thereof.
 - 5. Painted lines and markings on pavement at wheelchair accessible parking stalls shall be 4 inches wide (blue in color) equal of Color No. 15090 per Federal Standard 595B.
 - 6. Parking spaces for persons with disabilities shall be marked according to CBC Section 1129B.5.
 - 7. Tactile warning lines shall be in conformance to CBC Section 1133B.8.3 and 1133B.8.4.
 - 8. Traffic Directional Arrows: Paint directional traffic flow arrows in all aisles, and at parking lot entrances and exits.
- B. Stripes At Exterior Stairs:
 - 1. Stripes: 2" wide, located 2" from, and parallel to, nosing.
 - 2. Required Locations: All treads, all top landings, all intermediate landings.

END OF SECTION

**SECTION 32 31 13
CHAINLINK FENCE**

PART 1 – GENERAL

1.01. REFERENCE

- A. Requirements in Addenda, Alternates, Conditions, and Division 1 collectively apply to this work.

1.02. DESCRIPTION

- A. Principal Work Items Are:
 - 1. Chain link fence.
 - 2. Concrete post foundations.
 - 3. All hardware, except padlocks.
 - 4. Gates.
 - 5. Enclosures / Cages
 - 6. Existing Fencing: Removal, modifications and replacing fabric where indicated.

1.03. SUBSTITUTIONS

- A. Only written approval of Architect will permit substitutions for materials specified; see General Conditions for procedure.

1.04. QUALITY ASSURANCE

- A. Requirements Of Regulatory Agencies Relative to Gates and Hardware in the Path of Travel:
 - 1. Codes: Conform to 2001 Title 24 CBC Section 1007.3.11 and California Fire Code (CFC) Section 1208.
- B. Quality Standards: All work shall comply with Chain Link Fence Manufacturers Institute (CLFMI) standards, ASTM F567, and all requirements in these specifications: The most stringent requirements shall apply where there are conflicts.

1.05. SUBMITTALS

- A. Samples; 2 Copies: Provide sample of privacy slats, minimum sample size 8” long slat in specified width.
- B. Product Data; 4 Copies: Provide Mfr.'s latest specifications and technical information brochure with installation instructions for privacy slats, including 4 color charts showing all available colors.
- C. Shop Drawings; 4 Copies: Reference to Architects' drawings. Provide and submit for the following items:
 - 1. All new swing gates where leaf width exceeds 9'-0".

1.06. PRODUCT DELIVERY, STORAGE, AND HANDLING

- A. Deliver materials with mfr.'s tags and labels intact. Handle and store so as to avoid damage.

1.07. JOB CONDITIONS

- A. Sequencing, Scheduling: Coordinate with earthwork, concrete, masonry, pre-engineered structures, and paving installers and other related work.
- B. Where fencing is installed on continuous concrete or masonry walls or curbs, assist Concrete or Masonry Section in proper placement of sleeves for fence posts. See details.
- C. Closely coordinate with landscaping, turf and irrigation modifications, repair, and new work.
- D. Review and verify all new and existing underground utility locations to prevent footing interference with said existing utilities.

PART 2 – PRODUCTS

2.01. GENERAL

- A. All fence components to be galvanically compatible.

2.02. MATERIALS; FABRIC

- A. General: Drawn steel wire, hot-dipped zinc coated after weaving, ASTM A-392 Class 1, 1.2 oz/sq. ft. of wire surface, per ASTM A-90 stripping test; withstand 5 one-minute immersions per Preece test per ASTM A-392 & A-90.
- B. Fence & Gate Fabric:
 - 1. One-piece fabric full-height for fence thru 12'-0"; edges knuckled selvage. Top edges over 6'-0" above adjacent finish surface knuckle-prong for senior high schools.
 - 2. Mesh Size: 2" typical.
 - 3. Wire Dia.: #9 ga. typical.
 - 4. Fabric shall be free from barbs, icicles, or other projections resulting from the galvanizing process, which might be hazardous. Fence fabric having such defects will be rejected and Contractor shall replace it with suitable fabric at NO cost to District even if it has been installed.

2.03. MATERIALS; FRAMEWORK

- A. Pipe: ASTM F-1083, Class I, Sched. 40, standard welded or seamless steel pipe, commercial hot-dipped zinc coated, 1.8 oz/sq. ft. min. evenly deposited; reasonably straight, burrs removed, free of defects and all roughness.
- B. Reuse existing fence posts where indicated on Drawings and that are in good condition and approved for reuse by District Inspector and Architect. If not in good condition or approved, provide new posts per specifications herein.

