

PROJECT MANUAL

FOR

AMBUEHL ELEMENTARY SCHOOL HVAC REPLACEMENT

OWNER

CAPISTRANO UNIFIED SCHOOL DISTRICT
33122 VALLE ROAD
SAN JUAN CAPISTRANO, CA 92675-4859

ARCHITECT

PBK
600 ANTON BOULEVARD, SUITE 1375
COSTA MESA, 92626
(949) 548-5000

PROJECT 230415
NOVEMBER 21, 2023

PROJECT MANUAL
FOR
AMBUEHL ELEMENTARY SCHOOL HVAC REPLACEMENT

PROJECT 230415
NOVEMBER 21, 2023

CAPISTRANO UNIFIED SCHOOL DISTRICT
33122 VALLE ROAD
SAN JUAN CAPISTRANO, CA 92675-4859

PBK
2400 EAST KATELLA AVENUE, SUITE 950
ANAHEIM, CA 92806
(949) 548-5000



BRUCE OU
ARCHITECT

C34832

Stamp




PBK
2400 East Katella Avenue, Suite 950
Anaheim, CA 92806
Phone: (949) 548-5000

PROJECT MANUAL
FOR
AMBUEHL ELEMENTARY SCHOOL HVAC REPLACEMENT

PROJECT 230416
DSA APPLICATION NO. 04-122878
NOVEMBER 21, 2023

CAPISTRANO UNIFIED SCHOOL DISTRICT
33122 VALLE ROAD
SAN JUAN CAPISTRANO, CA 92675-4859

PBK
2400 EAST KATELLA AVENUE, SUITE 950
ANAHEIM, CA 92806
(949) 548-5000



MAJID KANI
STRUCTURAL ENGINEER S5072

Kabala Engineers
2400 East Katella Avenue, Suite 950
Anaheim, CA 92806
Phone: 949-548-5000

Stamp



IDENTIFICATION STAMP
DIV. OF THE STATE ARCHITECT

APP: 04-122878 INC:

REVIEWED FOR

SS ☒ FLS ☒ ACS ☒

DATE: 02/20/2024

WBLESTHER GAMA
MECHANICAL ENGINEER M38752

DCGA Engineers, Inc.
4750 East Ontario Mills Parkway
Ontario, CA 91764-5147
Phone: 909-987-0017

Stamp



CHEN FANG
ELECTRICAL ENGINEER E16952

DCGA Engineers, Inc.
4750 East Ontario Mills Parkway
Ontario, CA 91764-5147
Phone: 909-987-0017

Stamp



**TABLE OF CONTENTS
SPECIFICATIONS GROUP**

AMBUEHL ELEMENTARY SCHOOL HVAC REPLACEMENT

**SPECIFICATIONS GROUP
GENERAL REQUIREMENTS SUBGROUP**

DIVISION 01	GENERAL REQUIREMENTS	PAGES
01 11 00	Summary of Work	3
01 20 00	Price and Payment Procedures	4
01 25 13	Product Substitution Procedures	4
01 31 00	Project Management and Coordination	7
01 32 16	Construction Schedule - Network Analysis	9
01 33 00	Submittal Procedures	6
01 35 16	Alteration Project Procedures	4
01 42 19	Reference Standards	3
01 43 00	Quality Assurance	3
01 45 29	Testing Laboratory Services	7
01 50 00	Temporary Facilities and Controls	6
01 61 00	Product Requirements	3
01 73 00	Execution Requirements	4
01 73 29	Cutting and Patching	3
01 74 19	Construction Waste Management and Disposal	1
01 77 00	Closeout Procedures	6

**SPECIFICATION GROUP
FACILITY CONSTRUCTION SUBGROUP**

DIVISION 02	EXISTING CONDITIONS	
02 41 19	Selective Demolition	3

DIVISION 03 **CONCRETE**

NOT USED

DIVISION 04 **MASONRY**

NOT USED

DIVISION 05 **METALS**

NOT USED

DIVISION 06 **WOOD, PLASTICS, AND COMPOSITES**

06 10 00	Rough Carpentry	5
----------	-----------------	---

DIVISION 07 **THERMAL AND MOISTURE PROTECTION**

07 21 16	Blanket Insulation	3
07 54 19	PVC Thermoplastic Membrane Roofing	23
07 62 00	Sheet Metal Flashing and Trim	4
07 92 00	Joint Sealants	6

DIVISION 08 **OPENINGS**

NOT USED

DIVISION 09 FINISHES

09 51 13 Acoustical Panel Ceilings 4

DIVISION 10 SPECIALTIES

NOT USED

DIVISION 11 EQUIPMENT

NOT USED

DIVISION 12 FURNISHINGS

NOT USED

DIVISION 13 SPECIAL CONSTRUCTION

NOT USED

DIVISION 14 CONVEYING EQUIPMENT

NOT USED

DIVISION 15 TO 19 RESERVED

NOT USED

SPECIFICATIONS GROUP
FACILITY SERVICES SUBGROUP

DIVISION 20 RESERVED

NOT USED

DIVISION 21 FIRE SUPPRESSION

NOT USED

DIVISION 22 PLUMBING

22 05 00	Common Work Results for Plumbing	7
22 05 23	General-Duty Valves for Plumbing Piping	4
22 05 29	Hangers and Supports for Plumbing Piping and Equipment	7
22 05 53	Identification for Plumbing Piping and Equipment	5
22 11 16	Domestic Water Piping	5
22 11 19	Domestic Water Piping Specialties	4
22 13 16	Sanitary Waste and Vent Piping	8
22 13 19	Sanitary Waste Piping Specialties	4

DIVISION 23 HEATING, VENTILATING, AND AIR CONDITIONING

23 05 00	Common Work Results for HVAC	4
23 05 13	Common Motor Requirements for HVAC Equipment	2
23 05 29	Hangers and Supports for HVAC Piping and Equipment	7
23 05 53	Identification for HVAC Piping and Equipment	3
23 05 93	Testing, Adjusting, and Balancing for HVAC	7
23 07 13	Duct Insulation	10
23 31 13	Metal Ducts	13
23 33 00	Air Duct Accessories	5
23 37 13	Diffusers, Registers, and Grilles	3
23 41 00	Particulate Air Filtration	2
23 81 19	Rooftop Air Conditioners	5

DIVISION 24 RESERVED

NOT USED

DIVISION 25 INTEGRATED AUTOMATION

NOT USED

DIVISION 26 ELECTRICAL

26 01 00	Basic Electrical Requirements	7
26 01 60	Cabinets and Enclosures	2
26 04 40	Disconnect Switches	2
26 05 00	Common Work Results for Electrical	4
26 05 19	Low-Voltage Electrical Power Conductors and Cables	4
26 05 26	Grounding and Bonding for Electrical Systems	6
26 05 29	Hangers and Supports for Electrical Systems	5
26 05 32	Identification for Electrical Systems	2
26 05 33	Raceways and Boxes for Electrical Systems	12
26 05 72	Acceptance Testing	5
26 27 26	Wiring Devices	4

DIVISION 27 COMMUNICATIONS

NOT USED

DIVISION 28 ELECTRONIC SAFETY AND SECURITY

NOT USED

DIVISION 29 RESERVED

NOT USED

SPECIFICATIONS GROUP
SITE AND INFRASTRUCTURE SUBGROUP

DIVISION 30 RESERVED

NOT USED

DIVISION 31 EARTHWORK

NOT USED

DIVISION 32 EXTERIOR IMPROVEMENTS

NOT USED

DIVISION 33 UTILITIES

NOT USED

DIVISION 34 TRANSPORTATION

NOT USED

DIVISION 35 WATERWAY AND MARINE CONSTRUCTION

NOT USED

DIVISION 36 TO 39 RESERVED

NOT USED

SPECIFICATIONS GROUP
PROCESS EQUIPMENT SUBGROUP

DIVISION 40 PROCESS INTEGRATION

NOT USED

DIVISION 41 MATERIAL PROCESSING AND HANDLING EQUIPMENT

NOT USED

DIVISION 42 PROCESS HEATING, COOLING, AND DRYING EQUIPMENT

NOT USED

DIVISION 43 PROCESS GAS AND LIQUID HANDLING, PURIFICATION, AND STORAGE

NOT USED

DIVISION 44 POLLUTION CONTROL AND WASTE EQUIPMENT

NOT USED

DIVISION 45 INDUSTRY-SPECIFIC MANUFACTURING EQUIPMENT

NOT USED

DIVISION 46 INDUSTRY-SPECIFIC MANUFACTURING EQUIPMENT

NOT USED

DIVISION 47 INDUSTRY-SPECIFIC MANUFACTURING EQUIPMENT

NOT USED

DIVISION 48 ELECTRICAL POWER GENERATION

NOT USED

DIVISION 49 RESERVED

NOT USED

SECTION 01 11 00

SUMMARY OF WORK

1. PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Work Included.
- B. Work under separate contracts.
- C. Work by Owner.
- D. Owner furnished products.
- E. Contractor use of site and premises.
- F. Work Sequence.
- G. Owner occupancy.
- H. Work restrictions.

1.2 WORK INCLUDED

- A. Work of this Contract comprises general construction including HVAC Replacement work located at 28001 San Juan Creek Road, San Juan Capistrano, CA 92675 for Capistrano Unified School District, Owner.
- B. Construct the work under a single lump sum contract.

1.3 WORK UNDER SEPARATE CONTRACTS

- A. General: Cooperate fully with separate contractors so work on those contracts may be carried out smoothly, without interfering with or delaying work under this Contract. Coordinate the Work of this Contract with work performed under separate contracts.

1.4 WORK BY OWNER

- A. Items noted "NIC" (Not In Contract) will be furnished and installed by Owner.

1.5 OWNER FURNISHED PRODUCTS

- A. Items noted "OFICI" (Owner-Furnished Contractor Installed) will be furnished by Owner and installed by Contractor.
- B. Items noted "OFIOI" (Owner-Furnished Owner Installed) will be furnished by Owner and installed by Owner.
- C. Owner's Responsibilities:
 - 1. Arrange for and deliver Owner reviewed Shop Drawings, Product Data, and Samples to Contractor.
 - 2. Arrange and pay for Product delivery to site.
 - 3. On delivery, inspect Products jointly with Contractor.
 - 4. Submit claims for transportation damage and replace damaged, defective, or deficient items.

5. Arrange for manufacturer's warranties, inspections, and service.

D. Contractor's Responsibilities:

1. Review Owner reviewed Shop Drawings, Product Data, and Samples.
2. Receive and unload Products at site; inspect for completeness or damage, jointly with Owner.
3. Handle, store, install and finish Products.
4. Repair or replace items damaged after receipt.

1.6 CONTRACTOR USE OF SITE AND PREMISES

- A. Contractor shall have complete use of the site and premises throughout the construction period.

1.7 OWNER OCCUPANCY

- A. Partial Owner Occupancy: Owner will occupy the site and premises during entire construction period, with the exception of areas under construction.
- B. Owner Occupancy of Completed Areas of Construction: Owner reserves the right to occupy and to place and install equipment in completed areas of building, before Substantial Completion, provided such occupancy does not interfere with completion of the Work. Such placement of equipment and partial occupancy shall not constitute acceptance of the total Work.
- C. Architect will prepare a Certificate of Substantial Completion for each specific portion of the Work to be occupied before Owner occupancy.
- D. Before partial 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 building.
- E. On occupancy, Owner will assume responsibility for maintenance and custodial service for occupied portions of building.
- F. Cooperate with Owner during construction operations to minimize conflicts and facilitate Owner usage.
- G. Perform the Work so as not to interfere with Owner's day-to-day operations.
- H. Maintain existing exits, unless otherwise indicated.
- I. Provide not less than 72 hours notice to Owner of activities that will affect Owner's operations.

1.8 WORK RESTRICTIONS

- A. On-Site Work Hours: Work shall be generally performed during normal business working hours, Monday through Friday, except as otherwise indicated or required to conform to construction schedule and labor codes.
1. Weekend Hours: Any hours at no cost to the Owner if written notification to Owner has been submitted and approved.
 2. Early Morning Hours: 7:00 a.m.

- B. Existing Utility Interruptions: Do not interrupt utilities serving facilities occupied by Owner or others unless permitted to do so and then only after arranging to provide temporary utility services according to requirements indicated.

1. Notify Architect not less than 5 days in advance of proposed utility interruptions. Do not proceed with utility interruptions without Architect's permission.

2. PART 2 PRODUCTS

Not Used

3. PART 3 EXECUTION

Not Used

END OF SECTION

SECTION 01 20 00

PRICE AND PAYMENT PROCEDURES

1. PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Contingency allowances.
- B. Schedule of Values.
- C. Application for Payment.
- D. Defect assessment.
- E. Non-payment for rejected work.
- F. Change procedures.
- G. Alternates.
- H. Unit prices.

1.2 CONTINGENCY ALLOWANCE:

- A. Include in the contract sum and base bid all contingency allowances stated herein.
- B. Costs included in contingency allowance: Cost of work to Contractor or subcontractor, less applicable trade discounts; delivery to site and applicable taxes; product handling, including unloading, uncrating, and storage; protection of products from damage; labor for installation and finishing; reasonable overhead and profit and other expenses required by work.
- C. Funds will be drawn from contingency allowance amount only by written authorization of Owner.
- D. At closeout of Contract, funds remaining in contingency allowance amount will be credited to Owner by Change Order.
- E. Whenever costs are more than contingency allowance amount, the Contract amount will be adjusted accordingly by Change order.
- F. Contractor Responsibilities:
 - 1. Assist Architect in selection of products and suppliers.
 - 2. Obtain proposals from suppliers and offer recommendations.
 - 3. On notification of selection by Owner, execute agreement with designated supplier.
 - 4. Arrange for and process shop drawings, product data, and samples. Arrange for delivery of product to site.
 - 5. Promptly inspect products upon delivery for completeness, damage, and defects. Submit claims for damage.
- G. Contingency Allowance: As stated and indicated in the bid documents.

1.3 SCHEDULE OF VALUES

- A. Submit Schedule of Values for approval in duplicate within fourteen days after receipt of Notice to Proceed.
- B. Format: Submit typed schedule based upon the attached Schedule of Values augmented by the Table of Contents of this Project Manual. Identify each line item with number and title of the major specification Section.
- C. Include in each line item, the amount of Allowances specified in this Section.
- D. Include within each line item, a directly proportional amount of Contractor's overhead and profit.
- E. Revise schedule to list approved Change Orders, on continuation sheet, with each Application For Payment.

1.4 APPLICATIONS FOR PAYMENT

- A. Submit six copies of each application on AIA Form G702 - Application and Certificate for Payment and AIA Form G703 Continuation Sheet.
- B. Content and Format: Utilize Schedule of Values for listing items in Application for Payment.
- C. Payment Application Times: The date for each progress payment is indicated in the General Conditions of the Contract.
- D. Payment Application Periods: The period of construction covered by each application for payment is the period indicated in the General Conditions of the Contract.
- E. Application Preparation: Complete every entry on form. Notarize and execute by a person authorized to sign legal documents. Architect will return incomplete applications without action.
- F. Waiver of Stop Notices: With each application for payment, submit waivers of stop notices from subcontractors for construction period covered by previous application.
- G. Final Payment: As specified in the General Conditions of the Contract and in Section 01 77 00 - Closeout Procedures.
- H. Refer to the General Conditions of the Contract for additional payment provisions.

1.5 DEFECT ASSESSMENT

- A. Replace the Work, or portions of the Work, not conforming to specified requirements.
- B. If, in the opinion of the Architect, it is not practical to remove and replace the Work, the Architect will direct one of the following remedies:
 - 1. The defective Work may remain, but the listed schedule of value will be adjusted to a new value at the discretion of the Architect.
 - 2. The defective Work will be partially repaired to the instructions and satisfaction of the Architect and the listed schedule of value will be adjusted to reflect a new value at the discretion of the Architect.

1.6 NON-PAYMENT FOR REJECTED WORK

- A. Payment will not be made for any of the following:
 - 1. Products wasted or disposed of in a manner that is not acceptable.
 - 2. Products determined to be unacceptable before or after placement.
 - 3. Products not completely unloaded from the transporting vehicle.

4. Products placed beyond the lines and levels of the required work.
5. Products remaining on hand after completion of the work.
6. Loading, hauling and disposing of rejected products.

1.7 CHANGE PROCEDURES

- A. The Architect will advise of minor changes in the Work not involving an adjustment to Contract Sum/Price or Contract Time as authorized by General Conditions on AIA Form G710 Architect's Supplemental Instructions.
- B. The Architect may issue a Proposal Request which includes a detailed description of a proposed change with supplementary or revised Drawings and specifications. Proposal Requests are for information only and are not to be considered instructions to stop the work or to execute the proposed change. Contractor will prepare and submit a detailed estimate within 14 days.
- C. Any change in the Work which involves the adjustment to contract sum/price or contract time shall be properly certified by the Contractor as indicated in the General Conditions of the contract.
- D. The Contractor may propose a change by submitting a Change Order Request to the Architect (through the Construction Manager), describing the proposed change and its full effect on the Work. Include a statement describing the reason for the change, and the effect on the Contract Sum and Contract Time with full documentation and a statement describing the effect on Work by separate or other contractors.
- E. Stipulated Sum Change Order: Based on Proposal Request and Contractor's fixed price quotation or Contractor's Change Order Request as approved by Architect.
- F. Time and Material/Force Account Change Order: Submit itemized account and supporting data after completion of change, within time limits indicated in the General Conditions of the Contract.
- G. Maintain detailed records of work done on Time and Material/Force Account basis. Provide full information required for evaluation of proposed changes, and to substantiate costs for changes in the Work as indicated in the General Conditions of the Contract.
- H. Construction Change Directive: Architect may issue a directive, signed by the Owner and Architect, instructing the Contractor to proceed with a change in the Work, for subsequent inclusion in a Change Order. Document will describe changes in the Work, and designate method of determining any change in Contract Sum or Contract Time. Promptly execute the change.
- I. Allowance Adjustment: Adjustment of allowance amounts shall be based upon a properly documented and detailed Change Order Request which substantiates distribution of allowance amounts and actual costs of work in place.
- J. Change Order Forms: AIA G701 Change Order.
- K. Execution of Change Orders: Architect will issue Change Orders for signatures of parties as provided in the General Conditions of the Contract.
- L. All addenda (changes and/or revisions prior to award of contract) and construction changes (changes and revisions after award of contract) shall be approved by the Architect and the Division of the State Architect prior to start of construction covered by those changes and/or revisions in accordance with the requirements of Title 24 of the California Code of Regulations, Part 1, Section 4-338.
- M. Promptly revise Schedule of Values and Application for Payment forms to record each authorized Change Order as a separate line item and adjust the Contract Sum.
- N. Promptly revise progress schedules to reflect any changes in Contract Time, revise sub-schedules to adjust times for other items of work affected by the change and resubmit.
- O. Promptly enter changes in Project Record Documents.

1.8 UNIT PRICES

- A. A unit price is an amount proposed by the bidder and stated on the Bid Form as a price per unit of measurement for materials or services that will be added to or deducted from the Contract Sum by change order in the event the estimated quantities of work required by the Contract Documents are increased or decreased.
- B. Unit prices shall include all necessary material, overhead, profit and applicable taxes.
- C. The Owner reserves the right to reject the Contractor's measurement of work-in-place that involves use of established prices, and to have this work measured by an independent surveyor acceptable to the Contractor at the Owner's expense.
- D. Refer to individual specification sections for construction activities requiring the establishment of unit prices.
- E. Specification sections referenced in the Schedule of Unit Prices contain requirements for materials and methods described under each unit price.

2. PART 2 PRODUCTS

Not Used

3. PART 3 EXECUTION

Not Used

END OF SECTION

SECTION 01 25 13

PRODUCT SUBSTITUTION PROCEDURES

1. PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Product options.
- B. Substitution procedures.

1.2 DEFINITIONS

- A. Requests for changes in products, materials, or equipment required by Contract Documents proposed by the Contractor prior to and after award of the Contract are considered requests for substitutions. The following are not considered substitutions:
 - 1. Revisions to Contract Documents requested by the Owner or Architect.
 - 2. Specified options of products, materials, and equipment included in Contract Documents.

1.3 PRODUCT OPTIONS

- A. Products Specified by Reference Standards or by Description Only: Any product meeting those standards or description.
- B. Products Specified by Naming One or More Manufacturers with Provision for Substitution: Products of manufacturers named and meeting specifications with substitution of products or manufacturer only when submitted under provisions of this section.
- C. Products Specified by Naming One or More Manufacturers without Provision for Substitution: No substitution allowed.

1.4 LIMITATIONS ON SUBSTITUTIONS SUBMITTED PRIOR TO THE RECEIPT OF BIDS

- A. The Bid shall be based upon the standards of quality established by those items of equipment and/or materials which are specifically identified in the Contract Documents.
- B. The opportunity to request a substitution is not for the convenience of the Bidder to request acceptance of equipment and/or materials which may be more familiar or have a lesser cost.
- C. Architect may consider requests for substitutions of specified equipment and/or materials only when requests are received by Architect prior to the date established for the receipt of bids as stipulated in Document 00 21 13 - Instructions to Bidders.
- D. Consideration by Architect of a substitution request will be made only if request is made in strict conformance with provisions of this section.
- E. Burden of proof of merit of requested substitution is the responsibility of the entity requesting the substitution.
- F. It is the sole responsibility of the entity requesting the substitution to establish proper content of submittal for requests for substitutions. Incomplete submittals will be rejected.
- G. Architect's decision on substitution requests are final and do not require documentation or justification.
- H. When substitution is not accepted, provide specified product.
- I. Substitute products shall not be included within the bid without written acceptance by Addendum.

1.5 LIMITATIONS ON SUBSTITUTIONS SUBMITTED AFTER THE AWARD OF THE CONTRACT

- A. The Contract is based upon the standards of quality established by those items of equipment and/or materials which are specifically identified in the Contract Documents.
- B. The opportunity to request a substitution is not for the convenience of the Contractor to request acceptance of equipment and/or materials which may be more familiar or have a lesser cost.
- C. Consideration by Architect of substitution requests received after the established date of the receipt of bids or contract award will only be made when one or more of the following conditions are met and documented:
 - 1. Specified item fails to comply with regulatory requirements.
 - 2. Specified item has been discontinued.
 - 3. Specified item, through no fault of the Contractor, is unavailable in the time frame required to meet project schedule.
 - 4. Specified item, through subsequent information disclosure, will not perform properly or fit in designated space.
 - 5. Manufacturer declares specified product to be unsuitable for use intended or refuses to warrant installation of product.
 - 6. Substitution would be, in the sole judgement of the Architect, a substantial benefit to the Owner in terms of cost, time, energy conservation, or other consideration of merit.
- D. Notwithstanding the provisions of Article 1.4 of this section and the above, the Architect may consider a substitution request after the date of the receipt of bids or contract award, if in the sole discretion of the Architect, there appears to be just cause for such a request. The acceptance of such a late request does not waive any other requirement as stated herein.
- E. Consideration by Architect of a substitution request will be made only if request is made in strict conformance with provisions of this section.
- F. Substitutions will not be considered when they are indicated or implied on shop drawings or product data submittals without separate written request as required by provisions of this section.
- G. Review of shop drawings does not constitute acceptance of substitutions indicated or implied on shop drawings.
- H. Substitutions will not be considered when requested or submitted directly by subcontractor or supplier.
- I. Substitutions will not be considered as a result of the failure to pursue the work promptly or coordinate activities properly.
- J. Burden of proof of merit of requested substitution is the responsibility of the Contractor.
- K. It is the sole responsibility of the Contractor to establish proper content of submittal for requests for substitutions. Incomplete submittals will be rejected.
- L. Owner shall receive full benefit of any cost reduction as a result of any request for substitution.
- M. Architect's decision on substitution requests is final and does not require documentation or justification.
- N. When substitution is not accepted, provide specified product.
- O. Substitute products shall not be ordered or installed without written acceptance.

1.6 REGULATORY REQUIREMENTS

- A. It shall be the responsibility of the entity requesting the substitution to obtain all regulatory approvals required for proposed substitutions.
- B. All regulatory approvals shall be obtained for proposed substitutions prior to submittal of substitution request to Architect.
- C. All costs incurred by the Owner in obtaining regulatory approvals for proposed substitutions to include the costs of the Architect and any authority having jurisdiction over the project shall be reimbursed to the Owner. Costs of these services shall be reimbursed regardless of final acceptance or rejection of substitution.
- D. Substitutions of materials or work procedures which affect the health, safety and welfare of the public shall have prior approval of the Division of the State Architect (DSA) field representative.

1.7 SUBSTITUTION REPRESENTATION

- A. In submitting a request for substitution, the entity requesting the substitution makes the representation that he or she:
 - 1. Has investigated the proposed substitution and has determined that it meets or exceeds the quality level of the specified product.
 - 2. Will provide the same warranty or guarantee for the substitution as for the specified product.
 - 3. Will coordinate installation and make changes to other work which may be required for the work to be completed with no additional cost to the Owner.
 - 4. Waives claims for additional cost or time extension which may subsequently become apparent.
 - 5. Will reimburse Owner for the cost of Architect's review or redesign services associated with substitution request.

1.8 SUBMITTAL PROCEDURE

- A. Submit each Substitution Request in conformance with the requirements of this section.
- B. Assemble complete Substitution Request into a single bookmarked Portable Document Format (PDF) file.
- C. Transmit electronic PDF files via Architect's Project Collaboration Site address or designated email address.
- D. Submit request with Architect's Substitution Request Form. Form may be obtained at the office of the Architect. Substitution requests received without request form will be returned unreviewed.
- E. Limit each request to one proposed substitution.
- F. Request to include sufficient data so that direct comparison of proposed substitution can be made.
- G. Provide complete documentation for each request. Documentation shall include the following information, as appropriate, as a minimum:
 - 1. Statement of cause for substitution request.
 - 2. Identify product by specification section and article number.
 - 3. Provide manufacturer's name, address, and phone number. List fabricators, suppliers, and installers as appropriate.
 - 4. List similar projects where proposed substitution has been used, dates of installation and names of Architect and Owner.

5. List availability of maintenance services and replacement materials.
 6. Documented or confirmation of regulatory approval.
 7. Product data, including drawings and descriptions of products.
 8. Fabrication and installation procedures.
 9. Samples of proposed substitutions.
 10. Itemized comparison of significant qualities of the proposed substitution with those of the product specified. Significant qualities may include size, weight, durability, performance requirements and visual effects.
 11. Coordination information, including a list of changes or modifications needed to other items of work that will become necessary to accommodate proposed substitution.
 12. Statement on the substitutions effect on the construction schedule.
 13. Cost information including a proposal of the net change, if any, in the Contract sum if the substitution is submitted after the receipt of bids or contract award.
 14. Certification that the substitution is equal to or better in every respect to that required by the Contract Documents and that substitution will perform adequately in the application intended.
 15. Waiver of right to additional payment or time that may subsequently become necessary because of failure of substitution to perform adequately.
- H. Inadequate warranty, vagueness of submittal, failure to meet specified requirements, or submittal of insufficient data will be cause for rejection of substitution request.

1.9 ARCHITECT'S REVIEW

- A. Within 14 days of receipt of request for substitution, the Architect will accept or reject proposed substitution.
- B. If a decision on a substitution cannot be made within the time allocated, the product specified shall be used.
- C. There shall be no claim for additional time for review of proposed substitutions.
- D. Final acceptance of a substitution submitted prior to the date established for the receipt of bids will be in the form of an Addendum.
- E. Final acceptance of a substitution submitted after the award of the contract will be in the form of a Change Order.

2. PART 2 PRODUCTS

Not Used

3. PART 3 EXECUTION

Not Used

END OF SECTION

SECTION 01 31 00

PROJECT MANAGEMENT AND COORDINATION

1. PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Coordination.
- B. Preconstruction conference.
- C. Progress meetings.
- D. Request for Information (RFIs).
- E. Preinstallation conferences.
- F. Closeout conference.
- G. Post construction dedication.

1.2 DEFINITIONS

- A. RFI - Request from Contractor seeking additional information, interpretation or clarification of the Contract Documents.

1.3 COORDINATION

- A. Coordinate scheduling, submittals, and Work of the various Sections of Specifications to assure efficient and orderly sequence of installation of interdependent construction elements, with provisions for accommodating items installed later.
- B. Coordinate construction operations of the different Sections of the Specifications to ensure efficient and orderly installation of each part of the Work.
- C. Prior to commencement of a particular type or kind of work examine relevant information, contract documents and subsequent data issued to the project.
- D. Verify that utility requirement characteristics of operating equipment are compatible with building utilities. Coordinate work of various Sections having interdependent responsibilities for installing, connecting to, and placing in service, such equipment.
- E. Coordinate space requirements and installation of mechanical and electrical work which are indicated diagrammatically on Drawings. Follow routing shown for pipes, ducts, and conduit, as closely as practicable; place runs parallel with line of building. Utilize spaces efficiently to maximize accessibility for other installations, for maintenance, and for repairs.
- F. In finished areas except as otherwise indicated, conceal pipes, ducts, and wiring within the construction. Coordinate locations of fixtures and outlets with finish elements.
- G. In locations where several elements of mechanical and electrical work must be sequenced and positioned with precision in order to fit into available space, prepare coordination drawings showing the actual conditions required for the installation. Prepare coordination drawings prior to purchasing, fabricating or installing any of the elements required to be coordinated.
- H. Closing up of walls, partitions or furred spaces, backfilling and other covering up operations shall not proceed until all enclosed or covered work and inspections have been completed. Verify before proceeding.
- I. Coordinate completion and clean up of Work of separate sections in preparation for Substantial Completion.

- J. After Owner occupancy of premises, coordinate access to site for correction of defective Work and Work not in accordance with Contract Documents, to minimize disruption of Owner's activities.
- K. Coordinate all utility company work in accordance with the General Conditions.
- L. Coordinate field engineering with the provisions of Section 01 73 00.

1.4 PRECONSTRUCTION CONFERENCE

- A. Architect will schedule a conference immediately after receipt of fully executed contract documents prior to project mobilization.
- B. Mandatory Attendance: Owner, Owner's Resident Inspector, Owner's Testing Laboratory Representative, Architect, Contractor, Contractor's Project Manager and Contractor's Job Superintendent.
- C. Optional Attendance: Architect's consultants, subcontractors and utility company representatives.
- D. Architect will preside at conference, record minutes and distribute copies.
- E. Agenda:
 - 1. Execution of Owner-Contractor Agreement.
 - 2. Issue Notice to Proceed.
 - 3. Submission of executed bonds and insurance certificates.
 - 4. Distribution of Contract Documents.
 - 5. Federal and State labor law requirements applicable to Contract.
 - 6. Submission of list of Subcontractors, list of Products, schedule of values, and progress schedule.
 - 7. Designation of responsible personnel representing the parties.
 - 8. Procedures and processing of RFIs, field decisions, submittals, substitutions, applications for payments, proposal requests, Change Orders and Contract closeout procedures.
 - 9. Procedures for testing and inspection.
 - 10. Temporary facilities and controls.
 - 11. Procedures for moisture and mold control.
 - 12. Procedures for disruptions and shutdowns.
 - 13. Scheduling.
 - 14. Critical work sequence and long lead items.
 - 15. Work restrictions and working hours.
 - 16. Progress meetings.
 - 17. Use of site and premises.
 - 18. Storage.
 - 19. Authorities having jurisdiction over project.
 - 20. Owner occupancy requirements.

21. Owner-Furnished equipment.
22. Preparation of Record Drawings.
23. Security.
24. Parking availability.
25. Progress cleaning.

1.5 PROGRESS MEETINGS

- A. The Construction Manager will schedule and administer meetings throughout progress of the Work at maximum twice a month intervals.
- B. Architect will make arrangements for meetings, prepare agenda, preside at meetings, record minutes (Field Reports), and distribute copies.
- C. Attendance Required: Job superintendent, major Subcontractors and suppliers, Owner, Owner's Inspector, and Architect, as appropriate to agenda topics for each meeting.
- D. Agenda:
 1. Review minutes of previous meetings. (Field Reports)
 2. Review of Work progress.
 3. Field observations, problems, and decisions.
 4. Identification of problems which impede planned progress.
 5. Review of submittals schedule and status of submittals.
 6. Requests For Information (RFIs).
 7. Status of Proposal Requests (PRs).
 8. Status of Change Order Requests (CORs).
 9. Status of Change Orders (Cos).
 10. Status of corrective or deficient items.
 11. Review of off-site fabrication and delivery schedules.
 12. Maintenance of construction schedule.
 13. Corrective measures to regain projected schedules.
 14. Planned progress during succeeding work period.
 15. Coordination of projected progress.
 16. Maintenance of quality and work standards.
 17. Effect of proposed changes on progress schedule and coordination.
 18. Temporary facilities and controls.
 19. Progress cleaning.

20. Other business relating to Work.

1.6 REQUEST FOR INFORMATION (RFI'S)

- A. Procedure: Immediately on discovery of the need for additional information, interpretation of the Contract Documents, and if not possible to request interpretation at Progress Meeting, prepare and submit an RFI in the form specified.
1. RFIs shall originate with Contractor. RFIs submitted by entities other than Contractor will be returned 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.
 3. Each RFI shall address only one subject matter.
- B. Content of the RFI: Include a detailed, legible description of item needing interpretation and the following:
1. Date.
 2. Project name.
 3. Owner's name.
 4. Name of Contractor.
 5. Name of Architect.
 6. RFI number, numbered sequentially.
 7. Specification Section number and title and related paragraphs, as appropriate.
 8. Drawing number and detail references, as appropriate.
 9. Field dimensions and conditions, as appropriate.
 10. Contractor's suggested solution(s). If Contractor's solution(s) impact the Contract Time or the Contract Sum, Contractor shall state impact in the RFI.
 11. Contractor's signature.
 12. Attachments: Include drawings, descriptions, measurements, photos, Product Data, Shop Drawings, and other information necessary to fully describe items needing interpretation. Supplementary drawings prepared by Contractor shall include dimensions, thicknesses, structural grid references, and details of affected materials, assemblies, and attachments.
- C. Hard-Copy RFIs: Identify each page of attachments with the RFI number and sequential page number.
- D. Software-Generated RFIs: Software-generated form with substantially the same content as indicated above. Attachments shall be electronic files in a format that will allow electronic editing by the Architect.
- E. Architect's Action: Architect will review each RFI, determine action required, and return it. Allow fifteen days for Architect's response for each RFI. RFIs received after 1:00 p.m. will be considered as received the following working day. If the RFI is required to be forwarded to a consultant, subconsultant, or Owner for a response, the response time will be twenty five days.
1. The following RFIs will be returned without action:
 - (a) Requests for approval of submittals.
 - (b) Requests for approval of substitutions.

- (c) Requests for information already indicated in the Contract Documents.
 - (d) Requests for coordination information which is the responsibility of the Contractor.
 - (e) Requests for adjustments in the Contract Time or the Contract Sum.
 - (f) Requests for interpretation of Architect's actions on submittals and substitutions.
 - (g) Incomplete RFIs or RFIs with numerous errors.
- 2. Architect's action may include a request for additional information, in which case Architect's allowable time for response will start again.
 - 3. Architect's review of or response to RFIs shall not constitute an approval, direction, or procedure related to construction means, methods, techniques, sequences, or procedures of Contractor.
 - 4. Architect's review of or response to RFIs shall not constitute an approval, direction, or procedure related to the construction site safety precautions, procedures or methodology of Contractor.
 - 5. 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 Order Request according to Division 01 Section 01 20 00 - Price and Payment Procedures.
 - (a) If Contractor believes the RFI response warrants change in the Contract Time or the Contract Sum, notify Architect in writing within five days of receipt of the RFI response.
 - (b) Under no circumstances is the Architect's review of or response to RFIs to be considered an authorization to depart from the Contract Documents or an authorization to perform extra work.
- F. On receipt of Architect's action immediately distribute the RFI response to affected parties.
 - G. Review response and notify Architect within three days if Contractor disagrees with response.

1.7 PREINSTALLATION CONFERENCES

- A. When required in individual specification Section, convene a preinstallation conference prior to commencing work of the Section. Refer to individual specification section for timing requirements of conference.
- B. Require attendance of parties directly affecting, or affected by, work of the specific Section.
- C. Notify Architect a minimum of seven days in advance of meeting date.
- D. Preinstallation conference to coincide with regularly scheduled progress meeting.
- E. Prepare agenda, preside at conference, record minutes, and distribute copies within two days after conference to participants.
- F. Agenda:
 - 1. Review of Contract Documents.
 - 2. Manufacturer's recommendations.
 - 3. Status of submittals.
 - 4. Related RFIs.
 - 5. Related Change Orders.
 - 6. Schedule of work activities.

7. Deliveries of materials and equipment.
8. Sequence of operation.
9. Acceptable substrates.
10. Interface requirements.
11. Possible conflicts.
12. Access.
13. Site utilization.
14. Tests and inspections.
15. Review of Mockups.
16. Temporary facilities and controls.
17. Quality and work standards.
18. Weather limitations.

1.8 PROJECT CLOSEOUT CONFERENCE

- A. Architect will schedule a project closeout conference, at a time convenient to Owner and Contractor, but no later than 90 days prior to the scheduled date of Substantial Completion.
- B. Mandatory Attendance: Owner, Owner's Resident Inspector, Owner's Testing Laboratory, Architect, and Contractor.
- C. Architect will preside at conference, record minutes, and distribute copies.
- D. Refer to Section 01 77 00 for additional closeout requirements.
- E. Agenda: Discuss items of significance that could affect or delay Project closeout, including the following:
 1. Submittal procedures for closeout documents.
 2. Preparation of Record Documents.
 3. Procedures required prior to review for Substantial Completion and for final review for acceptance.
 4. Procedures for completing and archiving web-based Project software site data files.
 5. Submittal of written warranties.
 6. Requirements for preparing operations and maintenance data.
 7. Requirements for delivery of material samples, attic stock, and spare parts.
 8. Requirements for demonstration and training.
 9. Preparation of Contractor's punch list.
 10. Procedures for processing Applications for Payment at Substantial Completion and for final payment.
 11. Coordination of separate contracts.
 12. Owner's partial occupancy requirements.

13. Installation of Owner's furniture, fixtures, and equipment.
14. Responsibility for removing temporary facilities and controls.
15. DSA closeout and certification process.

1.9 POST CONSTRUCTION DEDICATION

- A. Attendance Required: Project superintendent, project manager, major subcontractors, Owner and Architect.
- B. Preparation prior to Dedication:
 1. Assist Owner in operation of mechanical systems.
 2. Verify operation and adjust controls for communication systems.
 3. Assist Owner in operation of lighting systems.

2. PART 2 PRODUCTS

Not Used

3. PART 3 EXECUTION

Not Used

END OF SECTION

SECTION 01 32 16

CONSTRUCTION SCHEDULE - NETWORK ANALYSIS

1. PART 1 GENERAL

1.1 SECTION INCLUDES

- A. References.
- B. Performance requirements.
- C. Quality assurance.
- D. Qualifications.
- E. Project record documents.
- F. Submittals.
- G. Review and evaluation.
- H. Format.
- I. Cost and schedule reports.
- J. Early work schedule.
- K. Construction schedule.
- L. Short interval schedule.
- M. Requested time adjustment schedule.
- N. Recovery schedule.
- O. Updating schedules.
- P. Distribution.

1.2 REFERENCES

- A. Construction Planning and Scheduling Manual - A Manual for General Contractors and the Construction Industry, The Associated General Contractors of America (AGC).
- B. CSI - Construction Specifications Institute MP-2-1 Master Format.
- C. National Weather Service - Local Climatological Data.

1.3 PERFORMANCE REQUIREMENTS

- A. Ensure adequate scheduling during construction activities so work may be prosecuted in an orderly and expeditious manner within stipulated Contract Time.
- B. Ensure coordination of Contractor and subcontractors at all levels.
- C. Ensure coordination of submittals, fabrication, delivery, erection, installation, and testing of materials and equipment.
- D. Ensure on-time delivery of Owner furnished materials and equipment.

- E. Ensure coordination of jurisdictional reviews.
- F. Assist in preparation and evaluation of applications for payment.
- G. Assist in monitoring progress of work.
- H. Assist in evaluation of proposed changes to Contract Time.
- I. Assist in evaluation of proposed changes to Construction Schedule.
- J. Assist in detection of schedule delays and identification of corrective actions.

1.4 QUALITY ASSURANCE

- A. Perform work in accordance with Construction Planning and Scheduling Manual published by the AGC.
- B. Maintain one copy of document on site.
- C. In the event of discrepancy between the AGC publication and this section, provisions of this section shall govern.

1.5 QUALIFICATIONS

- A. Scheduler: Personnel or specialist consultant with 5 years minimum experience in scheduling construction work of a complexity and size comparable to this Project.
- B. Administrative Personnel: 5 years minimum experience in using and monitoring schedules on comparable projects.

1.6 PROJECT RECORD DOCUMENTS

- A. Submit record documents under provisions of Section 01 77 00.
- B. Submit one electronic file and three copies of final Record Construction Schedule which reflects actual construction of this Project.
- C. Record schedule shall be certified for compliance with actual way project was constructed.
- D. Receipt of Record Construction Schedule shall be a condition precedent to any retainage release or final payment.

1.7 SUBMITTALS

- A. Submit under provisions of Section 01 33 00.
- B. Within 7 days from the Notice of Award submit proposed Early Work Schedule and preliminary Cost Report defining activities for first 60 days of Work.
- C. Within 45 days from Notice of Award submit proposed Construction Schedule and final Cost Report.
- D. Submit updated Construction Schedule at least 10 days prior to each Application for Payment.
- E. Submit Short Interval Schedule at each Construction Progress Meeting.
- F. Submit Time Adjustment Schedule within 10 days of commencement of a claimed delay.
- G. Submit Recovery Schedules as required by completion of work.
- H. Submit one electronic file and three copies of each schedule and cost report.

1.8 REVIEW AND EVALUATION

- A. Early Work Schedule shall be reviewed during Preconstruction Conference with Owner and Architect.
- B. Within 5 days of receipt of Owner and Architect's comments provide satisfactory revision to Early Work Schedule or adequate justification for activities in question.
- C. Acceptance by Owner of corrected Early Work Schedule shall be a condition precedent to making any progress payments for first 60 days of Contract.
- D. Cost loaded values of Early Work Schedule shall be basis for determining progress payments during first 60 days of Contract.
- E. Participate in joint review of Construction Schedule and Reports with Owner and Architect.
- F. Within 7 days of receipt of Owner and Architect's comments provide satisfactory revision to Construction Schedule or adequate justification for activities in question.
- G. In the event that an activity or element of work is not detected by Owner or Architect review, such omission or error shall be corrected by next scheduled update and shall not affect Contract Time.
- H. Acceptance by Owner of corrected Construction Schedule shall be a condition precedent to making any progress payments after first 60 days of Contract.
- I. Cost-loaded values of Construction Schedule shall be basis for determining progress payments.
- J. Review and acceptance by Owner and Architect of Early Work Schedule or Construction Schedule does not constitute responsibility whatsoever for accuracy or feasibility of schedules nor does such acceptance expressly or impliedly warrant, acknowledge or admit reasonableness of activities, logic, duration, manpower, cost or equipment loading stated or implied on schedules.

1.9 FORMAT

- A. Prepare diagrams and supporting mathematical analyses using Precedence Diagramming Method, under concepts and methods outlined in AGC Construction Planning and Scheduling Manual.
- B. Listings: Reading from left to right, in ascending order for each activity.
- C. Diagram Size: 42 inches maximum height x width required.
- D. Scale and Spacing: To allow for legible notations and revisions.
- E. Illustrate order and interdependence of activities and sequence of work.
- F. Illustrate complete sequence of construction by activity.
- G. Provide legend of symbols and abbreviations used.

1.10 COST AND SCHEDULE REPORTS

- A. Activity Analysis: Tabulate each activity of network diagram and identify for each activity:
 - 1. Description.
 - 2. Interface with outside contractors or agencies.
 - 3. Number.
 - 4. Preceding and following number.
 - 5. Duration.

6. Earliest start date.
7. Earliest finish date.
8. Actual start date.
9. Actual finish date.
10. Latest start date.
11. Latest finish date.
12. Total and free float.
13. Identification of critical path activity.
14. Monetary value keyed to Schedule of Values.
15. Manpower requirements.
16. Responsibility.
17. Percentage complete.
18. Variance positive or negative.

B. Cost Report: Tabulate each activity of network diagram and identify for each activity:

1. Description.
2. Number.
3. Total cost.
4. Percentage complete.
5. Value prior to current period.
6. Value this period.
7. Value to date.

C. Required Sorts: List activities in sorts or groups:

1. By activity number.
2. By amount of float time in order of early start.
3. By responsibility in order of earliest start date.
4. In order of latest start dates.
5. In order of latest finish dates.
6. Application for payment sorted by Schedule of Values.
7. Listing of activities on critical path.
8. Listing of basic input data which generates schedule.

1.11 EARLY WORK SCHEDULE

- A. Shall establish scope of work to be performed during first 60 days of Contract.
- B. Shall designate critical path or paths.
- C. Shall contain the following phases and activities:
 - 1. Procurement activities to include mobilization, shop drawings and sample submittals.
 - 2. Identification of key and long-lead elements and realistic delivery dates.
 - 3. Construction activities in units of whole days limited to 14 days for each activity except non-construction activities for procurement and delivery.
 - 4. Approximate cost and duration of each activity.
- D. Shall contain seasonal weather considerations. Seasonal rainfall shall be 10 year average for the month as evidenced by Local Climatological Data obtained from U.S. National Weather Service.
- E. Activities shall be incorporated into Construction Schedule.
- F. No application for payment will be evaluated or processed until Early Work Schedule has been submitted and reviewed.
- G. Shall be updated on a monthly basis while Construction Schedule is being developed.
- H. Failure to submit an adequate or accurate Early Work Schedule or failure to submit on established dates will be considered a substantial breach of Contract.

1.12 CONSTRUCTION SCHEDULE

- A. Include Early Work Schedule as first 60 days of Construction Schedule.
- B. Shall be a computer generated time scaled network diagram of activities.
- C. Indicate a completion date for project that is no later than required completion date subject to any time extensions processed as part of a change order.
- D. Conform to mandatory dates specified in the Contract Documents.
- E. Should schedule indicate a completion date earlier than any required completion date, Owner or Architect shall not be liable for any costs should project be unable to be completed by such date.
- F. Seasonal weather shall be considered in planning and scheduling of all work. Seasonal rainfall shall be 10 year average for the month as evidenced by Local Climatological Data obtained from U.S. National Weather Service.
- G. Level of detail shall correspond to complexity of work involved.
- H. Indicate procurement activities, delivery, and installation of Owner furnished material and equipment.
- I. Designate critical path or paths.
- J. Subcontractor work at all levels shall be included in schedule.
- K. As developed shall show sequence and interdependence of activities required for complete performance of Work.
- L. Shall be logical and show a coordinated plan of Work.