- C. Sizes: For fencing 8' high or less;

<u>ITEM</u>	<u>O.D.</u> <u>INCHES</u>	<u>WGT.</u> <u>LBS/L.F.</u>
1. Line Posts:	2.5	3.655
2. Corner, Terminal & Pull Posts:	3.0	5.79
3. Pedestrian Gate Posts:		

	a. For gate leaf 0' thru 6' wide:	3.0	5.79
	b. Leaf 6'-1" thru 13"	3.50	7.58
4.	Gate Posts: For gate leaf widths as listed:		
	a. 0' thru 6':	3.50	7.58
	b. 6'-1" thru 13':	4.50	10.79
	c. 13'-1" thru 18':	6.625	18.97
5.	Top Rails, Bottom Rails, Brace Rails, & Transom Rails:	1.66	2.27
6.	Gates: For gate leaf widths as listed.		
	a. Frame thru 12':	2.0	2.72
	b. Frame over 12':	2.5	3.65
	c. Bracing:	1.66	2.27
7.	At 12' high fencing;		
	a. Corner & Terminal Posts:	2 7/8	
	b. Line Posts:	2 3/8	
	c. Gate Posts (gate leaf widths less than 6'):	2 7/8	
	d. Top Rails, Bottom Rails, Brace Rails, & Transom Rails	1 7/8	

2.04. MATERIALS; ACCESSORIES

A. Wire: All galvanized.

1. Tension: #9 ga. steel, cold drawn, marcelled; ASTM A-82.
2. Ties: Soft annealed steel; FS QQ-W-461; for fastening fabric to posts, top rails, bottom rails and brace rails:
 - a. #9 ga. to posts.
 - b. #14 ga. to top & bottom rails, and tension wire.

B. Galvanizing; All Accessories, Except Wire: ASTM A-153.

C. Fittings:

1. Tension Bars: 3/16" x 3/4", mild steel.
2. Steel Bands: 1/8" x 1" typical, 1/8" x 3/4" at gates; mild steel.
3. Post Eye Caps: Cast malleable iron or pressed steel; snug fit to exclude moisture from posts; hole to accommodate top rail.
4. Truss Rods: 3/8" dia. steel; adjustable length.
5. Turnbuckles for Tension Wire: Eye/eye type, drop forged steel, 5/16" min. screws with 4-1/2" min. take-up.
6. Bolts: 3/8" dia. min.; cadmium plated.
7. Expansion Couplings For Rails: Steel, 6" long; designed to fit tightly inside rail, fitted with raised center.
8. Hog Rings: Sizes and gages as required; #9 ga. minimum galvanized steel.
9. Rail Ends For Top Rails and Brace Rails: Malleable iron (ASTM A47, Grade 32510) with holes to receive 3/8" bolts for securing to rail end bands.
10. Misc.: All other required fittings.
11. Sleeves For Posts: Steel pipe ASTM A36, or A53 Grade B; fully galvanized including exposed cut edges; sleeve diameters sized to suit posts, inside diameter of sleeve shall be 1' larger than outside diameter of posts to allow 3/8" to 5/8" clearance all around post for placing non-shrink grout into sleeve. Sleeve depth 12" min. for fence heights up to 8 ft. max.; greater depths for higher fences; see Details on Drawings.

12. 1 ¼" to 1 ½" bottom rail, fully welded in place bottom rail only.

2.05. MATERIALS; GATE HARDWARE

- A. General:
 1. Mfr.'s standard galvanized heavy duty hardware, unless noted otherwise on Drawings.
 2. Galvanizing For All Parts: ASTM A-153; galvanize after fabrication.
- B. Hinges: Typically, malleable iron, double clamping, non-lift-off, offset type for 180 deg. swing. Install and adjust hinges; burr or center punch threads of gate hinge bolts to prevent removal of nuts.
- C. Latches: Typically, malleable iron, forked or plunger-bar type, permit operation from either side of gate, gravity type automatically engaging gate frame; with padlock eyes for locking gates in both the open and closed positions; mounting height at 30" to 44" above finished floor.
- D. Keeper: Malleable iron; automatically engage gate when swung open 180 deg., and hold until manually released.
- E. Pairs Of Gates:
 1. Stops: Flush steel plate, with anchors.
 2. Latch: Center drop rod or plunger bar; with integral padlock eyes.

2.06. MATERIALS; MISC.

- A. Portland Cement Concrete: 1: 2-1/2: 3-1/2 mix (2500 psi min.) delivered by Ready-mix truck. Concrete bag mixes or concrete mixed on-site are not acceptable.
- B. Non-Shrink Grout: Por-Rok by Hallemite Co.; Embeco by Master Builders; Sika Grout #212. Color/tint grout to match adjacent concrete surfaces where grout is installed.
- C. Paint Touch-Up For Galvanizing Work:
 1. "Galvalloy", by Metalloy Products Co., Los Angeles, CA; as a standard of quality.
 2. Z.R.C. Cold Galvanizing Compound, "Galvilite" by Z.R.C. Chemical Products Co., Quincy, MA.