- M. Show order of activities and major points of interface, including specific dates of completion.
- N. Duration of activities shall be coordinated with subcontractors and suppliers and shall be best estimate of time required.
- O. Shall show description, duration and float for each activity.
- P. Failure to include any activity shall not be an excuse for completing all work by required completion date.
- Q. No activity shall have a duration longer than 14 days or a value over \$20,000.00 except non-construction activities for procurement and delivery.
- R. An activity shall meet the following criteria:
 - 1. Any portion or element of work, action, or reaction that is precisely described, readily identifiable, and is a function of a logical sequential process.
 - 2. Descriptions shall be clear and concise. Beginning and end shall be readily verifiable. Starts and finishes shall be scheduled by logical restraints.
 - 3. Responsibility shall be identified with a single performing entity.
 - 4. Additional codes shall identify building, floor, bid item and CSI classification.
 - 5. Assigned dollar value (cost-loading) of each activity shall cumulatively equal total contract amount. Mobilization, bond and insurance costs shall be separate. General requirement costs, overhead, profit, shall be prorated throughout all activities. Activity costs shall correlate with Schedule of Values.
 - 6. Each activity shall have manpower-loading assigned.
 - 7. Major construction equipment shall be assigned to each activity.
 - 8. Activities labeled start, continue or completion are not allowed.
- S. For major equipment and materials show a sequence of activities including:
 - 1. Preparation of shop drawings and sample submissions.
 - 2. Review of shop drawings and samples.
 - 3. Finish and color selection.
 - 4. Fabrication and delivery.
 - 5. Erection or installation.
 - 6. Testing.
- T. Include a minimum of 15 days prior to completion date for punch lists and clean up. No other activities shall be scheduled during this period.

1.13 SHORT INTERVAL SCHEDULE

- A. Shall be fully developed horizontal bar-chart-type schedule directly derived from Construction Schedule.
- B. Prepare schedule on sheet of sufficient width to clearly show data.
- C. Provide continuous heavy vertical line identifying first day of week.
- D. Provide continuous subordinate vertical line identifying each day of week.

- E. Identify activities by same activity number and description as Construction Schedule.
- F. Show each activity in proper sequence.
- G. Indicate graphically sequences necessary for related activities.
- H. Indicate activities completed or in progress for previous 2 week period.
- I. Indicate activities scheduled for succeeding 2 week period.
- J. Further detail may be added if necessary to monitor schedule.

1.14 REQUESTED TIME ADJUSTMENT SCHEDULE

- A. Updated Construction Schedule shall not show a completion date later than the Contract Time, subject to any time extensions processed as part of a Change Order.
- B. If an extension of time is requested, a separate schedule entitled "Requested Time Adjustment Schedule" shall be submitted to Owner and Architect.
- C. Indicate requested adjustments in Contract Time which are due to changes or delays in completion of work.
- D. Extension request shall include forecast of project completion date and actual achievement of any dates listed in Agreement.
- E. To the extent that any requests are pending at time of any Construction Schedule update, Time Adjustment Schedule shall also be updated.
- F. Schedule shall be a time-scaled network analysis.
- G. Accompany schedule with formal written time extension request and detailed impact analysis justifying extension.
- H. Time impact analysis shall demonstrate time impact based upon date of delay, and status of construction at that time and event time computation of all affected activities. Event times shall be those as shown in latest Construction Schedule.
- I. Activity delays shall not automatically constitute an extension of Contract Time.
- J. Failure of subcontractors shall not be justification for an extension of time.
- K. Float is not for the exclusive use or benefit of any single party. Float time shall be apportioned according to needs of project.
- L. Float suppression techniques such as preferential sequencing, special lead/lag logic restraints, extended activity durations, or imposed dates shall be apportioned according to benefit of project.
- M. Extensions will be granted only to extent that time adjustments to activities exceed total positive float of the critical path and extends Contract completion date.
- N. Owner shall not have an obligation to consider any time extension request unless requirements of Contract Documents, and specifically, but not limited to these requirements are complied with.
- O. Owner shall not be responsible or liable for any construction acceleration due to failure of Owner to grant time extensions under Contract Documents should requested adjustments in Contract Time not substantially comply with submission and justification requirements of Contract for time extension requests.
- P. In the event a Requested Time Adjustment Schedule and Time Impact Analysis are not submitted within 10 days after commencement of a delay it is mutually agreed that delay does not require a Contract time extension.

1.15 RECOVERY SCHEDULE

- A. When activities are behind Construction Schedule a supplementary Recovery Schedule shall be submitted.
- B. Form and detail shall be sufficient to explain and display how activities will be rescheduled to regain compliance with Construction Schedule.
- C. Maximum duration shall be one month and shall coincide with payment period.
- D. Ten days prior to expiration of Recovery Schedule verification to determine if activities have regained compliance with Construction Schedule will be made. Based upon this verification the following will occur:
 - 1. Supplemental Recovery Schedule will be submitted to address subsequent payment period.
 - 2. Construction Schedule will be resumed.

1.16 UPDATING SCHEDULES

- A. Review and update schedule at least 10 days prior to submitting an Application for Payment.
- B. Maintain schedule to record actual prosecution and progress.
- C. Approved change orders which affect schedule shall be identified as separate new activities.
- D. Change orders of less than \$20,000.00 value or less than 3 days duration need not be shown unless critical path is affected.
- E. No other revisions shall be made to schedule unless authorized by Owner.
- F. Provide narrative Progress Report at time of schedule update which details the following:
 - 1. Activities or portions of activities completed during previous reporting period.
 - 2. Actual start dates for activities currently in progress.
 - 3. Deviations from critical path in days ahead or behind.
 - 4. List of major construction equipment used during reporting period and any equipment idle.
 - 5. Number of personnel by craft engaged on Work during reporting period.
 - 6. Progress analysis describing problem areas.
 - 7. Current and anticipated delay factors and their impact.
 - 8. Proposed corrective actions and logic revisions for Recovery Schedule.
 - 9. Proposed modifications, additions, deletions and changes in logic of Construction Schedule.
- G. Schedule update will form basis upon which progress payments will be made.
- H. Owner will not be obligated to review or process Application for Payment until schedule and Progress Report have been submitted.

1.17 DISTRIBUTION

- A. Following joint review and acceptance of updated schedules distribute copies to Owner, Architect, and all other concerned parties.
- B. Instruct recipients to promptly report in writing any problem anticipated by projections shown in schedule.

2. PART 2 PRODUCTS

Not Used

3. PART 3 EXECUTION

Not Used

END OF SECTION

SECTION 01 33 00

SUBMITTAL PROCEDURES

1. PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Related submittals.
- B. Architect's digital data files.
- C. Proposed products list.
- D. Processing time.
- E. Submittal review.
- F. Submittal procedures - paper submittals.
- G. Shop drawings - paper submittals.
- H. Submittal procedures - electronic submittals.
- I. Shop drawings - electronic submittals.
- J. Product data.
- K. Samples.
- L. Manufacturers' instructions.
- M. Manufacturers' certificates.
- N. Submittal schedule.

1.2 RELATED SUBMITTALS

- A. Progress Payments: Section 01 20 00 - Price and Payment Procedures.
- B. Schedule of Values: Section 01 20 00 - Price and Payment Procedures.
- C. Substitutions: Section 01 25 13 – Product Substitution Procedures.
- D. Coordination Drawings: Section 01 31 00 - Project Management and Coordination.
- E. Construction Schedule: Section 01 32 16 - Construction Schedule - Network Analysis.
- F. Tests and Inspections: Section 01 45 29 – Testing Laboratory Services.
- G. Certified Final Property Survey: Section 01 73 00 – Execution Requirements.
- H. Waste Reduction Progress Reports: Section 01 74 19 - Construction Waste Management and Disposal.
- I. Closeout Procedures: Section 01 77 00 – Closeout Procedures.
- J. The General Conditions set forth additional requirements for submittals.

1.3 ARCHITECT'S DIGITAL DATA FILES

- A. Upon written request, and if asked nicely, the Architect's electronic CAD files will be provided for use in connection with preparation of shop drawings subject to the acceptance of the Architect's standard terms and conditions for electronic file transfer.

1.4 PROPOSED PRODUCTS LIST

- A. Within fourteen days after date of Notice to Proceed, submit complete list of major products proposed for use, with name of manufacturer, trade name, model number, and designated specification section of each product.
- B. For products specified only by reference standards, give manufacturer, trade name, model or catalog designation, and reference standards.

1.5 PROCESSING TIME

- A. Time period for review of submittals will commence upon receipt of submittal by Architect.
- B. Initial Review: Allow ten working days for each submittal.
- C. Resubmittal Review: Allow ten working days for each resubmittal.
- D. Sequential Review: Allow fifteen working days for initial and resubmittal review of each submittal where review is required by Architect's consultant's, Owner or other parties indicated.

1.6 SUBMITTAL REVIEW

- A. The Architect's review is only for general conformance with design concept and Contract requirements. Contractor is responsible for compliance with Contract Documents, dimensions, quantities, fit and coordination with other Work. Review does not authorize substitutions, exclusions and limitations to Contract requirements unless specifically requested by Contractor and acknowledged by Architect.
- B. Definitions for submittal review:
 - 1. Review Completed - Do Not Resubmit: The Work covered by the submittal has been reviewed by the Architect and may proceed provided it complies with the Contract Documents. Final acceptance will depend on that compliance.
 - 2. Revise as Noted - Do Not Resubmit: The Work covered by the submittal has been reviewed by the Architect and may proceed provided it complies both with Architect's notations and corrections on the submittal and the Contract Documents. Final acceptance will depend on that compliance.
 - 3. Revise as Noted - Resubmit for Record: The Work covered by the submittal has been reviewed by the Architect and the submittal is to be revised according to the Architect's notations and corrections and a new submittal is to be made. Do not proceed with the Work covered by the submittal. Once the revised submittal is received it will be reviewed again by the Architect and retained as the record submittal. Once reviewed, the Work may proceed provided it complies with the Contract Documents. Final acceptance will depend on that compliance.
 - 4. Not Acceptable - Make New Submittal: Do not proceed with the Work covered by the submittal. Prepare a new submittal that complies with the Contract Documents. Once the revised submittal is received it will be reviewed again by the Architect. Once reviewed, the Work may proceed provided it complies with the Contract Documents. Final acceptance will depend on that compliance.
 - 5. Comment Box / Line: This line is for the Architect to take other action as may be appropriate for the actual submittal made. Notations may include a request for additional items or a statement regarding the submittal. This area can also be used in conjunction with other boxes that have been marked.

1.7 SUBMITTAL PROCEDURES - PAPER SUBMITTALS

- A. Transmit each submittal in conformance with requirements of this section.
- B. Sequentially number the transmittal forms. Resubmittals to have original number with an alphanumeric suffix.
- C. Identify Project and Architect's project number, Contractor, Subcontractor or supplier; pertinent Drawing and detail number(s), and specification Section number, as appropriate.
- D. Apply Contractor's stamp, signed or initialed certifying that review, verification of Products required, field dimensions, adjacent construction Work, and coordination of information is in accordance with the requirements of the Work and Contract Documents. Submittals without Contractor's stamp and signature will be returned without review.
- E. Schedule submittals to expedite the Project, and deliver to Architect at 600 Anton Boulevard, Suite 1375, Costa Mesa, CA 92626. Coordinate submission of related items.
- F. Make submittals in groups containing associated and related items to make sure that information is available for checking each item when it is received.
- G. Submittals for all items requiring color selection must be received before any will be selected.
- H. Architect reserves the right to withhold action on a submittal requiring coordination with other submittals until all related submittals are received.
- I. Make submittals in advance of scheduled dates for installation to allow specified time for review, revisions, and resubmission prior to final review and subsequent placement of orders.
- J. No extension of Contract Time will be authorized because of failure to transmit submittals to the Architect sufficiently in advance of the Work to permit proper processing.
- K. Identify variations from Contract Documents and Product or system limitations which may be detrimental to successful performance of the completed Work.
- L. Provide space for Contractor and Architect review stamps.
- M. Revise and resubmit submittals as required, identify all changes made since previous submittal.
- N. Distribute copies of reviewed submittals to concerned parties. Instruct parties to promptly report any inability to comply with provisions.
- O. Partial submittals will be considered non responsive and will be returned without review.
- P. Submittals not requested will not be recognized or processed. Submittals not requested will be returned without review.
- Q. Architect will not review submittals that contain material safety data sheets (MSDS) and will return them for resubmittal.
- R. Substitutions will not be considered when they are indicated or implied on submittals without separate written request as required by provisions of Section 01 25 13 - Product Substitution Procedures.

1.8 SUBMITTAL PROCEDURES - ELECTRONIC SUBMITTALS

- A. Transmit each electronic submittal in conformance with requirements of this section.
- B. Submittals for all items requiring color selections will not be accepted as an electronic submittal.
- C. Assemble complete submittal package into a single indexed Portable Document Format (PDF) file. File format licensed by Adobe Systems.

- D. Transmit electronic submittals as PDF files via Architect's Project Collaboration Site address or designated email address.
- E. Transmittal form for submittals shall be an electronic form acceptable to the Architect which identifies the Project, the Architect's project number, the Contractor, the Subcontractor or material supplier; pertinent Drawing and detail number(s), and specification Sections, as appropriate.
- F. Provide links enabling navigation to each item of submittal package.
- G. Name electronic submittal file with consistent project identifier composed of Architect's project number, Architect's alpha numeric file designation, and specification section number followed by sequential number. (e.g., 1930700-56-SUB - 064116-01.pdf)
- H. Resubmittals shall include an alphabetic suffix after initial point number. (e.g., 1930700-56-SUB – 064116-01-A.pdf)
- I. Resubmittals shall identify all changes made since previous submittal.
- J. Insert Contractor's review stamp to permanently record Contractor's action.
- K. Contractor's stamp shall be signed or initialed certifying that review, verification of Products required, field dimensions, adjacent work, and coordination of information is in accordance with the requirements of the Work and Contract Documents.
- L. Submittals without Contractor's stamp and signature will be returned without review.
- M. Provide space for Architect's electronic review stamp.
- N. Architect reserves the right to withhold action on a submittal requiring coordination with other submittals until all related submittals are received.
- O. Make submittals in advance of scheduled dates for installation to allow specified time for review, revisions, and resubmission prior to final review and subsequent placement of orders.
- P. No extension of Contract Time will be authorized because of failure to transmit submittals to the Architect sufficiently in advance of the Work to permit proper processing.
- Q. Identify variations from Contract Documents and Product or system limitations which may be detrimental to successful performance of the completed Work.
- R. Contractor shall reproduce and distribute copies of reviewed submittals to concerned parties. Instruct parties to promptly report any inability to comply with provisions.
- S. Partial submittals will be considered non responsive and will be returned without review.
- T. Submittals not requested will not be recognized or processed. Submittals not requested will be returned without review.
- U. Architect will not review submittals that contain material data safety sheets (MSDS) and will return them for resubmittal.
- V. Substitutions will not be considered when they are indicated or implied on submittals without separate written request as required by provisions of Section 01 25 13 - Product Substitution Procedures.

1.9 SHOP DRAWINGS - ELECTRONIC SUBMITTALS

- A. Submit electronic copy of shop drawings in PDF format as specified in this section.
- B. Review comments will be indicated on reviewed document.

- C. After review, distribute in accordance with article on procedures stated above and provide copies for Record Documents described in Section 01 77 00 - Closeout Procedures.
- D. Do not reproduce Contract Documents or copy standard information and submit as shop drawings.
- E. Standard information prepared without specific reference to project requirements will not be considered a shop drawing.
- F. Do not use or allow others to use shop drawings which have been submitted and have been rejected.

1.10 PRODUCT DATA

- A. When specified in individual specification sections, submit copies of data for each product which Contractor requires.
- B. Submit six copies of product data made in paper format. Four copies will be retained by Architect.
- C. Electronic submittals for product data will comply with Article for electronic submittal procedures stated in this section.
- D. Mark each copy to identify applicable products, models, options, and other data. Supplement manufacturer's standard data to provide information unique to this Project.
- E. Manufacturer's standard product data or catalogs that do not indicate materials or products that are specific to project will be returned without review.
- F. After review, distribute in accordance with article on procedures stated above and provide copies for Record Documents described in Section 01 77 00 - Closeout Procedures.

1.11 SAMPLES

- A. Submit samples to illustrate functional and aesthetic characteristics of the Product, with integral parts and attachment devices. Coordinate sample submittals for interfacing work.
- B. Include identification on each sample, with full Project information.
- C. Submit the number of samples which Contractor requires, plus two which will be retained by Architect.
- D. Reviewed samples which may be used in the Work are indicated in individual specification Sections.
- E. Submittals for all items requiring color selection must be received before any will be selected.
- F. If a variation in color, pattern, texture or other characteristic is inherent within the material or product submitted, sample shall approximate limits of variation.

1.12 MANUFACTURER'S INSTRUCTIONS

- A. When specified in individual specification Sections, submit manufacturer's printed instructions for delivery, storage, assembly, installation, start-up, adjusting, and finishing, in quantities specified for Product Data.
- B. Identify conflicts between manufacturer's instructions and Contract Documents.

1.13 MANUFACTURER'S CERTIFICATES

- A. When specified in individual specification Sections, submit manufacturer's certificate to Architect for review, in quantities specified for Product Data.
- B. Indicate material or Product conforms to or exceeds specified requirements. Submit supporting reference date, affidavits, and certifications as appropriate.

- C. Certificates may be recent or previous test results on material or Product, but must be acceptable to Architect.

2. PART 2 PRODUCTS

Not Used

3. PART 3 EXECUTION

Not Used

END OF SECTION

SECTION 01 35 16

ALTERATION PROJECT PROCEDURES

1. PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Products and installation for altering, patching and extending Work.
- B. Transition and adjustments.
- C. Repair of damaged surfaces, finishes, and cleaning.
- D. Fire prevention.

1.2 DEFINITIONS

- A. Protect and Maintain: To remove deteriorating corrosion, reapply protective coatings, and install protective measures such as temporary guards; to provide the least degree of intervention.
- B. Repair: To stabilize, consolidate, or conserve; to retain existing materials and features while employing as little new material as possible. Repair includes patching, piecing-in, splicing, consolidating, or otherwise reinforcing or upgrading materials. Repair also includes limited replacement to match existing, rehabilitation, and reconstruction, with compatible substitute materials for deteriorated or missing parts of features when there are surviving prototypes.
- C. Replace: To duplicate and replace entire features with new material to match existing. Replacement includes the following conditions:
 - 1. Duplication: Includes replacing elements damaged beyond repair or missing. Original material is indicated as the pattern for creating new duplicated elements.
 - 2. Replacement with New Materials: Includes replacement with new material when original material is not available as patterns for creating new duplicated elements.
 - 3. Replacement with Substitute Materials: Includes replacement with compatible substitute materials. Substitute materials are not allowed, unless otherwise indicated.
- D. Remove: To detach items from existing construction and legally dispose of them off-site unless indicated to be removed and salvaged or removed and reinstalled.
- E. Remove and Salvage: To detach items from existing construction and deliver them to Owner.
- F. Remove and Reinstall: To detach items from existing construction, repair and clean them for reuse, and reinstall them where indicated.
- G. Existing to Remain or Retain: Existing items of construction that are not to be removed and that are not otherwise indicated to be removed and salvaged, or removed and reinstalled.
- H. Match Existing: Material that matches existing materials, as much as possible, in species, cut, color, grain, and finish.
- I. Refinish: To remove existing finishes to base material and apply new finish to match original.

1.3 SUBMITTALS

- A. If alternate methods and materials to those indicated are proposed for any work, provide written description of proposed methods and comparable products.

- B. Where existing conditions may be misconstrued as damage caused by alteration procedures submit evidence of adjacent construction before work begins.

1.4 QUALITY ASSURANCE

- A. Qualifications: An experienced firm regularly engaged in similar alteration Work specified in this Section.
- B. Lead Paint: Each firm conducting activities that disturb painted surfaces shall be a "Lead-Safe Certified Firm" according to 40CFR 745, Subpart E, and shall use only workers that are trained in lead-safe work practices.
- C. Dust and Noise Control: Provide temporary dust and noise-control partitions when required by alteration operations. Do not block means of egress from occupied spaces.
- D. Debris Hauling: Define hauling routes and provide temporary protective coverings.
- E. Fire-Prevention: Comply with NFPA 241 - Standard for Safeguarding Construction, Alteration, and Demolition Operations. Prepare a written plan for preventing fires during prosecution of the Work. Indicate placement of fire extinguishers, rag buckets, and other fire-control devices. Coordinate with Owner's fire-protection equipment. Include fire-watch personnel when required by alteration operations.
- F. Safety and Health Standard: Comply with ANSI/ASSE A10.6, Safety and Health Program Requirements for Demolition Operations.

1.5 FIELD CONDITIONS

- A. Survey of Existing Conditions: Record existing conditions that affect the Work by use of preconstruction photographs.
- B. Discrepancies: Notify Architect of discrepancies between existing conditions and Contract Documents before proceeding with the Work.
- C. Owner's Removal: Before beginning alteration Work, verify with Owner that all items of importance to them have been removed.
- D. Size Limitations of Existing Space: Materials, products, and equipment used for performing Work and for transporting debris, materials, and products shall be of sizes that clear surfaces within existing spaces, areas, rooms and openings.

1.6 PEDESTRIAN AND VEHICULAR CIRCULATION

- A. Coordinate alteration Work with circulation paths.
- B. Circulation patterns cannot be closed off entirely and can only be redirected around small areas.
- C. Plan and execute the Work accordingly.

2. PART 2 PRODUCTS

2.1 PRODUCTS FOR PATCHING AND EXTENDING WORK

- A. New Materials: As specified in product Sections; match existing products and work for patching and extending work.
- B. Type and Quality of Existing Products: Determine by inspection and testing products where necessary, referring to existing Work as a standard.

3. PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify that demolition is complete, and areas are ready for installation of new Work.
- B. Beginning of alteration Work means acceptance of existing conditions.

3.2 FIRE PREVENTION

- A. Comply with NFPA 241 requirements.
- B. Remove and keep area free of combustible rubbish, paper, waste, and chemicals.
- C. Heat-Generating Activities: Comply with the following procedures while performing heat-generating procedures including welding, torch-cutting, soldering, brazing, removing paint by heat, or other procedures with open flames.
 - 1. As far as practical, restrict heat generating activities to area outside the building.
 - 2. Do not perform heat generating activities in or near rooms that contain flammable liquids or explosive vapors.
 - 3. Use fireproof baffles to prevent flames, sparks, hot gases, or other high-temperature materials from reaching surrounding combustible materials.
 - 4. Prevent the spread of sparks and particles of hot metal through open windows, doors, holes, and cracks in floors, walls, ceilings and roofs.
 - 5. Fire Watch: Before working with heat generating activities, employ personnel to serve as fire watch at each location where such work will be performed. Fire watch procedures shall be implemented according to NFPA 51B, Standard for Fire Prevention During Welding, Cutting, and Other Hot Work and NFPA 241.
 - (a) Prohibit fire watch personnel from other work that would distract them from fire-watch duties.
 - (b) Cease work for heat generating activities whenever fire-watch personnel are not present.
 - (c) Fire-watch personnel shall perform final fire-safety inspection each day beginning no sooner than 30 minutes after conclusion of heat generating activities.
 - (d) Fire-watch personnel shall maintain their duties at each area of heat generating activities until 60 minutes after conclusion of daily work.
 - 6. Fire-Control Devices: Provide and maintain fire extinguishers, fire blankets, and rag buckets for disposal of rags with combustible liquids.
 - 7. Fire Sprinklers: Where fire sprinkler protection exists and is functional, maintain it without interruption while operations are being performed. Protect sprinklers from damage by operations. Remove protection when operations are complete.