2.07. FABRICATION; GATES

- A. Frame: Weld frames with integral radius or mitered and fully welded corners; horizontal bracing rails for gates exceeding 6' high; vertical bracing rails at 6' o.c. max. for gates exceeding 9' wide; diagonal cross-bracing truss rods to insure gates stay square and operate properly. Grind all welds flush and smooth. Galvanize after fabrication.
- B. Fabric: Stretch taut; tension bars and bands a 15" o.c. max. at vertical edges. Tension bars shall extend full height of gates. Wire tie fabric at 12" o.c. max. top, bottom, and bracing rails.
- C. Hardware: Attach all hardware securely with rivets or by other means which will provide security against removal and breakage. Two hinges per gate leaf typical; three hinges per leaf where leaf exceeds 100 sq. ft.

PART 3 – EXECUTION

3.01. INSPECTION

- A. Verify that final grading and paving at fence location is completed without irregularities, which would interfere with fence installation.
- B. Do not commence work until unsatisfactory conditions have been corrected.

3.02. PREPARATION

- A. Existing Conditions: Verify locations of existing and new underground utilities and water lines prior to excavating for footings.
- B. Layout: Measure and lay out complete fence line, gate(s), and modifications to existing fence.
- C. Post Spacing:
 - 1. General: Locate line posts at equal-distance spacing in a run, but do not exceed 8-feet on center, unless noted otherwise.

3.03. INSTALLATION; FOOTINGS

- A. Sizes; For Fencing 7' High or Less:

	<u>DEPTH (Inches)</u>	<u>DIAMETER (Inches)</u>
1. Line Posts:	36	12
2. Corner Posts:	36	18
3. Gate Posts: For gate leaf widths as listed.		
a. Leaf 0' thru 8'	36	18
b. Leaf 8'-1" thru 13':	48	24
c. Leaf 13'-1" thru 18':	60	24
4. Posts; For 8' High or greater Fencing:		
a. Line, Corner & Gate Posts:	48"	18
- B. Holes: Drill holes in firm, undisturbed, or compacted soil.

3.04. ERECTION; FRAMEWORK

- A. Posts:
 - 1. Typical Installation; Posts Set Into Concrete Footings:
 - a. General: Set posts into concrete footings plumb, centered, and aligned; 3" concrete cover between post bottom and earth.
 - b. Concrete: Place in continuous pour in hole; tamp to consolidate; crown concrete to drain water away from posts.
 - c. Rebar: Where indicated, install rebar cages.
 - d. Set posts and footings prior to installation of adjacent paving. Locate top of footing a minimum of 3 inches (4" at concrete) below indicated finish elevation of top of adjacent paving or mow strip, to allow paving or mow strip to cover footing and finish tight to post.

2. Installation of Fencing on Walls or Curbs Where Indicated; Posts Set Into Sleeves:
 - a. Check and verify that sleeves are properly galvanized, and installed by Concrete and/or Masonry sections.
 - b. Set posts plumb and true to line.
 - c. Fill space between post and sleeve solid with non-shrinking grout. Mix and place per mfr.'s printed recommendations. Color grout to match color of adjacent concrete. Finish flush to match adjacent concrete surface. Do not grind or damage sleeve or post galvanizing. Slightly crown grout to drain water away from posts.
 3. Corner/Terminal/Pull Posts: Install at ends of runs, horizontal direction changes of 15 deg. or more, vertical grade changes of 5 deg. or more, ends of curved fence section; pull post each 500' run of fence.
 4. Gate Posts: Install each side of gates.
- B. Top Rail: Install continuous at top of ALL fencing; insert thru eye posts caps; join pipe lengths (20'-0 plus or minus) with couplings, with expansion spring every fifth coupling. Secure at ends with rail-end fittings and bands and tack weld.
- C. Bottom Rail: Install continuous at bottom of ALL fencing unless noted otherwise; include couplings, end clamps and boulevards as required for complete assembly and securely anchor rail to each end connection to line and terminal posts per manufacturer's specifications with proper end clamp fittings; maximum 2" gap below fence. Weld all connections for bottom rails.
- D. Post Bracing Assemblies: Install horiz. brace rail, and diagonal truss rod in each fence panel adjacent to terminal, corner, pull, and gate posts. Brace rail not required for 4' or less height fence. Where applicable, install horizontal transom rail between gates and chain link fence above. Tack weld all connections.
- E. Lid of Enclosure: Provide horizontal support rails, 1 5/8" diameter, spaced at 24" on center to support 26" wide sheets of corrugated metal. Provide additional cross frame rails as required to adequately brace enclosure lid. Completely weld support and cross rails to form a welded lid assembly. Lid of enclosure and post supports shall be installed to allow corrugated roof to drain at 1/4" per ft. min. Provide and install galvanized, 24 ga. corrugated sheet metal in panels sized at 42" long x 26" wide. Install panels with overlap at sides and min. 6" overlap at each end. Weld and pop rivet to secure corrugated metal sheets to each other and to chain link frame. Seal pop rivets with silicone typical.
- F. Install additional horizontal and vertical rails as required or indicated to securely fasten fence fabric tightly at concrete curbs or at irregular conditions at bottom of fence(s) to provide maximum gap/opening of 2". Provide couplings, end clamps and boulevards as required for complete assembly per mfr.'s specifications. Tack weld all connections.