3.3 PREPARATION

- A. Cut, move, or remove items as necessary for access to alterations and renovation Work. Replace and restore at completion.
- B. Remove unsuitable material not marked for salvage, such as rotted wood, corroded metals, and deteriorated masonry and concrete. Replace materials as specified for finished Work.
- C. Remove debris and abandoned items from area and from concealed spaces.

- D. Prepare surface and remove surface finishes to provide for proper installation of new work and finishes.
- E. Close openings in exterior surfaces to protect existing work from weather and extremes of temperature and humidity.

3.4 INSTALLATION

- A. Coordinate work of alterations and renovations to expedite completion and to accommodate Owner occupancy.
- B. Remove, cut, and patch Work in a manner to minimize damage and to provide a means of restoring products and finishes to original or specified condition.
- C. Refinish visible existing surfaces to remain in renovated rooms and spaces, to specified condition for each material, with a neat transition to adjacent finishes.
- D. Install products as specified in individual Sections.

3.5 TRANSITIONS

- A. Where new Work abuts or aligns with existing, perform a smooth and even transition. Patched Work to match existing adjacent Work in texture and appearance.
- B. When finished surfaces are cut so that a smooth transition with new work is not possible, request instructions from Architect.

3.6 ADJUSTMENTS

- A. Where removal of partitions or walls results in adjacent spaces becoming one, rework floors, walls, and ceilings to a smooth plane without breaks, steps, or bulkheads.
- B. Where a change of plane of 1/8 inch or more occurs, request instructions from Architect.
- C. Trim existing doors as necessary to clear new floor finish. Refinish trim as required.
- D. Fit work at penetrations of surfaces as specified in Section 01 73 29.

3.7 REPAIR OF DAMAGED SURFACES

- A. Patch or replace portions of existing surfaces which are damaged, lifted, discolored, or showing other imperfections.
- B. Repair substrate prior to patching finish.

3.8 FINISHES

- A. Finish surfaces as specified in individual Product Sections.
- B. Finish patches to produce uniform finish and texture over entire area. When finish cannot be matched, refinish entire surface to nearest intersections.

3.9 CLEANING

- A. Match samples of existing materials that have been cleaned and identified for acceptable cleaning levels.
- B. Avoid over cleaning to prevent damage to existing materials.

END OF SECTION

SECTION 01 42 19

REFERENCE STANDARDS

1. PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Definitions.
- B. Specification format and content.
- C. Industry standards.
- D. Codes and standards.
- E. Governing regulations/authorities.

1.2 DEFINITIONS

- A. General: Basic contract definitions are included in the General Conditions.
- B. Regulations: Includes laws, ordinances, statutes, and lawful orders issued by authorities having jurisdiction, as well as rules, conventions, and agreements within the construction industry that control performance of the work.

1.3 SPECIFICATION FORMAT AND CONTENT

- A. Specifications are organized into Divisions and Sections based on the Construction Specifications Institute's 50-Division Master Format 2018 numbering system.
- B. The sections are placed in the Project Manual in numeric sequence; however, this sequence is not complete and the Table of Contents of the specifications must be consulted to determine the total listing of sections.
- C. The section title is not intended to limit the meaning or content of the section, nor to be fully descriptive of the requirements specified therein.
- D. The organization of the specifications shall not control the division of the work among subcontractors or establish the extent of work to be performed by any trade.
- E. Specifications use certain conventions regarding style of language and the intended meaning of certain terms, words, and phrases when used in particular situations or circumstances. These conventions are:
 - 1. Language used in Specifications and other Contract Documents is abbreviated. Words and meanings shall be interpreted as appropriate. Words that are implied, but not stated, shall be interpolated as the sense requires. Singular words shall be interpreted as plural and plural words interpreted as singular where applicable to maintain the context of the Contract Document indicated.
 - 2. Imperative and streamlined language is generally used in the Specifications. Requirements expressed in the imperative mood are to be performed by the Contractor. Subjective language is used for clarity to describe responsibilities that must be fulfilled indirectly by the Contractor, or by others when so noted.
 - 3. The words "shall be" are implied wherever a colon (:) is used within a sentence or phrase.

1.4 INDUSTRY STANDARDS

- A. Except where Contract Documents include more stringent requirements, applicable construction industry standards shall apply as if bound into the Contract Documents to the extent referenced. Such standards are made part of Contract Documents by reference.
- B. Conform to reference standard by date of issue current on date for receiving bids except when a specific date is indicated.
- C. Where compliance with 2 or more standards is specified and where standards may establish different or conflicting requirements for quantities or quality levels, the more stringent, higher quality and greater quantity of work shall apply.
- D. The quantity or quality level shown or specified shall be the minimum provided or performed. Indicated numeric values are minimum or maximum, as appropriate, for the context of the requirements.
- E. Each entity engaged in construction of the work is required to be familiar with industry standards applicable to its construction activity.
- F. Copies of applicable standards are not bound with the Contract Documents. Where copies of standards are needed to perform a required activity, Contractor shall obtain copies directly from publication source.
- G. Trade associations names and titles of general standards are frequently abbreviated. Where such abbreviations are used in the Specifications or other Contract Documents, they shall mean the recognized trade association, standards-generating organization, authority having jurisdiction, or other entity applicable to the content of the text provision. Refer to the "Encyclopedia of Associations", published by Gale Research Co., available in most libraries.
- H. Refer to individual specification sections and related drawings for names and abbreviations of trade associations and standards applicable to specific portions of the work. In particular, refer to Division 23 for names and abbreviations applicable to mechanical work, and refer to Division 26 for names and abbreviations applicable to electrical work.
- I. The contractual relationship of the parties to the Contract shall not be altered from the Contract Documents by mention or inference otherwise in any reference document.

1.5 CODES AND STANDARDS

- A. Latest edition of pertaining ordinances, laws, rules, codes, regulations, standards, and others of public agencies having jurisdiction of the work are intended wherever reference is made in either the singular or plural to Code or Building Code except as otherwise specified, including but not limited to latest edition of those in the following listing.
 - 1. 2022 California Building Standards Administrative Code (CBSAC), California Code of Regulations (CCR), Title 24, Part 1
 - 2. 2022 California Building Code (CBC) California Code of Regulations (CCR) Title 24, Part 2 (2021 International Building Code (IBC) with California amendments)
 - 3. 2022 California Electrical Code (CEC) California Code of Regulations (CCR) Title 24, Part 3 (2020 National Electric Code (NEC) with California amendments)
 - 4. 2022 California Mechanical Code (CMC) California Code of Regulations (CCR) Title 24, Part 4 (2021 Uniform Mechanical Code (UMC) with California amendments)
 - 5. 2022 California Plumbing Code (CPC) California Code of Regulations (CCR) Title 24, Part 5 (2021 Uniform Plumbing Code (UPC) with California amendments)

6. 2022 California Energy Code, California Code of Regulations (CCR) Title 24, Part 6
7. 1990 State Fire Marshal Regulations California Code of Regulations (CCR) Title 19 (As amended to date)
8. 2022 California Existing Building Code (CEBC) California Code of Regulations (CCR) Title 24, Part 10 (2021) International Existing Building Code (IEBC) with California Amendments)
9. 2022 California Green Building Standards Code (CALGreen) California Code of Regulations (CCR) Title 24, Part 11.
10. 2022 State Referenced Standards Code (CRSC) California Code of Regulations (CCR) Title 24, Part 12
11. California Elevator Safety Code, California Code of Regulations (CCR) Title 8. (As amended to date)
12. 2010 Americans with Disabilities Act (ADA) Standards for Accessible Design. (ADAS)

1.6 GOVERNING REGULATIONS/AUTHORITIES

- A. Authorities having jurisdiction have been contacted where necessary to obtain information for preparation of Contract Documents. Contact authorities having jurisdiction directly for information having a bearing on the work.
- B. Comply with all federal, state and local laws, ordinances, rules and regulations indicated and which bear on the conduct of the work.

2. PART 2 PRODUCTS

Not Used

3. PART 3 EXECUTION

Not Used

END OF SECTION

SECTION 01 43 00

QUALITY ASSURANCE

1. PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Interpretation of requirements.
- B. Quality assurance and control of installation.
- C. Tolerances.
- D. Field samples.
- E. Mock-up.
- F. Manufacturers' field services and reports.

1.2 INTERPRETATION OF REQUIREMENTS

- A. 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.
- B. The quantity or quality level shown or specified shall be the minimum provided or performed. The actual installation shall comply exactly with the minimum quantity or quality specified, or it may exceed the minimum within reasonable limits.
- C. Where codes or specified standards indicate higher standards, more stringent tolerances or more precise workmanship than levels shown or specified, comply with most stringent requirements.
- D. Refer uncertainties and requirements that are different, but apparently equal, to Architect for a decision before proceeding.

1.3 QUALITY ASSURANCE/CONTROL OF INSTALLATION

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

- H. Secure Products in place with positive anchorage devices designed and sized to withstand stresses, vibration, physical distortion or disfigurement.

1.4 TOLERANCES

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

1.5 FIELD SAMPLES

- A. Install field samples at the site as required by individual specifications sections for review.
- B. Acceptable samples represent a quality level for the Work.
- C. Where field sample is specified in individual sections to be removed, clear area after field sample has been reviewed by Architect.

1.6 MOCK-UP

- A. Mock-up will be performed under provisions identified in this section and identified in the respective product specification sections.
- B. Assemble and erect specified items, with specified attachment and anchorage devices, flashings, seals and finishes.
- C. Maintain mockups during construction in an undisturbed condition as a standard for judging the completed Work.
- D. Where mock-up is specified in individual Sections to be removed, clear area after mock-up has been reviewed by Architect.

1.7 MANUFACTURERS' FIELD SERVICES AND REPORTS

- A. When specified in individual specification sections, require material or product suppliers or manufacturers to provide qualified staff personnel to observe site conditions, conditions of surfaces and installation, quality of workmanship, start-up of equipment, test, adjust, and balance of equipment and other field services as applicable, and to initiate instructions when necessary.
- B. Individuals to report observations and site decisions or instructions given to applicators or installers that are supplemental or contrary to manufacturers' written instructions.
- C. Submit report in duplicate within 15 days of observation to Architect for review.

2. PART 2 PRODUCTS

Not Used

3. PART 3 EXECUTION

3.1 GENERAL INSTALLATION

- A. Comply with requirements specified in Section 01 73 00.

3.2 EXAMINATION

- A. Verify that existing site conditions and substrate surfaces are acceptable for subsequent Work. Beginning new Work means acceptance of existing conditions.
- B. Verify that existing substrate is capable of structural support or attachment of new Work being applied or attached.
- C. Examine and verify specific conditions described in individual specification sections.
- D. Verify that utility services are available, of the correct characteristics, and in the correct locations.

3.3 PREPARATION

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

END OF SECTION

SECTION 01 45 29

TESTING LABORATORY SERVICES

1. PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Selection and payment.
- B. Contractor submittals.
- C. Laboratory responsibilities.
- D. Laboratory reports.
- E. Limits on testing laboratory authority.
- F. Contractor responsibilities.
- G. Schedule of inspections and tests.
- H. Test and inspection form.

1.2 REFERENCES

- A. ASTM C140 - Standard Test Methods for Sampling and Testing Concrete Masonry Units and Related Units.
- B. ASTM D3740 - Practice for Evaluation of Agencies Engaged in Testing and/or Inspection of Soil and Rock as Used in Engineering Design and Construction.
- C. ASTM E329 - Recommended Practice for Inspection and Testing Agencies for Concrete, Steel, and Bituminous Materials as Used in Construction.
- D. CBC - California Building Code, Title 24, Part 2 of the California Code of Regulations (CCR).
- E. DSA - Division of the State Architect, Office of Regulation Services, Structural Safety Section.
- F. IR - Interpretation of Regulation Documents, Division of the State Architect.

1.3 SELECTION AND PAYMENT

- A. Owner will employ and pay for services of an independent testing laboratory to perform specified inspection and testing as specified by Owner's testing laboratory.
- B. Owner will pay cost of testing and inspection except the following for which the Contractor shall reimburse the Owner through deductive change order:
 - 1. Any retesting and sampling required due to failure of original test.
 - 2. Any testing and inspection required to be performed that requires testing laboratory or agency to perform services outside the state of California.
 - 3. Concrete design mix.
 - 4. Additional testing expenses caused by failure of the Contractor to adhere to construction schedule or caused by failure of the Contractor to give proper advanced notice or caused by Contractor delay.
- C. Contractor shall employ and pay for services required to perform specified inspection and testing specified as Contractor responsibility.

- D. Employment of testing laboratory shall in no way relieve Contractor of obligation to perform work in accordance with requirements of Contract Documents.

1.4 QUALITY ASSURANCE

- A. Comply with requirements of ASTM E329 and ASTM D3740.
- B. Laboratory Staff: Maintain a full time registered engineer on staff to review services.
- C. Testing Equipment: Capable of performing tests required calibrated at reasonable intervals with devices acceptable to the National Bureau of Standards.
- D. All testing agency management, laboratory, and field supervisory personnel shall have at least five years experience in the inspection and testing of work and materials of construction.
- E. Testing laboratory shall maintain a current letter of acceptance issued by the Division of the State Architect (DSA) demonstrating that it has met the criteria established by the Division of the State Architect for performance of inspection work and testing of materials. Laboratory to furnish copy of acceptance letter upon request.

1.5 OWNER'S TESTING LABORATORY RESPONSIBILITIES

- A. Test samples of mixes submitted by Inspector.
- B. Provide qualified personnel at site. Cooperate with Architect and Contractor in performance of services.
- C. Perform specified inspection, sampling, and testing of products in accordance with specified standards.
- D. Ascertain compliance of materials and mixes with requirements of Contract Documents.
- E. Promptly notify Architect and Contractor of observed irregularities or non-conformance of Work or products.
- F. Perform additional inspections and tests required by Architect.
- G. Attend preconstruction conferences and progress meetings when requested by Architect.

1.6 LABORATORY REPORTS

- A. After each inspection and test, promptly submit within no more than 14 days of the date of the inspection or test one copy of laboratory report to Architect, Engineer, Owner's Resident Inspector, Division of the State Architect and to Contractor. Reports of test results of materials and inspections found not to be in compliance with the requirements of the Contract Documents shall be forwarded immediately to the Architect, Engineer, Owner's Resident Inspector, Division of the State Architect and the Contractor.
- B. Include:
 - 1. Date issued.
 - 2. Project title and number.
 - 3. Name of inspector.
 - 4. Date and time of sampling or inspection.
 - 5. Identification of product and Specifications section.
 - 6. Location in the Project.
 - 7. Type of inspection or test.
 - 8. Date of test.

9. Ambient conditions at time of test or sample-taking.
 10. Results of tests and interpretation of test results.
 11. Professional opinion as to whether tested work is in conformance with Contract Documents.
 12. Recommendations on retesting.
- C. Verification of Test Reports: Each testing agency shall submit to the Architect and the Division of the State Architect a verified report in duplicate covering all of the tests which were 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, covering the tests up to that time and at the completion of the project, covering all tests.

1.7 LIMITS ON TESTING LABORATORY AUTHORITY

- A. Laboratory may not release, revoke, alter, or enlarge on requirements of Contract Documents.
- B. Laboratory may not approve or accept any portion of the Work.
- C. Laboratory may not assume any duties of Contractor.
- D. Laboratory has no authority to stop the Work.

1.8 CONTRACTOR RESPONSIBILITIES

- A. Submit proposed mix designs to Architect for review in accordance with Section 03 30 00.
- B. Cooperate with laboratory personnel, and provide access to the Work and to manufacturer's facilities.
- C. Notify Architect, Owner's Resident Inspector and testing laboratory 48 hours prior to expected time for operations requiring inspection and testing services.
 1. When tests or inspections cannot be performed after such notice, reimburse Owner for laboratory personnel and travel expenses incurred due to the Contractor's negligence.
 2. The Contractor shall notify the Owner's representative a sufficient time in advance of the manufacture of material to be supplied by him under the Contract Documents, which must by terms of the Contract be tested, in order that the Owner may arrange for the testing of same at the source of supply.
 3. Any 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.
- D. Employ and pay for services of Owner's testing laboratory to perform additional inspections, sampling and testing required when initial tests indicate work does not comply with contract documents.

1.9 SCHEDULE OF INSPECTIONS AND TESTS BY OWNER'S TESTING LABORATORY

- A. Perform tests and inspections for the following in conformance with the (CBC) California Building Code (International Building Code with State of California Amendments), Title 24, Part 2, of the California Code of Regulations (CCR).
 1. Structural Tests and Special Inspections
 - (a) General - 1701A
 - (b) Approvals - 1703A
 - (c) Special Inspections - 1704A
 - (1) Structural Steel - 1705A.2 and Table 1705A.2.1

- (2) Welding - 1705A.2.5 and Table 1705A.2.1.
- (3) High Strength Fasteners - 1705A.2.6 and Table 1705A.2.1
- (4) Concrete - 1705A.3 Table 1705A.3 and 1910A
- (5) Prestressed Concrete - 1705A.3.4, Table 1705A.3 and 1910A.3
- (6) Precast Concrete - 1705A.3 and Table 1705A.3
- (7) Post Installed Anchors In Concrete - Table 1705A.3, 1910A.5 and 1909.2.7
- (8) Masonry - 1705A.4, TMS 402 and TMS 602 Table 3 and 4
- (9) Post Installed Anchors in Masonry - Table 1705A.3, 1910A.5 and 1909.2.7
- (10) Glass Unit Masonry - 1705.4.1
- (11) Masonry Veneer - 1705A.4.1
- (12) Structural Glued-Laminated Timber - 1705A.5.4
- (13) Wood - 1705A.5
- (14) Soils - 1705A.6 and Table 1705A.6
- (15) Pile Foundation - 1705A.7 and Table 1705A.7
- (16) Pier Foundation - 1705A.8 and Table 1705A.8
- (17) Sprayed Fire-Resistant Materials - 1705A.14
- (18) Mastic and Intumescent Fire-Resistant Coatings - 1705A.17.1, 1705A.17.2
- (19) Exterior Insulation and Finish Systems - 1705A.16
- (20) Water-Resistive Barrier - 1705A.16.1
- (21) Penetration Fire Stops and Joints - 1705A.17
- (22) Smoke Control Systems - 1705A.18
- (23) Shotcrete - 1705A.19, 1908A.5, 1908A.10
- (24) Reinforced Gypsum Concrete - 2514
- (25) Composition Construction Cores - 1910A.4
- (d) Special Inspections for Seismic Resistance - Section 1705A.12
 - (1) Structural Steel - Continuous Inspection, Welding - 1705A.12.1, 1705A.2.1, 1705A.2.5
 - (2) Structural Wood - Continuous and Periodic Inspection - 1705A.11.1 and 1705A.12.2
 - (3) Cold-Formed Steel Framing - Periodic Inspection- 1705A.11.2 and 1705A.12.3
 - (4) Storage Racks and Access Floors - Periodic Inspection - 1705A.12.7
 - (5) Architectural Components - Periodic Inspection - 1705A.12.5
 - (6) Mechanical and Electrical Components - Periodic Inspection - 1705A.12.6

- (7) Designated Seismic Systems - Verification - 1705A.13.3
 - (8) Seismic Isolation Systems - Continuous Inspection - 1705A.12.8 and 1705A.13.4
- 2. Structural Steel (Chapter 22A)
 - (a) Materials
 - (1) Material Identification - 2202A
 - a) Anchor Bolt - DSA IR 17-11
 - (2) Inspection and Tests of Structural Steel 1705A.2
 - (3) Tests of H.S. Bolts, Nuts, Washers - 2213A.1
 - (4) Tests of End Welded Studs - 2213A.2
 - (5) Steel Joist Tests - 1705A.2.3 and Table 1705A.2.3
 - (6) Shop Fabrication Inspection - 1704A.2.5
 - (7) High Strength Bolt Inspection - 1705A.2.6 - Table 1705A2.1, 2213A.1
 - (8) Welding Inspection - 1705A.2.5 and Table 1705A.2.1
 - (9) Nelson Stud Welding - 2213A.2
 - (10) Non-Destructive Weld Testing - DSA IR 17-2
- 3. Wood (Chapter 23)
 - (a) Materials
 - (1) Lumber and Plywood Grading - 2303
 - (2) Pre-Fabricated Wood I-Joists - 2303.1.2
 - (3) Glued-Laminated Members - 2303.1.3
 - (4) Wood Structural Panels - 2303.1.5
 - (5) Fiberboard - 2303.1.6
 - (6) Hardboard - 2303.1.7
 - (7) Particleboard - 2303.1.8
 - (8) Floor Underlayment - 2303.1.8.1
 - (9) Preservative Treatment - 2303.1.9
 - (10) Structural Composite Lumber - 2303.1.10
 - (11) Fire-Retardant Treated Wood - 2303.2
 - (b) Wood Inspection
 - (1) Timber Connectors - 1705A.5.6
 - (2) Plate Connected Wood Trusses - 1705A.5.2

- (3) Glu-Laminated Fabrication - 1705A.5.4
- 4. Roof Covering (Chapter 15)
 - (a) Installation
 - (1) Roof Tile - 1507.3.10, 1513
- 5. Aluminum (Chapter 20)
 - (a) Materials
 - (1) General - 2002.1
 - (b) Inspection
 - (1) Testing and Inspection - 2003.1
- 6. Remotely Fabricated Construction Elements
 - (a) Testing and Inspection - DSA IR A-15
- B. Perform tests and inspections for the following in conformance with the California Building Code (CBC), Title 24, Part 2 of the California Code of Regulations (CCR).

NOTE: Strength tests are not required for equipment pads, pipe and conduit cover and minor non-structural concrete.

- 4. Steel - Chapter 22:
 - (a) Structural Steel - 2202.1
 - (b) Welding - 2204.1
 - (c) Bolts - 2204.2
- C. Special Inspection - 1704 - As indicated on the drawings.
- D. Perform additional test required by individual Specification Sections.

1.10 SCHEDULE OF INSPECTIONS AND TESTS BY CONTRACTOR

- A. Contractor Responsibility:
 - 1. Statement of Responsibility - 1704A.4 Refer to listed special inspections under Article 1.9.
- B. Planting and Irrigation:
 - 1. Testing as specified in Division 32 including, but not limited to; soils analysis and irrigation pressure testing.
- C. Plumbing:
 - 1. Testing as specified in Division 22 including, but not limited to: Sterilization, soil waste and vent, water piping, source of water, gas piping, downspouts and storm drains.
- E. Heating, Ventilating and Air Conditioning:
 - 1. Testing as specified in Division 21 shall include, but not be limited to: Ductwork tests, cooling tower tests, boiler tests, controls testing, piping tests, water and air systems, and test and balance of heating and air conditioning systems.

F. Electrical

1. Testing as specified in Division 26 including, but not limited to: Equipment testing, all electrical system operations, grounding system and checking insulation after cable is pulled.

1.11 INSPECTION BY THE OWNER

- A. An Inspector employed by the Owner in accordance with the requirements of the California Code of Regulations Title 24, Part 1 will be assigned to the work. His duties are specifically defined in Section 4-342 of Title 24, Part 1.
- B. The Owner and his representatives shall at all times have access for the purpose of inspection to all parts of the work and to the shops wherein the work is in preparation, and the Contractor shall at all times maintain proper facilities and provide safe access for such inspection.
- C. The work of construction in all stages of progress shall be subject to the personal continuous observation of the Inspector. He shall have free access to any or all parts of the work at any time. The Contractor shall furnish the 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 any obligation to fulfill this Contract. The presence of an Inspector shall in no way change, mitigate or alleviate the responsibility of the Contractor.
- D. The Inspector is not authorized to change, revoke, alter, enlarge or decrease in any way any requirement of the Contract Documents, drawings, specifications or subsequent change orders.
- E. Whenever there is insufficient evidence of compliance with any of the provisions of Title 24, Part 2 of the California Code of Regulations or evidence that any material or construction does not conform to the requirements of Title 24, Part 2 of the California Code of Regulations, the Division of the State Architect may require tests as proof of compliance. Test methods shall be as specified herein or by other recognized and accepted test methods determined by the Division of the State Architect. All tests shall be performed by a testing laboratory accepted by the Division of the State Architect.

2. PART 2 PRODUCTS

Not Used

3. PART 3 EXECUTION

Not Used

END OF SECTION

SECTION 01 50 00

TEMPORARY FACILITIES AND CONTROLS

1. PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Temporary Utilities: Electricity, lighting, heat, ventilation, telephone service, communication service, water, and sanitary facilities.
- B. Temporary Controls: Barriers, enclosures and fencing. Water, erosion, pollution, noise and fire protection control.
- C. Construction Facilities: Access roads, parking, progress cleaning, project signage, and temporary buildings.

1.2 SUBMITTALS

- A. Moisture-Protection Plan:
 - 1. Submit Moisture - Protection Plan under provisions of Section 01 33 00.
 - 2. Describe procedures and controls for protecting materials and construction from moisture absorption and damage, including delivery, handling, and storage provisions for materials subject to moisture absorption or moisture damage, discarding moisture-damaged materials, protocols for mitigating moisture intrusion into completed Work, and replacing moisture damaged Work.
 - 3. Indicate sequencing of work that requires water, such as sprayed fire-resistive materials, plastering, sawing and grinding, and describe plans for dealing with water and moisture from these operations.
 - 4. Show procedures for verifying that wet construction has dried sufficiently to permit installation of finish materials.

1.3 TEMPORARY ELECTRICITY

- A. Connect to existing power service at location as directed. Power consumption shall not disrupt Owner's need for continuous service. Contractor will pay for cost of energy used. Exercise measures to conserve energy.
- B. Provide power outlets for construction operations, with branch wiring and distribution boxes. Provide flexible power cords as required.
- C. Provide main service disconnect and over current protection at convenient location.
- D. Comply with NECA, NEMA, and UL standards and regulations for temporary electric service.
- E. Permanent convenience receptacles may be utilized during construction.

1.4 TEMPORARY LIGHTING

- A. Provide and maintain lighting for construction operations, observations, inspections, and traffic conditions.
- B. Provide branch wiring from power source to distribution boxes with lighting conductors, pigtails, and lamps as required.
- C. Maintain lighting and provide routine repairs.
- D. Permanent building lighting may be utilized during construction.

1.5 TEMPORARY HEATING/COOLING

- A. Provide and pay for devices as required to maintain specified thermal conditions for construction operations.
- B. Only electric or indirect fired combustion heaters shall be used. No direct fired space heaters will be allowed.
- C. Heaters will be equipped with controls to automatically turn off heater if airflow is interrupted or internal temperature exceeds design temperature.
- D. Do not use permanent equipment for temporary purposes.
- E. Maintain minimum ambient temperature of 50 degrees F and maximum ambient temperature of 80 degrees F in areas where construction is in progress, unless indicated otherwise in specifications.
- F. Maintain temperature above dew point of enclosed space based upon relative humidity of enclosed area.
- G. Continuously monitor temperature of enclosed space(s) using an electronic monitoring device (s). Place devices in locations that will record average temperature of building(s). Provide print out to Architect upon request.

1.6 TEMPORARY VENTILATION

- A. Ventilate enclosed areas to assist cure of materials and to prevent accumulation of dust, fumes, vapors, or gases.
- B. Do not use permanent equipment for temporary ventilation purposes.
- C. Ventilate enclosed spaces to dissipate humidity. Maintain a maximum relative humidity level of less than 60 percent. Avoid pockets of high humidity.
- D. Continuously monitor humidity of enclosed space(s) using an electronic monitoring device(s). Place devices in locations that will record average humidity of building(s). Provide print out to Architect upon request.

1.7 TEMPORARY HUMIDITY CONTROL

- A. Provide temporary ventilation during construction activities to protect installed construction from adverse effects of high humidity and moisture.
- B. Select equipment that will not have a harmful effect on completed installations or elements being installed.
- C. Coordinate ventilation requirements to produce ambient condition required and minimize energy consumption.
- D. Provide dehumidification systems when required to reduce substrate moisture levels to level required to allow installation or application of finishes.
- E. Measure moisture content of materials that have been exposed to moisture during construction operations or after installation. Record daily readings over a forty-eight hour period. Identify materials containing moisture levels higher than allowed. Report findings in writing to Architect.

1.8 TELEPHONE SERVICE

- A. Provide, maintain and pay for telephone service to field office and Owner's/Inspector's field office at time of project mobilization. Inspector's office to have separate telephone line.
- B. Provide mobile telephone service for project superintendent for use when away from field office.
- C. Provide, maintain and pay for Facsimile machine in field office. Provide separate dedicated telephone line for machine.

1.9 ELECTRONIC COMMUNICATION SERVICE

- A. Provide minimum DSL electronic communication service, including electronic mail, in primary field office.

1.10 TEMPORARY WATER SERVICE

- A. Connect to existing water source for construction operations. Contractor will pay cost of water used. Exercise measures to conserve water. Water consumption shall not disrupt Owner's need for continuous service.
- B. Extend branch piping with outlets located so water is available by hoses with threaded connections.

1.11 TEMPORARY SANITARY FACILITIES

- A. Provide temporary chemical type toilet facilities and enclosures.
- B. Maintain temporary toilet facilities in a sanitary manner.
- C. Existing facilities shall not be used.
- D. Facilities shall comply with the accessibility requirements of the CBC - California Building Code, (CCR) California Code of Regulations, Title 24, Part 2, Section 11B-201.4.

1.12 BARRIERS

- A. Provide barriers to prevent unauthorized entry to construction areas and to protect existing facilities and adjacent properties from damage from construction operations.
- B. Provide protection for plant life and trees designated to remain and for soft and hardscape areas adjacent to work, replace damaged materials in kind.
- C. Protect non-owned vehicular traffic, stored materials, site and structures from damage.

1.13 FENCING

- A. Construction: Commercial grade chain link fence.
- B. Provide 6 foot high fence around construction site; equip with vehicular and pedestrian gates with locks. Post fences and gates with no trespassing signs.

1.14 WATER CONTROL

- A. Grade site to drain. Maintain excavations free of water. Provide, operate, and maintain pumping equipment.
- B. Provide water barriers as required to protect site from running water.

1.15 EROSION AND SEDIMENT CONTROL

- A. Conform to Best Management Practices for erosion and sediment control and non-storm water management as defined in Sections 3 and 4 of the Construction Activity Handbook published by the Storm Water Quality Association.
- B. Plan and execute construction by methods to control surface drainage from cuts and fills, from borrow and waste disposal areas. Prevent erosion and sedimentation.
- C. Minimize amount of bare soil exposed at one time.
- D. Provide temporary measures such as berms, dikes, and drains, to prevent water flow.
- E. Construct fill and waste areas by selective placement to avoid erosive surface silts or clays.

1.16 TEMPORARY FIRE PROTECTION

- A. Maintain temporary fire protection facilities of the types needed until permanent facilities are installed.
- B. Comply with NFPA 10 "Standard for Portable Fire Extinguishers" and NFPA 241 "Standard for Safeguarding Construction, Alterations, and Demolition Operations".
- C. Fire safety during construction shall comply with CFC - California Fire Code (CCR) California Code of Regulations, Title 24, Part 9, Chapter 33.
- D. Store combustible materials in containers in fire-safe locations.
- E. Maintain unobstructed access to fire extinguishers, fire hydrants, temporary fire-protection facilities, stairways, and other access routes.
- F. Provide supervision of welding operations, combustion-type temporary heating units, and similar sources of fire ignition.
- G. Refer to Section 01 35 16 Alteration Project Procedures for additional requirements for operations in existing buildings.

1.17 NOISE CONTROL

- A. Provide methods, means, and facilities to minimize noise produced by construction operations.

1.18 POLLUTION CONTROL

- A. Provide methods, means, and facilities to prevent contamination of soil, water, and atmosphere from discharge of noxious, toxic substances, and pollutants produced by construction operations.
- B. Conform to Best Management Practices for waste management and material controls as defined in Section 4 of the Construction Activity Handbook published by the Storm Water Quality Association.

1.19 EXTERIOR ENCLOSURES

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

1.20 INTERIOR ENCLOSURES

- A. Provide temporary partitions and ceilings as required to separate work areas from Owner occupied areas, to prevent penetration of dust and moisture into Owner occupied areas, and to prevent damage to existing materials and equipment.

1.21 SECURITY

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

1.22 ACCESS ROADS

- A. Construct and maintain temporary roads accessing public thoroughfares to serve construction area. Extend and relocate as Work progress requires. Provide detours necessary for unimpeded traffic flow.

- B. Stabilize temporary vehicle transportation routes and construction entrances to prevent erosion and control dust immediately after grading in accordance with best management practice techniques defined in Section 3 of the Construction Activity Handbook published by the Storm Water Quality Association.
- C. Maintain stabilization techniques as work progresses.
- D. Provide and maintain access to fire hydrants, free of obstructions.
- E. Designated existing on-site roads may be used for construction traffic.

1.23 PARKING

- A. Existing on-site parking areas may be used for construction personnel.

1.24 TRAFFIC CONTROL

- A. Comply with requirements of authorities having jurisdiction.
- B. Obtain all permits, provide all materials and maintain controls as required of authorities having jurisdiction.
- C. Maintain access for fire-fighting equipment and access to hydrants.

1.25 PROGRESS CLEANING

- A. Remove debris and rubbish from pipe chases, plenums, attics, crawl spaces, and other closed or remote spaces, prior to enclosing the space.
- B. Broom and vacuum clean interior areas prior to start of surface finishing, and continue cleaning to eliminate dust.
- C. Provide walk-off mats at each building entry.

1.26 WASTE DISPOSAL

- A. Provide waste collection containers in sizes adequate to handle waste from construction operations.
- B. Maintain building areas free of waste materials, debris, and rubbish.
- C. Remove waste materials, debris, and rubbish from site periodically and legally dispose of off site.
- D. Maintain site area in a clean and orderly condition.

1.27 PROJECT IDENTIFICATION

- A. Provide 8 x 4 foot project sign of exterior grade plywood and wood frame construction, painted, with exhibit lettering by professional sign painter to Architect's design and colors.
- B. List title of Project, names of Owner, Architect and Contractor.
- C. Erect on site at location established by Architect.
- D. Sign to remain in place through construction period and shall be removed only after dedication of the project.
- E. Provide temporary directional signs for construction personnel and visitors.
- F. No other signs are allowed except those required by law.

1.28 FIELD OFFICES

- A. Office: Weather-tight, with lighting, electrical outlets, heating, cooling and ventilating equipment, and equipped with sturdy furniture drawing rack and drawing display table.

- B. Maintain daily janitorial service for offices. Maintain approach to office free of mud and water.
- C. Provide space for Project meetings, with table and chairs to accommodate 8 persons.
- D. Provide separate private office, minimum of 120 sq. ft., similarly equipped and furnished, for use of Architect Resident Inspector.
- E. When permanent facilities are enclosed with operable utilities, relocate offices into building, with written agreement of Owner, and remove temporary buildings.
- F. Facilities shall comply with the accessibility requirements of the CBC - California Building Code, (CCR) California Code of Regulations, Title 24, Part 2, Section 11B-201.4.

1.29 STORAGE AREAS AND SHEDS

- A. Size to storage requirements for products of individual Sections. Allow for access and orderly provision for maintenance and for inspection of products.

1.30 REMOVAL OF UTILITIES, FACILITIES, AND CONTROLS

- A. Maintain temporary equipment, facilities and controls until Substantial Completion or when use is no longer required.
- B. Remove temporary above grade or buried utilities, equipment, facilities, materials, prior to Substantial Completion review.
- C. Remove underground installations to a minimum depth of 2 feet. Grade site as indicated.
- D. Clean and repair damage caused by installation or use of temporary work.
- E. Materials and facilities that constitute temporary facilities are property of the Contractor.
- F. Restore existing facilities used during construction to original condition.
- G. Restore permanent facilities used during construction to specified condition.
- H. Replace construction that cannot be satisfactorily restored.

2. PART 2 PRODUCTS

Not Used

3. PART 3 EXECUTION

Not Used

END OF SECTION

SECTION 01 61 00

PRODUCT REQUIREMENTS

1. PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Products.
- B. Transportation and handling.
- C. Storage and protection.
- D. Damage and restoration.

1.2 PRODUCTS

- A. Products: Means new material, machinery, components, equipment, fixtures, and systems forming the Work. Does not include machinery and equipment used for preparation, fabrication, conveying and erection of the Work.
- B. Products may also include existing materials or components required for reuse that were obtained from this project.
- C. Products specified or recycled from other projects are not considered new products.
- D. Provide interchangeable components of the same manufacturer, for similar components.
- E. Provide products that comply with the Contract Documents, that are undamaged and are unused at the time of installation.
- F. Provide products complete with all accessories, trim, finish, safety guards and other devices and detail needed for a complete installation and for the intended use and effect.
- G. Where a specific manufacturer's product is specified as the basis of design, the designation shall establish the qualities relating to type, function, dimension, in-service performance, physical properties, appearance and other characteristics for comparable products of other named manufacturers.
- H. Where products are specified by name or by manufacturer provide the product or manufacturer specified. No substitutions will be permitted unless made under the provisions of Section 01 25 13.
- I. Where specifications only describe a product or assembly by listing exact characteristics required, provide a product or assembly that provides the characteristics.
- J. Where specifications only require compliance with performance requirements, provide products that comply with those requirements.
- K. Where the specifications only require compliance with an imposed code, standard or regulation, provide a product that complies with the standards, codes or regulations specified.
- L. Where specifications require review and acceptance of a sample, the Architect's decision will be final on whether a proposed product sample is acceptable or not.
- M. Provide materials and products specified in the full range of color, texture and pattern for selection by Architect. Range shall include standard stocked color/texture/pattern, as advertised in product data and brochures. Unless otherwise indicated in individual specification sections, Architect may select from any color range at no additional cost to Owner.
- N. Do not use materials and equipment removed from existing premises, except as specifically permitted by the Contract Documents.

- O. Where product is designated to match an existing product, provide product that matches in size, profile, finish, dimension and other characteristics the existing product identified.

1.3 TRANSPORTATION AND HANDLING

- A. Transport and handle products in accordance with manufacturer's instructions.
- B. Schedule delivery to minimize long-term storage at site to prevent overcrowding of construction spaces.
- C. Coordinate delivery with installation time to ensure minimum holding time for items that are flammable, hazardous, easily damaged, or sensitive to deterioration, theft and other losses.
- D. Deliver products in manufacturer's original sealed container or packaging system, complete with labels and instructions for handling, storing, unpacking, protecting, and installing.
- E. Promptly inspect shipments to assure that products comply with requirements, quantities are correct, and products are undamaged.
- F. Provide equipment and personnel to handle products by methods to prevent soiling, disfigurement, or damage.

1.4 STORAGE

- A. Store products in accordance with manufacturer's instructions, with seals and labels intact and legible.
- B. Store sensitive products in weather-tight, climate controlled enclosures.
- C. Store products in a manner that will not damage or overload project structure.
- D. For exterior storage of fabricated products, place on sloped supports, above ground.
- E. Provide off-site storage when site does not permit on-site storage .
- F. Cover products subject to deterioration with impervious sheet covering. Provide ventilation to avoid condensation.
- G. Store loose granular materials on solid flat surfaces in a well-drained area. Prevent mixing with foreign matter.
- H. Provide equipment and personnel to store products by methods to prevent soiling, disfigurement, or damage.
- I. Arrange storage of products to permit access for inspection. Periodically inspect to assure products are undamaged and are maintained under specified conditions.
- J. Prevent the discharge of pollutants to storm water from storage of materials on-site using best management practice techniques defined in Chapter 4 of the Construction Activity Handbook published by the Storm Water Quality Task Force.

1.5 PROTECTION

- A. Protect installed Work and provide special protection where specified in individual specification Sections.
- B. Provide temporary and removable protection for installed Products. Control activity in immediate work area to minimize damage.
- C. Provide protective coverings at walls, projections, jambs, sills, and soffits of openings.
- D. Protect finished floors, stairs, and other surfaces from traffic, dirt, wear, damage, or movement of heavy objects.

- E. Prohibit traffic or storage upon waterproofed or roofed surfaces. If traffic or activity is necessary, obtain recommendations for protection from waterproofing or roofing material manufacturer.
- F. Provide humidity and temperature control for installed products as recommended by materials manufacturer.
- G. Prohibit traffic from landscaped areas.

1.6 DAMAGE AND RESTORATIONS

- A. Damage to existing or new work whether accidental or not shall be restored or replaced as specified or directed by Architect.
- B. Restoration shall be equal to structural performance of original work.
- C. Finish shall match appearance of existing adjacent work.
- D. Work not properly restored or where not capable of being restored shall be removed and replaced.

2. PART 2 PRODUCTS

Not Used

3. PART 3 EXECUTION

Not Used

END OF SECTION

SECTION 01 73 00

EXECUTION REQUIREMENTS

1. PART 1 GENERAL

1.1 SECTION INCLUDES

A. General procedural requirements governing execution of the Work.

1. Construction layout.
2. Field engineering and surveying.
3. General installation of products.

1.2 SUBMITTALS

- A. Certificates:** Submit certificate signed by land surveyor certifying that location and elevation of improvements comply with requirements.
- B. Certified Surveys:** Submit two copies signed by land surveyor.
- C. Final Property Survey:** Submit 2 copies showing the Work performed and record survey data.

2. PART 2 PRODUCTS

Not Used

3. PART 3 EXECUTION

3.1 EXAMINATION

- A. Existing Conditions:** Existence and location of site improvements and other construction indicated as existing are not guaranteed. Before beginning work, investigate and verify existence and location of construction affecting the Work.
- B. Existing Utilities:** Existence and location of underground and other utilities indicated as existing are not guaranteed. Before beginning work, investigate and verify existence and location of underground utilities affecting the Work.
1. Before construction, verify location and invert elevation at points of connection of sanitary sewer, storm sewer, and water-service piping; and electrical services.
 2. Furnish location data for work related to Project that must be performed by public utilities serving Project site.
- C. Acceptance of Conditions:** Examine substrates, areas, and conditions, with Installer or Applicator present for compliance with requirements for installation tolerances and other conditions affecting performance. Record observations.
1. Written Report: Where conditions detrimental to performance of the Work are encountered, provide a written report listing the following:
 - (a) Description of the Work.
 - (b) List of detrimental conditions, including substrates.
 - (c) List of unacceptable installation tolerances.

- (d) Recommended corrections.
- 2. Verify compatibility with and suitability of substrates, including compatibility of existing finishes or primers.
- 3. Examine roughing-in for mechanical and electrical systems to verify actual locations of connections before equipment and fixture installation.
- 4. Examine walls, floors, and roofs for suitable conditions where products and systems are to be installed.
- 5. Proceed with installation only after unsatisfactory conditions have been corrected. Proceeding with the Work indicates acceptance of surfaces and conditions.

3.2 PREPARATION

- A. Existing Utility Information: Furnish information to Owner that is necessary to adjust, move, or relocate existing utility structures, utility poles, lines, services, or other utility appurtenances located in or affected by construction. Coordinate with authorities having jurisdiction.
- B. Field Measurements: Take field measurements as required to fit the Work properly. Recheck measurements before installing each product. Where portions of the Work are indicated to fit to other construction, verify dimensions of other construction by field measurements before fabrication. Coordinate fabrication schedule with construction progress to avoid delaying the Work.
- C. Space Requirements: Verify space requirements and dimensions of items shown diagrammatically on Drawings.
- D. Review of Contract Documents and Field Conditions: Immediately on discovery of need for clarification of Contract Documents, submit a Request For Information (RFI) to Architect. Include a detailed description of problem encountered, together with recommendations for resolution of the item discovered.

3.3 CONSTRUCTION LAYOUT

- A. Verification: Before proceeding to lay out the Work, verify layout information shown on Drawings, in relation to the property survey and existing benchmarks. If discrepancies are discovered, notify Architect promptly.
- B. General: Engage a land surveyor, registered in the state of California to lay out the Work using accepted surveying practices.
 - 1. Establish benchmarks and control points to set lines and levels at each story of construction and elsewhere as needed to locate each element of Project.
 - 2. Establish dimensions within tolerances indicated. Do not scale Drawings to obtain required dimensions.
 - 3. Inform installers of lines and levels to which they must comply.
 - 4. Check the location, level and plumb, of every major element as the Work progresses.
 - 5. Notify Architect when deviations from required lines and levels exceed allowable tolerances.
 - 6. Close site surveys with an error of closure equal to or less than the standard established by authorities having jurisdiction.
- C. Site Improvements: Locate and lay out site improvements, including pavements, grading, fill and topsoil placement, utility slopes, and invert elevations.
- D. Building Lines and Levels: Locate and lay out control lines and levels for structures, building foundations, column grids, and floor levels, including those required for mechanical and electrical work. Transfer survey markings and elevations for use with control lines and levels. Level foundations and piers from two or more locations.

- E. Record Log: Maintain a log of layout control work. Record deviations from required lines and levels. Include beginning and ending dates and times of surveys, weather conditions, name and duty of each survey party member, and types of instruments and tapes used. Make the log available for reference by Architect.

3.4 FIELD ENGINEERING

- A. Identification: Control datum for survey is that established by Owner provided survey.
- B. Reference Points: Locate existing permanent benchmarks, control points, and similar reference points before beginning the Work. Preserve and protect permanent benchmarks and control points during construction operations.
 - 1. Do not change or relocate existing benchmarks or control points without prior written approval of Architect. Report lost or destroyed permanent benchmarks or control points promptly. Report the need to relocate permanent benchmarks or control points to Architect before proceeding.
 - 2. Replace lost or destroyed permanent benchmarks and control points promptly. Base replacements on the original survey control points.
- C. Benchmarks: Establish and maintain a minimum of two permanent benchmarks on Project site, referenced to data established by survey control points.
 - 1. Record benchmark locations, with horizontal and vertical data, on Project Record Documents.
 - 2. Where the actual location or elevation of layout points cannot be marked, provide temporary reference points sufficient to locate the Work.
 - 3. Remove temporary reference points when no longer needed. Restore marked construction to its original condition.
- D. Certified Survey: On completion of foundation walls, major site improvements, and other work requiring field-engineering services, prepare a certified survey showing dimensions, locations, angles, and elevations of construction and sitework.
- E. Final Property Survey: Prepare a final property survey showing significant features (real property) for Project. Include on the survey a certification, signed by land surveyor that principal metes, bounds, lines, and levels of Project are accurately positioned as shown on the survey.
 - 1. Show boundary lines, monuments, streets, site improvements and utilities, existing improvements and significant vegetation, adjoining properties, acreage, grade contours, and the distance and bearing from a site corner to a legal point.