3.05 ERECTION; FENCE FABRIC

- A. Fabric: Install in one continuous piece wherever possible; stretch taut.
1. Adjoining existing fencing: Match existing.
 2. At Replacement of Fence Fabric: Match existing, unless noted otherwise.

- B. Fastenings:
 - 1. At terminal/corner/pull/gates posts, thread tension bars thru mesh; secure to posts with bands at 15" o.c. max.
 - 2. Wire-tie fabric to line posts at 16" o.c.; to top rail, bottom rails, brace rails, and intermediate rails at 18" o.c.
 - 3. Hog-ring to bottom tension wire at 18" o.c., where bottom rails do not occur.
 - 4. Hooked ties with links are NOT permitted.
- C. Tension Wires: Install tension wires with a turnbuckle each 150' of wire; stretch wire taut; and wire tie to posts. Install two tension wires within bottom two feet of fence fabric.
- D. Clearances: Set bottom of fence fabric to maintain stated clear distances.
 - 1. Earth: 1" to 2"; trench and shape locally to permit uniform top and bottom alignment of fabric.
 - 2. Asphalt Concrete Paving: 1" to 1-1/2".
 - 3. Concrete Paving or Mow Strip: Touching surface.
 - 4. Top Of Wall: Touching surface, or tight to bottom rail, where occurs.

3.06 ERECTION; GATES

- A. Install gates plumb and level to a tolerance of 1/4 in. in 10 ft.
- B. Install ground-set items in concrete.
- C. Adjust hardware to provide smooth operation. Lubricate where required.
- D. Knuckle ends of fabric to eliminate hazards. Allow clearance on gates of 1-1/2" at bottom.

3.07 EXISTING FENCING; REMOVAL, REUSE, SALVAGE, & MODIFICATIONS

- A. Removal Work:
 - 1. Remove existing fencing as indicated, including concrete post footings and mow strips.
 - 2. Post Holes: Fill with earth, compact to same density as surrounding earth. At paving areas, compact fill to 95% max. dry density, and flush with adjoining surfaces.
 - 3. Disposal: Dispose of all removed materials which are not indicated to be reused or salvaged, off-site at Contractor's expense.
- B. Reuse Of Existing Fencing; where indicated and approved by Architect:
 - 1. Remove existing fence fabric as indicated. Leave posts and footings in place.
 - 2. Fully clean existing posts of all rust, properly prep, and apply galvanizing paint per mfr.'s specifications. Finish surface to be clean and smooth and with consistent galvanized coating equal to G-90 hot-dipped galvanizing.
 - 3. Replace any damaged posts as determined by the Architect.
 - 4. Provide new posts and framing members as indicated on Drawings.
 - 5. Install new fence fabric and hardware to same requirements as specified for all-new work.
 - 6. Do not reuse defective materials or parts.
 - 7. Supply any missing and/or additional parts necessary for a complete installation.

8. Conform to same standards as for all-new work.
9. Dispose of all removed materials which are not indicated to be reused, off-site at Contractor's expense.

C. Modifications To Existing Work:

1. Where only partial removal is indicated, install posts and rails as required to terminate fencing.
2. Fence Fabric: Knuckle cut edges; stretch taut; reattach to framework and tension wire.
3. Posts: Existing posts to remain as much as possible. Add new posts at new gate(s) and where necessary at existing fence so line post spacing does not exceed 8 feet on center.
4. Sleeved Conditions: At posts to be sleeved, insert full height posts over the top of existing posts, and tack weld new post to existing post at bottom. Note that sleeve posts shall be continuous, from grade to lid of batting enclosure and shall be sized to fit snugly over existing posts.
5. Conform to same standards as for all-new work.

3.08 ADJUSTMENT & CLEANING

- A. Adjustment: Adjust brace rails and tension rods for rigid installation. Tighten hardware, fasteners, and accessories.
- B. Repair of Damaged Work: Where operations damage work to remain, repair, replace or restore work as directed by Architect and/or District using qualified workmen of respective trades. Closely coordinate work with irrigation, paving, concrete, landscaping, electrical and utilities, and all other related or adjacent work.
- C. Cleaning: Remove excess and waste materials from Project site.

END OF SECTION