3.5 INSTALLATION

- A. General: Locate the Work and components of the Work accurately, in correct alignment and elevation, as indicated.
 - 1. Make vertical work plumb and make horizontal work level.
 - 2. Where space is limited, install components to maximize space available for maintenance and ease of removal for replacement.
 - 3. Conceal pipes, ducts, and wiring in finished areas, unless otherwise indicated.
 - 4. Maintain maximum headroom clearance in spaces without a suspended ceiling.
- B. Comply with manufacturer's written instructions and recommendations for installing products in applications indicated.
- C. Install products at the time and under conditions that will ensure the best possible results. Maintain conditions required for product performance until Substantial Completion.

- D. Conduct construction operations so no part of the Work is subjected to damaging operations or loading in excess of that expected during normal conditions of occupancy.
- E. Tools and Equipment: Do not use tools or equipment that produce harmful noise levels.
- F. Templates: Obtain and distribute to the parties involved templates for work specified to be factory prepared and field installed. Check Shop Drawings of other work to confirm that adequate provisions are made for locating and installing products to comply with indicated requirements.
- G. Anchors and Fasteners: Provide anchors and fasteners as required to anchor each component securely in place, accurately located and aligned with other portions of the Work.
 - 1. Mounting Heights: Where mounting heights are not indicated, mount components at heights directed by Architect.
 - 2. Allow for building movement, including thermal expansion and contraction.
 - 3. Coordinate installation of anchorages. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, and items with integral anchors, that are to be embedded in concrete or masonry. Deliver such items to Project site in time for installation.
- H. Joints: Make joints of uniform width. Where joint locations in exposed work are not indicated, arrange joints for the best visual effect. Fit exposed connections together to form hairline joints.
- I. Hazardous Materials: Use products, cleaners, and installation materials that are not considered hazardous.

END OF SECTION

SECTION 01 73 29

CUTTING AND PATCHING

1. PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Requirements and limitations for cutting and patching of Work.

1.2 DEFINITIONS

- A. Cutting: Removal of in-place construction necessary to permit installation or performance of other work.
- B. Patching: Fitting and repair work required to restore surfaces to original or specified conditions after installation of other work.

1.3 REGULATORY REQUIREMENTS

- A. Unless specifically shown on the drawings, no structural member shall be cut, drilled, or notched without prior written authorization from the Architect and the Division of the State Architect.

1.4 SUBMITTALS

- A. Submit written request in advance of cutting or patching which affects:

- 1. Structural integrity of any element of Project.
- 2. Integrity of weather-exposed or moisture-resistant element.
- 3. Efficiency, maintenance, or safety of any operational element.
- 4. Visual qualities of sight exposed elements.
- 5. Work of Owner or separate contractor.

- B. Include in request:

- 1. Identification of Project.
- 2. Location and description of affected work.
- 3. Necessity for cutting or patching.
- 4. Description of proposed work, and Products to be used.
- 5. Alternatives to cutting and patching.
- 6. Effect on work of Owner or separate contractor.
- 7. Written permission of affected separate contractor.
- 8. Date and time work will be executed.

1.5 QUALITY ASSURANCE

- A. Do not cut and patch structural elements in a manner that could change their load-carrying capacity or load-deflection ratio.

- B. Do not cut or patch operating elements that would reduce their capacity to perform or that would result in increased maintenance or decreased operational life or safety.
- C. Do not cut or patch construction that would result in visual evidence of cutting or patching.
- D. Remove and replace construction that has been cut or patched in a visually unsatisfactory manner.

2. PART 2 PRODUCTS

2.1 MATERIALS

- A. Primary Products: Those required for original installation.
- B. Substitutions: Under provisions of Section 01 25 13.

3. PART 3 EXECUTION

3.1 EXAMINATION

- A. Inspect existing conditions prior to commencing Work, including elements subject to damage or movement during cutting and patching.
- B. After uncovering existing Work, inspect conditions affecting performance of work.
- C. Beginning of cutting or patching means acceptance of existing conditions.

3.2 PREPARATION

- A. Provide temporary supports to ensure structural integrity of the Work. Provide devices and methods to protect other portions of Project from damage.
- B. Provide protection from elements for areas which may be exposed by uncovering work.

3.3 CUTTING AND PATCHING

- A. Execute cutting, fitting, and patching to complete Work.
- B. Fit Products together, to integrate with other work.
- C. Uncover work to install ill timed work.
- D. Remove and replace defective or non-conforming work.
- E. Remove samples of installed work for testing when requested.
- F. Provide openings in the Work for penetration of mechanical and electrical work.
- G. Cut rigid materials using saw or drill. Pneumatic tools not allowed without prior approval.

3.4 PERFORMANCE

- A. Execute work by methods to avoid damage to other Work, and which will provide appropriate surfaces to receive patching and finishing.
- B. Employ skilled and experienced installer to perform cutting and patching.
- C. Cut rigid materials using masonry saw or core drill. Pneumatic tools not allowed without prior approval.
- D. Restore work with new Products in accordance with requirements of Contract Documents.
- E. Fit work air tight to pipes, sleeves, ducts, conduit, and other penetrations through surfaces.

- F. At penetrations of fire rated walls, partitions, ceiling, or floor construction, completely seal voids with fire rated material, to full thickness of the penetrated element.
- G. Refinish surfaces to match adjacent finish. For continuous surfaces, refinish to nearest intersection or natural break. For an assembly, refinish entire unit.

3.5 CLEANING

- A. Clean areas and spaces where cutting and patching was performed.
- B. Completely remove paint, mortar, oils, sealant, and similar materials.

END OF SECTION

SECTION 01 74 19

CONSTRUCTION WASTE MANAGEMENT AND DISPOSAL

1. PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Administrative and procedural requirements for the following:
 - 1. Disposing of nonhazardous demolition and construction waste.

1.2 DEFINITIONS

- A. Construction Waste: Building and site improvement materials and other solid waste resulting from construction, remodeling, renovation, or repair operations. Construction waste includes packaging.
- B. Demolition Waste: Building and site improvement materials resulting from demolition or selective demolition operations.
- C. Disposal: Removal off-site of demolition and construction waste and subsequent sale, recycling, reuse, or deposit in landfill or incinerator acceptable to authorities having jurisdiction.

2. PART 2 PRODUCTS

Not Used

3. PART 3 EXECUTION

3.1 PLAN IMPLEMENTATION

- A. General: Provide handling, containers, storage, signage, transportation, and other items as required to implement waste management plan during the entire duration of the Contract.

3.2 DISPOSAL OF WASTE

- A. General: Except for items or materials to be salvaged, recycled, or otherwise reused, remove waste materials from Project site and legally dispose of them in a landfill or incinerator acceptable to authorities having jurisdiction.
- B. Do not allow waste materials that are to be disposed of accumulate on-site. Remove and transport debris in a manner that will prevent spillage on adjacent surfaces and areas.
- C. Burning: Do not burn waste materials.
- D. Disposal: Transport waste materials off Owner's property and legally dispose of them.

END OF SECTION

SECTION 01 77 00

CLOSEOUT PROCEDURES

1. PART 1 GENERAL

1.1 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.
- J. DVBE Participation Report.

1.2 PROJECT CLOSEOUT CONFERENCE

- A. As specified under Section 01 31 00.

1.3 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. Submit final Application for Payment identifying total adjusted Contract Sum, previous payments, and sum remaining due.
- I. Submit affidavit of payment of debts and claims, AIA Document G706.
- J. Submit affidavit of release of liens, AIA Document G706A.
- K. Submit consent of contractors surety to final payment, AIA Document G707.

- L. Owner will occupy portions of the building as specified in Section 01 11 00.

1.4 REGULATORY REQUIREMENTS

- A. Provide final verified reports required by Section 39151 and 81141 of the Education Code in the manner prescribed by Title 24, Part 1, Section 4-336 and 4-343 in compliance with DSA Procedure: Project Certification Process PR 13-02.

1.5 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.

1.6 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.

1.7 ADJUSTING

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

1.8 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.

1.9 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 installer's 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 and Construction Manager. 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 through Construction Manager 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 73 00.
- H. Record Construction Schedule: Under the provisions of Section 01 32 16.
- I. Submit documents to Architect at time of Substantial Completion.

1.10 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 02 through 49 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.

1.11 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, manufacturers, 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.

1.12 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.

1.13 DISABLED VETERAN BUSINESS ENTERPRISE ("DBVE") PARTICIPATION

- A. Submit DVBE Participation Report as stipulated by Document 00 65 73.
- B. Provide supplemental report to substantiate non-compliance with District goal of three percent (3%) participation if required.

2. PART 2 PRODUCTS

Not Used

3. PART 3 EXECUTION

Not Used

END OF SECTION

SECTION 02 41 19

SELECTIVE DEMOLITION

1. PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Removal of designated building equipment and fixtures.
- B. Removal of designated construction.
- C. Disposal of materials.
- D. Cap and identify utilities.
- E. Temporary partitions to allow building occupancy.
- F. Temporary fire protection.
- G. Schedule of materials and equipment.

1.2 DEFINITIONS

- A. Remove: Detach items from existing construction and legally dispose of them off-site.
- B. Disposal: Removal off-site of demolition waste and subsequently deposit in landfill acceptable to authorities having jurisdiction.
- C. Existing to Remain: Items of construction that are not to be removed and that are not indicated to be removed.

1.3 MATERIALS OWNERSHIP

- A. Historic items, relics, cornerstones, commemorative plaques, tablets and similar objects encountered during demolition are to remain the Owner's property.
- B. Carefully remove each item in a manner to prevent damage and deliver to Owner.

1.4 SUBMITTALS

- A. Predemolition Photographs: Show conditions of exiting adjacent construction and site improvements that might be misconstrued as damaged by demolition operations. Submit before work begins.
- B. Record Documents: Submit under provisions of Section 01 77 00. Accurately record locations of utilities and subsurface obstructions.

1.5 REGULATORY REQUIREMENTS

- A. Conform to applicable codes for demolition work, safety of structure, electrical disconnection and reconnection dust control and disposal of materials.
- B. Comply with California Fire Code (CFC), California Code of Regulations, (CCR) Title 24, Part 9, Chapter 5 - Fire Service Features and Chapter 33 - Fire Safety During Construction and Demolition.
- C. Obtain required permits from authorities.
- D. Notify affected utility companies before starting work and comply with their requirements.
- E. Do not close or obstruct egress width to exits.

- F. Do not disable or disrupt building fire or life safety systems without 3 day prior written notice to the Owner.

1.6 EXISTING CONDITIONS

- A. Areas of buildings to be demolished will be evacuated and their use discontinued before start of work.
- B. Owner will occupy building(s) adjacent to demolition area. Conduct demolition so owner's operation will not be disrupted.
- C. Provide at least 72 hour notice to Owner of activities that will affect Owner's operation.
- D. Maintain access to existing walkways, exits and other adjacent occupied facilities.
- E. Owner assumes no responsibility for areas of buildings to be demolished.
- F. Hazardous Materials: It is not anticipated that hazardous materials will be encountered in the work.
 - 1. If materials suspected of containing hazardous materials are encountered, do not disturb. Notify Architect.
 - 2. Conform to applicable regulatory procedures when discovering hazardous or contaminated materials.

1.7 SCHEDULING

- A. Schedule work under provisions of Section 01 32 16.
- B. Schedule Work to coincide with new construction owner occupancy.
- C. Perform work during normal hours of operation.
- D. Notify Owner in writing 5 days in advance of any required work to be performed on a weekend or holiday.
- E. Perform noisy, malodorous, dusty work:
 - 1. Between the hours of 7:00 a.m. and 5:00 p.m.
- F. Coordinate utility and building service interruptions with Owner.
- G. Schedule tie-ins to existing systems to minimize disruption.
- H. Coordinate Work to ensure fire sprinklers, fire alarms, smoke detectors, emergency lighting, exit signs and other life safety systems remain in full operation in occupied areas.

1.8 PROJECT CONDITIONS

- A. Conduct demolition to minimize interference with adjacent and occupied building areas.
- B. Cease operations immediately if structure appears to be in danger and notify Architect. Do not resume operations until directed.

2. PART 2 PRODUCTS

Not Used.

3. PART 3 EXECUTION

3.1 EXAMINATION

- A. Correlate existing conditions with requirements indicated.
- B. Inventory and record condition of items to be removed and salvaged.

- C. Execute predemolition photographs.

3.2 PREPARATION

- A. Existing Utilities: Locate, identify, disconnect and seal or cap off indicated utilities serving areas to be demolished.
- B. Salvaged Items: Clean, pack and identify items for delivery to Owner.
- C. Protect existing items which are not indicated to be salvaged, removed, or altered.
- D. Erect and maintain weatherproof closures for exterior openings.
- E. Erect and maintain temporary partitions to prevent spread of dust, fumes, noise, and smoke to provide for Owner occupancy as specified in Section 01 11 00.

3.3 DEMOLITION

- A. Conduct demolition to minimize interference with adjacent and occupied building areas.
- B. Cease operations immediately if structure appears to be in danger. Notify Architect. Do not resume operations until directed.
- C. Maintain protected egress and access to the Work.
- D. Maintain fire safety during demolition in accordance with CFC, Chapter 33.
- E. Demolish in an orderly and careful manner. Protect existing supporting structural members.

3.4 SALVAGING OF DEMOLITION MATERIALS

- A. Clean salvaged items.
- B. Pack or crate items after cleaning. Identify contents.
- C. Store items in secure area until delivery to Owner .
- D. Protect items from damage.

3.5 DISPOSAL OF DEMOLISHED MATERIALS

- A. Except for items to be recycled, reused, salvaged, reinstalled, or otherwise indicated to remain, remove demolished materials from Project site and legally dispose of them in an EPA – approved landfill.
- B. Do not burn or bury materials on site.

3.6 CLEANING

- A. Clean adjacent structures and improvements of dust, dirt and debris caused by demolition.
- B. Remove temporary construction.
- C. Return adjacent areas to condition existing before demolition operations began.
- D. Leave site in a clean condition.

END OF SECTION

SECTION 06 10 00

ROUGH CARPENTRY

1. PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Structural floor, wall, and roof framing.
- B. Built-up structural beams.
- C. Floor, wall, and roof sheathing.
- D. Plywood underlayment over all wood subfloors.
- E. Combination subfloor - underlayment.
- F. Wood furring, backing and grounds.
- G. Preservative treatment of wood.
- H. Fire retardant treatment of wood.

1.2 REFERENCES

- A. CBC - California Building Code, (CCR) California Code of Regulations Title 24, Part 2.
- B. ALSC - American Lumber Standards Committee: Softwood Lumber Standards.
- C. ANSI/AF & PA NDS-12 - National Design Specifications for Wood Construction.
- D. ANSI/SDPWS - Special Design Provisions for Wind and Seismic.
- E. APA - The Engineered Wood Association.
- F. ASTM D6109 – Standard Test Methods for Flexural Properties of Unreinforced and Reinforced Plastic Lumber.
- G. ASTM E84 - Standard Test Method for Surface burning Characteristics of Building Materials.
- H. AWP - American Wood Preservers' Association: Book of Standards.
- I. MS MIL-L-19140 - Fire Retardant Wood Preservative Chemicals.
- J. National Bureau of Standards - Product Standard PS-1-09 for Construction and Industrial Plywood.
- K. WCLIB - West Coast Lumber Inspection Bureau: Standard Grading Rules for West Coast Lumber.
- L. WWPA - Western Wood Products Association.

1.3 QUALITY ASSURANCE

- A. Lumber Grading Agency: Certified by ALSC.
- B. Plywood Grading Agency: Certified by APA.

1.4 REGULATORY REQUIREMENTS

- A. Conform to CBC, California Building Code, (CCR) California Code of Regulations, Title 24, Part 2, Chapter 23.

- B. Allowable stress design values shall be in compliance with the CBC, California Building Code, (CCR) California Code of Regulations, Title 24, Part 2, Section 2306, ANSI/AF & PA NDS-12 - National Design Specifications for Wood Construction, and ANSI/SDPWS - Special Design Provisions for Wind and Seismic.

1.5 SUBMITTALS

- A. Submit product data under provisions of Section 01 33 00.
- B. Provide technical data on wood preservative materials and application instructions.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Store and protect products under provisions of Section 01 61 00.
- B. Deliver materials free from pest infestation. Protect materials on site to prevent termite, beetle or other wood boring insect attacks.
- C. Stack lumber flat, off grade, with spacers between each bundle to promote air circulation. Provide for air circulation around and under coverings.

2. PART 2 PRODUCTS

2.1 LUMBER MATERIALS

- A. Lumber Grading Rules: WCLIB and WWP. Lumber shall bear WCLIB grade stamp.
- B. Beam Framing: Douglas Fir species, Dense No. 1 grade.
- C. Joist Framing: Douglas Fir species, No. 1 grade.
- D. Rafter Framing: Douglas Fir species, No. 1 grade.
- E. Structural Framing, Studs, Plate and Blocking: Douglas Fir Species, No. 1 grade.
- F. Non-structural Light Framing Studs, Plate and Blocking: Douglas Fir species, construction grade.
- G. Plank and Decking: Douglas Fir species, Com Dex.

2.2 MOISTURE CONTENT

- A. 2x and 3x material, 19 percent moisture content, S-Dry. Structural and non structural framing, beam, rafters, joists, studs, plates and blocking.
- B. 4x and 6x material, 19 percent moisture content at time of application of Architectural finishes. 22 percent maximum moisture content at time of delivery to project site. Materials to be air dried as required to achieve 22 percent moisture content prior to delivery to site. Structural and non structural framing, beam, rafters, joists, studs, plates and blocking.
- C. Lumber materials with a moisture content above 19 percent and less than 22 percent at the time of installation shall be tested for moisture content prior to covering with Architectural finishes. Moisture tests shall be performed under the provisions of Section 01 45 29.
- D. No lumber shall be covered with an Architectural finish until the moisture content of the lumber is 19 percent or below.

2.3 PLYWOOD MATERIALS

- A. Roof Sheathing: APA Structural I, Grade C-D, Exposure 1 minimum 5-ply construction, meeting product Standard PS-1.

- B. Wall Sheathing: APA Structural I, Grade C-D, Exposure 1 minimum 5-ply construction, meeting product standard PS-1.
- C. Telephone and Electrical Panel Boards: APA Grade C-D with exterior glue, minimum 5 ply, 3/4 inch thick, meeting PS-1.

2.4 ORIENTED STRAND BOARD (OSB)

- A. OSB sheathing shall conform to ICC ESR - 2586.
- B. Roof Sheathing: APA rated sheathing, Exposure 1, Structural 1, meeting PS-2 and PRP-108 with radiant aluminum foil barrier. Nominal thickness not less than 15/32 inch. Span rating of 32/16.
- C. Wall Sheathing: APA rated sheathing, Exposure 1, Structural 1, meeting PS-2 and PRP-108. Nominal thickness not less than 15/32 inch. Span rating of 32/16.

2.5 ACCESSORIES

- A. Fasteners: Hot-dipped galvanized steel for exterior, high humidity, and treated wood locations; plain finish elsewhere; size and type to suit condition.
- B. Connectors: As indicated.
- C. Joist Hangers: Galvanized steel, sized to suit joists and framing conditions; manufactured by Simpson, USP Connectors or KC Metals.
- D. Anchors: Thru bolt or anchor bolt to concrete or masonry unless otherwise noted. Bolt for anchorage to steel unless otherwise noted.
- E. Building Paper: No. 15 asphalt felt. Plain untreated cellulosic building paper.

2.6 WOOD TREATMENT

- A. Preservative Treatment: Where lumber or plywood is indicated as treated or is specified herein to be treated, comply with applicable requirements of AWPA Standards C2 (Lumber) and C9 (Plywood).
- B. Pressure treat all lumber in contact with ground. After treatment kiln-dry lumber to a maximum moisture content of 19 percent.
- C. Pressure treat above ground items as indicated. After treatment, kiln-dry lumber and plywood to a maximum moisture content, respectively, of 19 percent and 15 percent. Treat indicated items and the following:
 - 1. Wood cants, nailers, curbs, equipment support bases, blocking, stripping and similar members in connection with roofing, flashing, vapor barriers and waterproofing.
 - 2. Horizontal wood sills, sleepers, blocking, furring, stripping and similar concealed members in contact with masonry or concrete.
 - 3. Horizontal wood framing members less than 18 inches above grade.
 - 4. Wood floor plates installed over concrete slabs directly in contact with earth.
 - 5. Ends of wood girders entering masonry or concrete walls.
 - 6. Framing members used in exterior door, window, or louver openings.
- D. Complete fabrication of treated items prior to treatment, where possible. If cut or drilled after treatment, coat cut or drilled surfaces with heavy brush coat of same chemical used for treatment and to comply with AWPA M4. Inspect each piece of lumber or plywood after drying and discard damaged or defective pieces.

2.7 FIRE RETARDANT TREATMENT

- A. Fire retardant wood to have a flame spread of less than 25 when tested in an extended 30-minute tunnel test according to ASTM E84.
- B. Dimensional lumber to be kiln dried to a maximum moisture content of 19 percent after treatment.
- C. Plywood to be kiln dried to a maximum moisture content of 15 percent after treatment.
- D. Fire retardant wood to comply with AWPAC Standard C20 for lumber and C27 for plywood.
- E. Fire retardant chemicals to comply with FR-1 of AWPAC Standard P-17 and shall be free of halogens, sulfates and ammonium phosphate.
- F. Carbon steel, galvanized steel, aluminum, copper, and red brass in contact with fire retardant wood shall exhibit corrosion rates less than one mil per year when tested in accordance with FS MIL-L-19140, Paragraph 4.6.5.2.
- G. Fire retardant chemicals must be registered for use as a wood preservative by the U.S. Environmental Protection Agency.
- H. Fire retardant treat indicated items and the following:
 - 1. Roof sheathing.
 - 2. Wall sheathing.
 - 3. Wood studs, plates and blocking.
 - 4. Wood nailers, curbs, equipment support bases, and similar members in connection with roofing and flashing.

3. PART 3 EXECUTION

3.1 FRAMING

- A. Erect wood framing members level and plumb.
- B. Place horizontal members laid flat, crown side-up.
- C. Construct framing members full length without splices.
- D. Double members at openings over 1 sq ft. Space short studs over and under opening to stud spacing.
- E. Construct double joist headers at floor and ceiling openings. Frame rigidly into joists.
- F. Construct double joists under wall studding.
- G. Bridge joists in excess of 8 feet span at mid-span members. Fit solid blocking at ends of members.

3.2 FURRING, BLOCKING AND GROUNDS

- A. Provide wherever shown and where required for attachment of other work. Coordinate with work of other sections.
- B. Item locations include but are not limited to toilet accessories, toilet partitions, door frames, window frames, hardware, access doors and ladders, cabinetry, miscellaneous equipment locations and mechanical, plumbing and electrical item locations and all other locations of wall mounted items.
- C. Install plywood backboards for telephone, data and other electrical equipment.

- D. Form to shapes as shown and cut as required for true line and level of work to be attached. Coordinate location with other work involved.
- E. Attach to substrates as required to support applied loading. Countersink bolts and nuts flush with surfaces, unless otherwise indicated.
- F. Build into masonry during installation of masonry work. Where possible, anchor to formwork before concrete placement.
- G. Install plumb and level with closure strips at edges and openings. Shim with wood as required for tolerance of finished work.
- H. Firestop all concealed spaces of wood stud walls, ceilings and floor levels at 10 foot intervals both vertically and horizontally.
- I. Firestop all concealed vertical and horizontal spaces as occur at soffits, vents, stair stringers, pipes and similar openings in compliance with CBC, (CCR) Title 24, Part 2, Section 718.
- J. Firestopping shall consist of closely fitted wood blocks of 2 inch nominal thickness lumber of same width as framing members.

3.3 SHEATHING

- A. Secure roof sheathing perpendicular to framing members with ends staggered. Secure sheet edges over firm bearing. Provide solid edge blocking between sheets. Space panels 1/8 inch apart at ends and edges. Install radiant barrier towards interior of roof.
- B. Secure wall sheathing perpendicular to wall studs, with ends staggered, over firm bearing.
- C. Install telephone and electrical panel back boards where required. Size of backboards to be 12 inches beyond size of electrical panel boards.

3.4 FIELD QUALITY CONTROL

- A. Field inspection and testing will be performed under provisions of Section 01 45 29.
- B. Lumber materials will be inspected for compliance with material grading rules, limitations for moisture content and pest infestation prior to any materials being concealed from view or being covered with an architectural finish.

3.5 TOLERANCES

- A. Framing Members: 1/4 inch maximum from true position.
- B. Surface Flatness of Floor: 1/4 inch in 10 feet maximum.

END OF SECTION

SECTION 07 21 16

BLANKET INSULATION

1. PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Batt insulation and vapor barrier in roof construction.

1.2 REFERENCES

- A. ASTM C665 - Mineral Fiber Blanket Thermal Insulation for Light Frame Construction and Manufactured Housing.
- B. ASTM C1320 - Installation of Mineral Fiber Batt and Thermal Insulation for Light Frame Construction.
- C. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials.
- D. CBC - California Building Code, (CCR) California Code of Regulations, Title 24, Part 6.
- E. Business and Professions Code.

1.3 PERFORMANCE REQUIREMENTS

- A. Materials of this Section shall provide continuity of thermal and moisture barrier at building enclosure elements.
- B. Materials of this Section shall provide continuity of sound control where indicated or scheduled.

1.4 REGULATORY REQUIREMENTS

- A. Installation of insulation may only commence if insulation meets mandatory manufacturer certification to the California Energy Commission required by Title 24, Part 6, Section 110.8 of the CBC - California Building Code, (CCR) California Code of Regulations that insulation complies with Title 24, Part 12, Chapter 12-13, Article 3 of the California Quality Standards for Insulating Materials.
- B. Insulation products shall comply with the requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."
- C. Insulation materials to be certified in compliance with Business and Professions Code Section 19165.
- D. Insulation manufacturer to be licensed by the California Department of Consumer Affairs, Bureau of Home Furnishing and Thermal Insulation according to Business and Professions Code, Section 19059.7.

1.5 SUBMITTALS

- A. Submit manufacturer's certificates under provisions of Section 01 33 00 that materials meet or exceed specified regulatory requirements.

2. PART 2 PRODUCTS

2.1 MANUFACTURERS - INSULATION MATERIALS

- A. Certain Teed Corp., www.certainteed.com.
- B. Johns Manville Corp., www.jm.com.
- C. Knauf Insulation, www.knaufinsulation.us.

D. Owens-Corning Fiberglass Corporation, www.owenscorning.com.

E. Substitutions: Under provisions of Section 01 25 13.

2.2 MATERIALS

- A. Thermal Batt Insulation, Exposed Wall and Roof: ASTM C665 preformed glass fiber batt, Type III, Class A, with an FSK-25 reflective membrane faced surface that has a flame spread of 25 or less, and a smoke density of 50 or less when tested in accordance with ASTM E-84. Category 1 with stapling flanges for attachment of blanket to applicable construction. Equivalent continuous FSK-25 roll membrane facing may be utilized in lieu of individual faced glass fiber batts. Provide R30 at roofs.
- B. Insulation to be formaldehyde-free.
- C. Nails or Staples: Steel wire; electroplated; type and size to suit application.
- D. Tape: Bright aluminum self-adhering type, mesh reinforced, 2 inch wide.
- E. Support Wire: 16 gauge steel wire.
- F. Support Rods: 13 gauge, pointed spring steel length as required for stud spacing.
- G. Spindle Fasteners: Steel impale spindle and clip on flat metal base, self adhering backing, length to suit insulation thickness, capable of securely and rigidly fastening insulation in place.

3. PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify that substrate, adjacent materials, and insulation are dry and ready to receive insulation.
- B. Verify that enclosed spaces are ventilated to dissipate humidity.
- C. Maximum relative humidity level of less than 50 percent shall be maintained during installation of insulation.

3.2 INSTALLATION

- A. Install insulation in accordance with insulation manufacturer's instructions and ASTM C1320.
- B. Fill any small spaces around door frames, window frames, skylight frames, and other wall or roof openings with insulation.
- C. Fill hollow space of steel door frame, steel window frame and other wall or roof frame with insulation.
- D. Fill hollow space created by wall or roof framed headers and jamb spaces with insulation.
- E. Install batt sound insulation in interior walls full height of wall.
- F. Install batt sound insulation above ceilings in areas as indicated. Extend a minimum of 4'-0" beyond face of vertical dividing partitions of space to be insulated where partition terminates at ceiling.
- G. Install batt sound insulation at underside of floor decking between adjacent floor levels.
- H. Trim insulation neatly to fit spaces.
- I. Fit insulation tight in spaces and tight to exterior side of mechanical and electrical services within the plane of insulation. Leave no gaps or voids.
- J. Install with factory applied membrane facing warm side of building spaces.
- K. Lap ends and side flanges of vapor barrier membrane over face of framing members.

- L. Extend vapor barrier on to any adjacent construction and tape seal edge of vapor barrier.
- M. Seal butt ends, lapped flanges, and tears or cuts in membrane with tape or another layer of membrane.
- N. Seal joints in vapor barrier caused by pipes, conduits, electrical boxes, and similar items penetrating vapor barrier.
- O. Retain unsupported roof insulation to metal or concrete substrate with spindle fasteners at 24 inches on center.

END OF SECTION

SECTION 07 54 19 PVC THERMOPLASTIC MEMBRANE ROOFING

PART 1 GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes:
1. Installation of adhered Thermostatic roofing membrane with flashings and other components to comprise a roofing system.
 2. Flashing and caulking (Detailed on drawings).
 3. Tapered roof insulation.
 4. Crickets.
 5. Cover board.
 6. Wood nailers and shims.
 7. Sheet metal terminations
 8. Walkway protection
 9. Expansion Joints
 10. Deck repair/replacement
 11. Other work incidental to the complete and proper installation of a watertight roofing system as shown on the Drawings and specified herein, and in accordance with all applicable requirements of the Contract Documents and existing warranty requirements where in effect.
- B. Related Requirements:
1. Section 06 10 53; Miscellaneous Rough Carpentry. For wood nailers, curbs, and blocking.
 2. Section 06 16 10; Sheathing, wood-based, structural-use roof deck panels.
 3. Section 07 62 00; Roof Related Sheet Metal.
 4. Section 07 72 00; Roof Accessories.
 5. Section 07 92 00; Joint Sealants.
 6. Section 07 95 00; Expansion Control.
- C. Related Work:
1. All Sections of Work relating to the roofing system, including mechanical, plumbing and electrical items penetrating the roof system.
- D. Intentions of the Work – It is the intent of this Section that the Work shall:
1. Provide a watertight facility using a sustainable “Cool Roof” system.
 2. Provide a complete roofing system that moves stormwater off and away from the buildings.
 3. Provide / Maintain (Where Existing) a long-term system warranty.
 4. Conform to all applicable building code requirements and of authorities having jurisdiction (AHJ).
 5. Coordinate with General Contractor related temporary equipment and conduit on roof and protection of existing and previously installed roof membrane.

1.3 DEFINITIONS

- A. Roofing Terminology: Definitions in NRCA's "The NRCA Roofing and Waterproofing Manual" apply to work of this Section.

1.4 REFERENCES

- A. American Society for Testing and Materials (ASTM)
 - 1. A385, Practice for Providing High-Quality Zinc Coatings (Hot-Dip)
 - 2. D570, Water Absorption of Plastics
 - 3. D638, Tensile Properties of Plastics
 - 4. D751, Method of Testing Coated Fabrics
 - 5. D882, Tensile Properties of Thin Plastic Sheeting
 - 6. D1004 Initial Tear Resistance of Plastic Film and Sheeting
 - 7. D1204 Linear Dimensional Changes of Non-rigid Thermoplastic Sheeting or Film at Elevated Temperature
 - 8. D2136 Coated Fabrics — Low-Temperature Bend Test
 - 9. D2565 Operating Xenon Arc-Type Light Exposure Apparatus with and Without Water for Exposure of Plastics
 - 10. D3045 Heat Aging of Plastics Without Load
 - 11. D4434 Poly (Vinyl Chloride) Sheet Roofing
 - 12. E108 (Rev A) Fire Tests of Roof Coverings
 - 13. G21 Determining Resistance of Synthetic Polymeric Materials to Fungi
 - 14. G53 Operating Light — and Water-Exposure Apparatus (Fluorescent UV-Condensation Type) for Exposure of Nonmetallic Materials
- B. ASCE-7 Wind uplifts requirements for geographical area.
- C. Federal Specifications (FS)
 - 1. TT-S-00230C: Federal Specification Standard TT-S-00230C Elastomeric type, cold applied single component for caulking, sealing and glazing in buildings, building areas (plazas, decks, pavements) and other structures
- D. National Roofing Contractors Association (NRCA)
 - 1. Roofing and Waterproofing Manual – Latest Edition
- E. Single Ply Roofing Institute (SPRI)
 - 1. ANSI/SPRI ES-1 Perimeter Roof Edge Compliance
 - 2. ANSI/SPRI/FM 4435/ES-1
- F. Sheet Metal and Air Conditioning Contractors National Association, Inc. (SMACNA)
 - 1. Architectural Sheet Metal Manual – Latest Edition
- G. Underwriters' Laboratories (UL)
 - 1. Fire Hazard Classifications
 - 2. Class 90-wind uplift.
- H. California Building Code (CBC)

1.5 PERFORMANCE REQUIREMENTS

- A. General Requirements: Provide an installed Thermoplastic single-ply roofing system, flashing and related work that is watertight and will not permit the passage of liquid water, able to withstand wind loads, thermally induced movement and exposure to weather without failure and does not conflict with existing thermoplastic roof system or warranty.
- B. Material Compatibility: Provide roofing materials that are compatible with one another and existing roof membrane at perimeter of areas to be demolished, under conditions of service and application required, as demonstrated by roofing system Manufacturer based on testing and field experience.

- C. Roofing System Design: Comply with SPRI "Wind Design Guide for Fully Adhered Roofing Systems" for the following ground roughness exposure and system design:
 - 1. Exposure C:
 - 2. Risk Category: III
 - 3. Wind: 115 mph, 3-second gust
 - 4. Mechanically Attached Underlayment and substrate / Fully-Adhered Membrane to match existing
- D. Underwriter's Laboratories Inc. (UL)
 - 1. UL RMSD — 1998 Roofing Materials and Systems Directory
 - 2. UL 790 — 1998 Fire Resistance of Roofing Coverings Materials
 - 3. Exterior Fire Exposure Classification: Class A, ASTM E 108, for application and slopes shown.
 - 4. UL 90 — Wind uplift requirements
- E. ASCE-7 Wind uplifts requirements for geographical area.
- F. American National Standards Institute (ANSI)
- G. American Architectural Manufacturer's Association (AAMA)
- H. Occupational Safety and Health ACT (OSHA)
- I. California Building Code (CBC)

1.6 PRE-INSTALLATION CONFERENCE

- A. Preinstallation Roofing Conference: Conduct conference at Project site.
 - 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 and compatibility with existing roofing warranty.
 - 3. Review and finalize construction schedule, and verify availability of materials, Installer's personnel, equipment, and facilities needed to make progress and avoid delays.
 - 4. Examine deck substrate conditions and finishes for compliance with requirements, including flatness and fastening.
 - 5. Review structural loading limitations of roof deck during and after roofing.
 - 6. Review base flashings, special roofing details, roof drainage, roof penetrations, equipment curbs, and condition of other construction that affects roofing system.
 - 7. Review governing regulations and requirements for insurance and certificates if applicable.
 - 8. Review existing warranty requirements tie-in detailing and coverage for conflicts.
 - 9. Review temporary protection requirements for roofing system during and after installation.
 - 10. Review roof observation and repair procedures to be followed after roofing installation.

1.7 ACTION SUBMITTALS

- A. Product Data: For each type of product. MSDS sheets. Manufacturer's printed instructions, schedules, charts, literature, and illustrations to indicate the performance, fabrication procedures, product variations, adhesive, and accessories to be used in the Work.

- B. Shop Drawings: Furnish from copies of the Manufacturer's literature or from copies of NRCA "Roofing and Waterproofing Manual", Latest Edition.
- C. Shop Drawings: For roofing system. Include plans, elevations, sections, details, and attachments to other work, including:
 - 1. Furnish for approval any proposed details, which differ from those, included with this proposal package. All proposed details shall first be approved in writing by roofing Manufacturer (and existing warranty Manufacturer where different) prior to submitting to Architect for approval.
 - 2. Base flashings and membrane terminations.
 - 3. Tapered insulation, including slopes.
 - 4. Roof plan showing orientation of roof deck and orientation of roofing, fastening spacing, and patterns for mechanically fastened roofing.
 - 5. Insulation fastening patterns for corner, perimeter, and field-of-roof locations including roof drains and roof access panels.
 - 6. Furnish detail project sequencing, staging, material loading, manpower plans, and project construction schedule for approval.
- D. Samples:
 - 1. Furnish copy of sample warranty that is to be issued upon project completion.
 - 2. Furnish sign-off by existing warranty manufacturer where required at tie-in detail areas.
 - 3. Furnish samples of roof membrane.
 - 4. Furnish sample of metal edge to be installed.
 - 5. Determine compatibility of adjacent patch to existing at perimeter of new areas. Verify weld is able to withstand required test limits at patch strip locations. Provide pull-test for welds of new thermoplastic roofing membrane to existing membrane (test sample removed from area to be demolished) to provide new roof with appropriate substrate and attachment at membrane patch.

1.8 SUBMITTALS

- A. Qualification Data: For Installer and manufacturer.
- B. Product Data: Manufacturer's printed instructions, schedules, charts, literature, and illustrations to indicate the performance, fabrication procedures, product variations, adhesive, and accessories to be used in the Work.
- C. Fire rated documents showing compliance with UL
- D. Manufacturer Certificates: Signed by roofing manufacturer certifying that roofing system complies with requirements specified. Sign-off by both manufacturers if original warranty is in-place and new membrane is tying into existing with warranty in-tact.
- E. Shop Drawings: Furnish from copies of the Manufacturer's literature or from copies of NRCA "Roofing and Waterproofing Manual", fourth edition.
 - 1. Furnish for approval any proposed details, which differ from those, included with this proposal package. All proposed details shall first be approved in writing by roofing Manufacturer prior to submitting to Architect for approval.
 - 2. Furnish detail project sequencing, staging, material loading, manpower plans, and project construction schedule for approval.

- F. Samples:
 - 1. Furnish copy of sample warranty that is to be issued upon project completion.
 - 2. Copy ASTM 2523 Test Reports.
 - 3. Furnish samples of roof membrane.
 - 4. Furnish sample of metal edge to be installed.
- G. Product Test Reports: For components of roofing system, for tests performed by manufacturer and witnessed by a qualified testing agency.
- H. Research/Evaluation Reports: For components of roofing system, from ICC-ES.
- I. Field quality-control reports.
- J. Sample Warranties: For manufacturer's special warranties.
- K. Certifications:
 - 1. Manufacturer's written certification that installer is approved and licensed to install specified roofing system. (Submit a copy with Proposal Form)
 - 2. Manufacturer's affidavits that materials used in Project contain no asbestos.
 - 3. Installer shall submit resume and project experience list for proposed system for Project Manager and job site superintendent.
 - 4. Installer shall submit written certification that there are no undocumented workers being employed by them or any subcontractor on this project and that covers all workers on this project by workmen's compensation.
 - 5. Installer shall submit list of all subcontractors with evidence of subcontractor's insurance coverage in compliance with contract requirements.
 - 6. Manufacturer's written certification of approval / acceptance of these specifications and details.
- L. Referenced Standards: Two (2) copies of each referenced standard and retain approved copies at site.
- M. Upon Substantial Completion of Work, submit the following to Architect for his submission to Owner:
 - 1. Manufacturer's Warranty: Manufacturer's written warranty as specified.
 - 2. Contractor's Warranty: Contractor's written warranty as specified.
 - 3. Maintenance Procedures: Three (3) copies of roof system Manufacturer's printed instructions for Owner's use regarding care and maintenance of roof.
 - 4. Contractor's Warranty: Contractor's written warranty as specified.
 - 5. Affidavits from material manufacturers, suppliers and sub-contractors for release of liens.
 - 6. Refer to section 01 78 39 for additional requirements of close-out documents.
 - 7. Maintenance Data: For roofing system to include in maintenance manuals.

1.9 INSPECTIONS / TESTS

- A. The Owner's, Architect's, and Manufacturer's representative shall at all times have access to the job site and work areas. The contractor will provide proper and safe facilities for such access and inspection.
 - 1. Owner / Architect Inspections: The Owner / Architect will be providing periodic inspections throughout the duration of the project. Owner's / Architect's Representative shall be required to inspect after completion of each major phase of construction for approval.

2. Manufacturer Inspections:
 - a. An inspection shall be made by a representative of the material Manufacturer four (4) times per month during performance of Work and at all major phases of construction, to ensure that said project is installed in accordance with the Manufacturer's specifications and illustrated details. Daily written reports by the Manufacturer shall be turned over to the Architect, on each Monday following the inspection.
 - b. The authorized material Manufacturer's field representative shall be responsible for:
 - 1) Keeping the Architect's representative informed after periodic inspections as to the progress and quality of the work observed.
 - 2) Calling to the attention of the contractor those matters observed which are considered to be in violation of the contract requirements.
 - 3) Reporting to the Architect's representative, in writing, any failure or refusal of the contractor to correct unacceptable practices called to his attention.
 - 4) Confirming, after completion of the work and based on his observation and test, that he has observed no application procedures in conflict with these specifications. Final payment will not be released until the Architect has received all specified warranties.
- B. Any failure by the Owner's, Architect's, or Manufacturer's Representative to detect, pinpoint, or object to any defect or noncompliance of these specifications of work in progress or completed work shall not relieve the contractor, or reduce, or in any way limit, his responsibility of full performance of work required of him under these specifications.
- C. Architect may require tests and inspections as necessary to verify quality of roofing materials and workmanship. Laboratory tests will be performed in accordance with ASTM standard procedures.
 1. Owner will select testing laboratory and will pay for Work required by testing laboratory.
 2. Retest for work which fails initial tests shall be required. In this event, contractor shall pay inspections and testing fees.
 3. Non-Compliance with contractor requirements will result in the Architect / Owner to assign full-time quality control and will be subject to reimbursement by the construction manager / contractor.

1.10 QUALITY ASSURANCE

- A. Manufacturer Qualifications: A qualified manufacturer that is ISO 9001 certified for roofing system identical to that used for this Project.
- B. Installer Qualifications: A qualified firm that is approved, authorized, or licensed by roofing system manufacturer to install manufacturer's product and that is eligible to receive manufacturer's special warranty.
- C. Regulatory Requirements:
 1. Classification by Underwriters' Laboratories, Inc. as a Class A roof covering.
 2. Roofing system shall be installed in accordance with ASCE-7-16 wind uplift requirements for geographical location. and a 115 MPH 3-second gust wind speed zone with an importance factor of 1.15 based on CBC requirements. Wind- resistance loads listed below have a safety factor of 2.0 incorporated into the calculation.
 - a. Zone 1 Field -33.6
 - b. Zone 2 Perimeter -56.1
 - c. Zone 3 Corner -84.6

3. Follow local, state, and federal regulations of safety standards and codes. Refer to applicable building code California Building Code for roofing system installation requirements and limitations.
- D. Installer shall be an experienced, single firm specializing in the type of roofing and sheet metal work required, employing only experienced workers for the class of work in which they are employed, having at least five (5) years successful experience on projects similar in size and scope and acceptable and licensed as applicators by the material Manufacturer.
- E. No subcontracting of sheet metal fabrication or installation will be accepted. Contractor must have a sheet metal license and shop on company premises to perform such Work.
- F. Contractor: The contractor is responsible for the management and control of the work. He shall give his Personal superintendence of the work satisfactory to the Architect on the job site at all times while work is in progress, with full authority to act for the contractor as his agent.
- G. Work and materials hereinafter specified shall be best-of-kind described and, unless specified otherwise, shall be new and of best quality. All roofing materials utilized in performance of each type of work shall be the products of one manufacturer or supplier. Unless otherwise indicated, the materials to be used in this specification are those specified and denote the type, quality, performance, etc. required. All proposals shall be based upon the use of the specified material.
- H. Materials will be securely fastened in place in a watertight, neat and workmanlike manner. Contractor shall plan and conduct the operations of the work so that each section started on one day is complete, details installed and thoroughly protected before the close of work for that day.
- I. Application of materials shall be in accordance with the Manufacturer's recommendations. In the instance of a conflict between these specifications and those of the Manufacturer, the most stringent shall take precedence.
- J. Roof system shall be installed in accordance with ASCE 7-16 wind uplift requirements and Factory Mutual I-49 perimeter flashing requirements and shall meet Underwriter's Laboratory Class "A" fire rating.
- K. Contractor shall ensure that fastener pull out resistance tests on existing decks were performed and approved by Architect and coordinated with Roofing Consultant prior to starting roofing application.
- L. Contractor shall take all necessary precautions to protect the new roof mat and deck from damage. The contractor shall be responsible for repairing all new areas of damage caused by the negligence of the contractor, at the contractor's expense. The Architect's on-site representative shall determine damage caused by contractor negligence.
- M. Contractor shall keep the job clean and free from all loose materials and foreign matter. Contractor shall take necessary precautions to keep outside walls clean and shall allow no roofing materials to remain on the outside walls.

1.11 INSTALLATION CONFERENCE

- A. Refer to Section 01 31 13— Project Coordination.

1.12 DELIVERY, STORAGE, AND HANDLING

- A. Deliver materials in Manufacturer's original unopened packaging with all tags and labels intact and legible. Carton and can labels, shall indicate appropriate warnings, storage conditions, lot numbers, and usage instructions. Handle and store materials and equipment in such a manner as to avoid damage. The proper storage of materials is the sole responsibility of the contractor. Materials damaged in shipping or storage shall not be used. Wet or damaged roofing materials shall be discarded, removed from job site, and replaced with new materials prior to application.
- B. Deliver roofing materials to Project site in original containers with seals unbroken and labeled with manufacturer's name, product brand name and type, date of manufacture, approval or listing agency markings, and directions for storing and mixing with other components.
- C. Manufacturer's packaging and / or roll plastic is not acceptable for exterior storage. Tarpaulin with grommets shall be accepted minimum for exterior coverings. All materials stored, as above shall be minimum of four (4) inches off the substrate, and the tarpaulin tied off with rope.
- D. Moisture sensitive products shall be maintained in dry storage areas or properly covered. Roofing insulation and felts must always be covered or stored in a dry area when not being used.
- E. Store liquid materials in their original undamaged containers in a clean, dry, protected location and within the temperature range required by roofing system manufacturer. Protect stored liquid material from direct sunlight.
- F. Products liable to degrade as a result of being frozen shall be maintained above 40° F in heated storage.
- G. Discard and legally dispose of liquid material that cannot be applied within its stated shelf life.
- H. Protect roof insulation materials from physical damage and from deterioration by sunlight, moisture, soiling, and other sources. Store in a dry location. Comply with insulation manufacturer's written instructions for handling, storing, and protecting during installation.
- I. Protection: Use all means necessary to protect the adjacent buildings, equipment, and membrane roofing materials before, during, and after installation and to protect the installed work and materials of other trades.
- J. Handle and store roofing materials, and place equipment in a manner to avoid permanent deflection of deck.
- K. No storage of materials shall be permitted on roof areas other than those materials that are to be installed the same day. Any exception must be in written form. Do not place materials or equipment in such a manner as to overload structure.
- L. Repairs: In the event of damage, immediately make all repairs and replacements necessary to the approval of the Architect/Owner/IOR at no additional cost to the Owner.

1.13 FIELD CONDITIONS

- A. Weather Limitations: Proceed with installation only when existing and forecasted weather conditions permit roofing system to be installed according to manufacturer's written instructions and warranty requirements.
- B. Existing perimeter of demolition areas shall be maintained in watertight condition at all times, and tie-in details shall be signed off on by the original warranty manufacturer before providing patch to new membrane detailing.

1.14 WARRANTY

- A. Manufacturer System Warranty:
 - 1. Maintain existing warranty where possible: Obtain sign-off by manufacturer of new tie-in details.
 - 2. Alternate: Provide TWENTY (20) year System Warranty. The System Warranty shall provide for the roof membrane, all accessories that comprise a roof system and contractor labor. The Warranty shall be Non-prorated provide for No Dollar Limit (NDL), and shall not exclude ponding water and no time limited shall be assigned for any such ponding water during the warranty period.
- B. Installer Warranty: Form attached.
 - 1. Provide separate 5-year (Five) workmanship warranty. In the event any work related to roofing, flashing, or metal is found to be within the Installer warranty term, defective or otherwise not in accordance with the Contract Documents, the Installer shall repair that defect to the Owner and copy be sent to the manufacturer.

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. Source Limitations: Obtain components including for roofing system from manufacturer approved by membrane roofing manufacturer. The components of the roof system are to be products of a single manufacturer as required providing the specified system warranty.
- B. Install all materials in accordance with Manufacturer's current written specifications and details. Deviations shall not be made without prior written approval from the Manufacturer and the Owner's Representative. Should any specifications or details conflict with the Contract Documents, submit to Owner the recommended alternative that provides the best long term moisture protection and complies with Manufacturer's warranty requirements for approval.
- C. All materials shall be manufactured, specified, or accepted in writing by membrane manufacturer issuing the warranty. Proposed materials shall ensure full system warranty from said manufacturer. Installer shall be an applicator licensed by the Manufacturer.
- D. Samples of all materials used on the project, which are not supplied by the membrane Manufacturer, shall be submitted to the membrane Manufacturer for written approval prior to starting work.
- E. All materials used on the project shall be asbestos-free.

- F. Thermoplastic Membrane Roofing: Subject to compliance with requirements, provide either the named product or a comparable product by one of the other manufactures specified.
 - 1. Refer to existing warranty, coordinate with manufacturer and warranty provider to assure that warranty is maintained or that new warranty on replaced area does not conflict with existing remaining warranty for the remainder of the roof.
 - 2. Membrane to match existing thickness and manufacturer or be approved by existing warranty provider for tie-in.

2.2 GENERAL:

- A. The components of the adhered roof system are to be products of the manufacturer as indicated on the Detail Drawings and specified in the Contract Documents.
- B. Components to be used that are other than those supplied of manufactured by the membrane manufacturer may be submitted for review and acceptance by the manufacturer. The manufacturer acceptance of any other product is only for a determination of compatibility with membrane products and not for inclusion in the warranty. The specifications, installation instructions, limitations, and/or restrictions of the respective manufacturers must be reviewed by the Owner for acceptability for the intended use with membrane products.
- C. Membrane shall be certified by the manufacturer to be within two (2) mils of the specified membrane thickness as stated in this section.
- D. Membrane shall have a minimum of twenty-two (22) mils of waterproofing polymers above the reinforcements as documented by a third-party source.

2.3 APPROVED MANUFACTURERS

- A. Manufacturers whose products meet or exceed the specifications, who have manufactured and installed roof materials and systems of the type specified for a minimum of ten (10) years and who maintains a single source responsibility for the total roofing system, as described herein, may apply for approval as a substitution in accordance with Division 1 requirements regarding substitutions.
 - 1. Original Manufacturer per warranty where still in effect.
 - 2. Or Manufacturer/Architect Approved Compatible Equal
 - a) Sika Sarnafil
 - b) Soprema
 - c) Flex Roofing System
- B. All materials shall be manufactured, specified, or accepted in writing by membrane manufacturer issuing the warranty. Proposed materials shall ensure full system warranty from said manufacturer. Installer shall be an applicator licensed by the Manufacturer.
- C. Samples of all materials used on the project, which are not supplied by the membrane Manufacturer, shall be submitted to the membrane Manufacturer for written approval prior to starting work.
- D. All materials used on the project shall be asbestos-free.

2.4 ROUGH CARPENTRY

- A. All nailers, cants and wooden curbs shall be No. 2 or better treated lumber selected to meet design details and field dimensions and requirements of Section 06 10 00, Rough Carpentry.

2.5 ROOFING SHEET METAL

- A. Refer to Section 07 63 00, Roof Related Sheet Metal.

2.6 ROOF ASSEMBLY

- A. Class A roofing: (Assembly from bottom up)
1. Existing roof structure
 2. Plywood roof decking
 3. Non-rigid thermal insulation below deck (to match existing system)
 4. Rigid insulation (flat stock, 3.5-inches)
 5. Rigid insulation (sloped, finish slope of 1/4:12)
 6. Recovery Board (thickness to match existing system)
 7. Membrane Roofing (to match existing system)

2.7 MEMBRANE ROOFING

- A. **Membrane shall conform to:**
1. ASTM D4434 (latest version), "Standard for Polyvinyl Chloride Sheet Roofing". Classification: Type II, Grade I.
 2. NSF/ANSI Standard 347, "Sustainability Assessment for PVC Single-Ply Roofing Membranes". Certification Level: Platinum.
 3. The manufacture to guarantee that the membrane thickness meets or exceeds [the specified thickness] when tested according to ASTM D751
- B. Single-ply membrane system shall be a complete system, all components of which are provided by one manufacturer. Verify compliance with existing manufacturer warranty if in effect:
1. Existing system manufacturer where applicable
 2. Approved Alternates:
 - a) Sika Sarnafil
 - b) Soprema
 - c) Flex Roofing Systems
- C. Color: Title 24 Compliant, Standard Color from Manufacturer's palette – Match existing adjacent material to remain where possible and provide Cool-Roof Compatible color coating.
- D. Provide textured walkway material three feet wide meeting OSHA requirements and provided by the membrane manufacturer. (See spec this section)

2.8 AUXILIARY ROOFING MATERIALS

- A. General: Auxiliary materials recommended by roofing system manufacturer for intended use and compatible with roofing. As required by Roof System Manufacturer.
1. Furnish liquid-type auxiliary materials that meet VOC limits of authorities having jurisdictions.
 2. Auxiliary Materials as required.
- B. Wall/Curb Flashing: As required by Roof System Manufacturer.
1. Membrane: fiberglass reinforced membrane adhered to approved substrate.
 2. Clad: thermoplastic-coated, heat-weldable sheet metal capable of being formed into a variety of shapes and profiles. Clad to be 25-gauge min, G90 galvanized metal sheet with a 20-mil unsupported membrane laminated on one side.
 3. As required by Roof System Manufacturer

- C. Perimeter Edge Flashing: As required by Roof System Manufacturer.
 - As required by Roof System Manufacturer:
 - a) Clad: see previous item specification.
 - b) Non-typical Edge: Project-specific perimeter edge detail reviewed and accepted for one-time use by the Manufacturer's Technical Department.
 - c) Manufacturer to review prior to start of work.
- D. Liquid Applied Flashing System: As required by Roof System Manufacturer.
 - 1. Renew flashings with new Liquid-Applied Flashing System to preserve the life of the details. 3-Course flashing installation at penetrations and protrusions.
 - 2. Warrantable with Roofing System. Include in Roof System Warranty.
 - 3. Fast-cure liquid membrane flashing system.
 - 4. Flashing drains, penetrations, protrusions, electrical penetrations, low curb details, I-beams and other similar or unconventional conditions.
 - 5. As required by Roof System Manufacturer.
- E. Sealants: A single component, high performance, elastomeric sealant conforming to ASTM D232 or ASTM C920 requirements. Specified by new system and to existing warranty system tie-in by original warranty provider where in effect.
- F. Heat-Resistant, High-Temperature Sealant:
 - Manufacturer-approved / specified sealant, per warranty requirement.
- G. Miscellaneous Flashing: As required by Roof System Manufacturer.
 - 1. Flashing: Prefabricated expansion joint cover made from the membrane. Flashing is designed for securement to wall or horizontal surfaces to span and accommodate the movement of the new and existing expansion gaps, refer to roof expansion details.
 - 2. Stack: Prefabricated vent pipe flashing. As required by Roof System Manufacturer.
 - 3. T-Joint Circle Patches at material t-joint intersections.
 - 4. Pre-Formed Corners: Outside and inside flashing corners that are heat-welded to membrane of Clad base flashings.
 - 5. Multi-Purpose Sealant: A sealant used at flashing terminations.
 - 6. Adhesive: Solvent based to attach membrane to flashing substrate.
- H. Walkpads / Protection Pads: As required by Roof System Manufacturer.
 - 1. Walk pads shall have adequately contrasting color from surfacing.
 - 2. Provided walk pads shall be installed at point of roof access, at service points of all roof-mounted equipment requiring periodic maintenance.
 - 3. Protection pads shall have rounded corners and extend minimum four (4) inches beyond edge of overlying element.
 - 4. Provide new protection pads under all pipe supports, at HVAC and mechanical access points, in front of all rooftop doors and access openings:
 - a) Install *around* mechanical units and roof top units.
 - b) Install on 3-sides of roof access hatch.
 - c) Install at roof access locations
 - d) Install beneath conduit support blocks
 - 5. Tred-V Design Basis:
 - a. Polyester reinforced, weldable membrane with surface embossment similar to a chevron pattern.
 - b. Used as a protection layer from rooftop traffic.
 - c. Tred-V is supplied in rolls of 39 inches (1.0 m) wide and 50 feet (15 m) long.
- I. Substrate cover board or Separation Board: Fiberglass mat gypsum roof boards to be Den Deck Prime by Georgia Pacific, complying with ASTM C1177 or as required by Roof System Manufacturer.
 - 1. Match existing assembly thickness

2. Verify thickness is warrantable as specified
- J. Miscellaneous Accessories: Provide concrete splash blocks at roof leader terminated 6-inches above roof. Coordinated bird and bug screens. Roof hatch access steps and flashing. Mechanical equipment curbs and access panels.
- K. Metal Termination Bars: Manufacturer's standard aluminum bars, approximately 1-inch wide, roll formed and pre-punched.
- L. Metal Battens: Manufacturer's standard aluminum-zinc-alloy-coated or zinc-coated steel sheet, approximately 1 inch wide by 0.05 inch thick, pre-punched.
- M. Metal Flashings, Copings, Edge Trim and Accessories: Provide all roofing Manufacturer's metal required for a complete roofing system covered under the Manufacturer's warranty.
- N. Sealants: Membrane Manufacturer's approved sealant shall be used to seal penetrations through the membrane system and at miscellaneous sealant applications that come in contact with roof systems components.
- O. Air Seal Membrane: If required by Manufacturer to meet wind design requirements. Air seal membrane shall be a minimum 4 mil. Polyethylene sheeting or as required by roof system Manufacturer.
- P. Sealing Tape Strip: Compressible foam with pressure-sensitive tape on one side. Sealing tape strip is to be used with metal flashing as a preventive measure against air and windblown moisture entry.
- Q. Metal Reglet: Manufacturer's 6063T5 extruded aluminum counterflashing, approximately 2.25 inches wide and 0.10 inches thick, pre-punched at 8 inches o.c. for attachment to the wall or curb. Use prefabricated mitered inside and outside corners where walls interest.
- R. Miscellaneous Accessories: Provide pourable sealants, performed cone and vent sheet flashings, pre-formed inside and outside corner sheet flashings, T-joint covers, termination reglets, and other accessories as recommended by roofing system Manufacturer for intended use.
- S. Other miscellaneous materials shall be of the best grade available and approved in writing by roof system Manufacturer, prior to use, for the specific application.

2.9 ROOF INSULATION

- A. General: Preformed roof insulation boards manufactured or approved by thermoplastic roofing manufacturer, selected from manufacturer's standard sizes suitable for application, of thicknesses indicated - to match existing adjacent system.
- B. Recovery Board: As required by Roof System Manufacturer.
 1. Alternate: Glass-Faced Gypsum Roof Board equal to UL rated Type X "Dens Deck Prime" as produced by Georgia-Pacific. Board sizes shall be 48" x 96" x 1/2" or as indicated on drawings for roof assembly - to match existing roof assembly system level.
- C. Tapered Board Insulation: As required by Roof System Manufacturer.
 1. Provide one of the following:
 - a. ASTM C578
 - b. Match existing adjacent system

c. Warrantable by Roofing System Manufacturer

- D. Polyisocyanurate Roof Insulation: As required by Roof System Manufacturer.
 - 1. Shall comply with ASTM C1289 and Federal Specification (FS) HH-I-1972/Gen and HH-I-1972/2, with a 20-psi minimum compressive strength.
 - 2. Insulation shall be surfaced on both sides with non-asphaltic fiberglass facers.
 - 3. Thickness shall match existing system layering, where occurs.
 - 4. Warrantable by Roofing System Manufacturer.
- E. Tapered Polyisocyanurate Roof Insulation: As required by Roof System Manufacturer.
 - 1. Factory cut 48 inches x 48 inches polyisocyanurate board;
 - 2. Slope and thickness to vary as required to achieve a minimum 1/4 inch per foot finished slope unless noted otherwise on the Drawings;
 - a) ASTM C1289, UL Class A, Factory Mutual Class 1.
 - b) Warrantable by Roofing System Manufacturer.
 - c) 20 psi rigid polyisocyanurate insulation board with a cellulosic felt facer.
 - 3. Provide 1/2-inch recovery board similar to that specified above over tapered polyisocyanurate board insulation.
- F. Thermoplastic Roof Membrane Adhesive: As required by Roof System Manufacturer.
 - a. A low odor, VOC compliant, one step foamable polyurethane adhesive used to attach membrane to approved compatible substrates.
- G. Tapered Edge Strip: As required by Roof System Manufacturer.
 - 1-1/2 inches to 0 inches (or as required, field verify), 18 inches x 48 inches, install at all expansion joints, curbs, projections, crickets, saddles and base flashings.
 - Approved material shall be per manufacturer specification.

2.10 MISCELLANEOUS MATERIALS AND ACCESSORIES

- A. Other materials shall be as shown, specified or required and be of the best grade for the proposed use as recommended by the Manufacturer.
 - 1. Expansion Joint: As detailed on drawings and outlined in NRCA and SMACNA manuals.
 - 2. Low Level expansion joints, as noted on the drawings, to be fabricated similar to Situra Inc. "Red Line" Low level expansion joint details. Install as per Manufacturer's recommendations.
 - a. Approved Substitute Soprema's "Sopra Joint". Install as per Manufacturer's recommendations.
 - 3. Sealant Backer Rod: Provide compressible rod stock of polyethylene foam, polyurethane foam, polyethylene jacketed polyurethane foam, butyl rubber foam, neoprene foam or other flexible, permanent, durable, non-absorptive material as recommended by sealant Manufacturer for back-up of and compatibility with sealant. Where used with hot-applied sealant, provide heat-resistant type which will not be deteriorated by sealant application temperature as indicated.
 - 4. Pipe Hangers and Supports: Provide and install all necessary supports for gas lines, conduit, chilled water lines, duct work, condensate lines, etc. Refer to Section 07 72 00, Roof Accessories.
 - 5. Cant Strips: Shall be wood fiber where used for non-structural purposes. Shall be treated solid wood where used for structural purposes meeting NRCA, Factory Mutual and Underwriters Laboratory guidelines. If solid wood cant is used where insulation exists, cant is to be toe nailed into treated solid wood nailer the same height as insulation.

6. Termination Bar:
 - a. Material: Extruded aluminum bar with lip profile.
 - b. Size: 0.090-inch thick by 3/4-inch wide with 3/16 inch lip width and a 45-degree lip angle, factory punched 1/4 inch x 3/8 inch oval holes spaced six (6) inches on center.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Existing Conditions: Examine existing building and new construction to determine existing physical conditions that affect installation of new roofing. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements and other conditions affecting performance of the Work:
 1. Verify that roof openings and penetrations are in place, curbs are set and braced, and roof-drain bodies are securely clamped in place.
 2. Verify that wood blocking, curbs, and nailers are securely anchored to roof deck at penetrations and terminations and that nailers match thicknesses of insulation.
 3. Verify that minimum drying period recommended by roofing system manufacturer has passed.
 4. Verify all roof surfaces are smooth and free of dirt, debris and incompatible materials.
 5. Verify all roof surfaces shall be free of water.
 6. Verify that weldable surface of adjacent existing membrane to new membrane patch areas is not chalking or degrading and may be welded to per submittal tests.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.
- C. Weather Limitations: Proceed with roofing work only when existing and forecasted weather conditions permit roofing to be installed according to Manufacturer's written instructions and warranty requirements.
- D. Environmental Requirements:
 1. Apply roofing in dry weather.
 2. Do not expose roof components and flashing in inclement weather or when it is predicted 30% or more possibility for inclement weather.
 3. When ambient temperature is below 40 degrees Fahrenheit, expose only enough sensitive cements, sealants, and adhesives as required for use within a four-hour period.
 4. Do not expose membrane and accessories to a constant temperature of 180 degrees Fahrenheit.
- E. Protection:
 1. Provide special protection and avoid traffic on completed areas of membrane installation.
 2. Restore to original condition or replace work or materials damaged during handling of roof materials.
 3. Take precautions as required to protect adjacent work and structures.
- F. Emergency Equipment: Maintain on site equipment necessary to apply emergency temporary edge seal in event of sudden storms or inclement weather.
- G. Restrictions:
 1. Comply with General Requirements on use of site.
 2. Smoking is prohibited on all roof areas or in existing buildings.
 3. Maintain facility and all utility services in a functional condition.

4. Provide sanitary facilities for employees.
- H. Examine and verify that receiving substrate surfaces of the structure have no defects or errors, which would result in poor or potentially defective application or cause latent defects in workmanship.
 1. Examine substrate to which roofing material is to be applied to ensure that its condition is satisfactory for roofing application. Do not permit voids greater than 1/4 inch wide in the substrate. Substrates for roofing materials shall be dry and free of oil, dirt, grease, sharp edges, and debris. Inspect substrates, and correct defects before application of thermoplastic sheets.
- I. Verify that roofing openings and penetrations are in place and set and braced and that roof drains are properly clamped into position.
- J. Do not proceed with installation until unsatisfactory conditions have been corrected. Starting installation shall imply acceptance of surfaces and conditions.
- K. Nailers:
 1. Wooden nailers shall be installed at perimeter edges or drip edges on outside perimeter of building.
 2. All Construction: Nailers shall be the same height as the new insulation being installed or to existing raised roof edge whichever is applicable.
 3. Nailers shall be anchored to resist a pullout force of 300 pounds per linear foot per Factory Mutual Data Sheet 1-49.
 4. Fasteners shall be no less than two (2) per nailer and be spaced at 24-inches on center maximum.
 5. Raise all curbs, flashing, etc., a minimum of ten (10) inches above the deck.

3.2 PREPARATION

- A. Clean substrate of dust, debris, moisture, and other substances detrimental to roofing installation according to roofing system manufacturer's written instructions. Remove sharp projections.
- B. Clean adjacent existing membrane surface to provide for satisfactory tie-in to existing of path to new membrane.
- C. 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.

3.3 SUBSTRATE PREPARATION

- A. Substrate Surface: Prepare substrate surfaces to insure proper and adequate installation, in strict accordance with the Contract Documents and approved Shop Drawings, or Manufacturer's requirements.
- B. Fill all gaps and voids between substrate components that are wider than 1/4 inch. Fill all gaps with same materials as the substrate.
- C. The membrane Manufacturer shall specify types of substrates that are suitable for use with the bonding adhesive.
- D. Protection of Adjacent Areas or Surfaces: Protect adjacent areas or surfaces from damage as a result of the Work of this section. 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.
- F. Complete terminations and base flashings and provide temporary seals to prevent water from entering completed sections of the roofing system at the end of the workday or when rain is forecast. Remove and discard temporary seals before beginning work on adjoining roofing.
- G. Tear-off (if applicable):
 - 1. Cut existing membrane and substrate neatly down to structure along perimeter of area to be demolished.
 - 2. Tear-off existing roof system down to existing deck, deck to remain. Remove all associated Flashings and abandoned equipment.
 - 3. Repair / Patch all existing decks as required, due to removal of equipment or deteriorated conditions.
 - 4. Sweep or vacuum all surfaces, removing all loose aggregate and foreign substances prior to commencement of roofing. Ensure dry, smooth surface with no depressions or ponding water. Notify Architect prior to roofing any areas that may result in ponding water.
 - 5. Trash Chutes: Roofing materials and other discarded materials shall be put into an enclosed trash chute. No material may be thrown off roof. Remove debris daily from roof and from grounds.
 - 6. Refer to phasing plans for flashing of existing curbs now and demolition of existing curbs and penetrations at future dates, flashing of new curbs and penetrations at a future date.

3.4 ROOFING INSTALLATION, GENERAL

- A. Install roofing system according to roofing system manufacturer's written instructions.
- B. Complete terminations and base flashings and provide temporary seals to prevent water from entering completed sections of roofing system at end of workday or when rain is forecast. Remove and discard temporary seals before beginning work on adjoining roofing.
- C. Base Flashing: Fully adhere base flashings to the substrate in manufacturer provided bonding adhesive. Install termination bar and sealant at the top of base flashing.
- D. Install roofing and auxiliary materials to tie-in to existing roofing where applicable to maintain weather-tightness of transition and in a manner which does not void warranty for existing roofing system where it exists.

3.5 INSULATION INSTALLATION

- A. General:
 - 1. Manufacturer's Instructions: In regard to attachment, the Manufacturer's instructions or specifications shall determine the suitability for an application.
 - 2. Precautions: The surface of the insulation must not be ruptured or damaged prior to installation of the roof membrane. Replace damaged boards and sheathing and have it inspected where required.
 - 3. Coordinate installing roofing system components so insulation is not exposed to precipitation or left exposed at the end of the workday.
 - 4. Comply with roofing system and insulation manufacturer's written instructions for installing roof insulation.

5. Thermal insulation boards shall be laid on the substrate in parallel rows with end joints staggered and butted as close as possible. All joints shall be tight and at the roof perimeter and roof penetrations, insulation shall be cut neatly and fitted to reduce openings to a minimum. All openings 1/4 inch or larger shall be filled with insulation.
 6. Insulation shall be tapered or feathered at drains and scuppers to provide proper drainage (if applicable).
 7. No more insulation shall be installed than can be covered by the completed roof system by the end of the day or the onset of inclement weather.
 8. Tapered insulation and crickets, when specified, shall be placed in accordance with the drawings and / or as required NRCA standards.
- B. Install tapered insulation under area of roofing to enhance drainage and provide positive drainage.
- C. Install insulation under area of roofing to achieve required thickness.
1. Where overall insulation thickness is 3.5 inches or greater, install two or more layers with joints of each succeeding layer staggered from joints of previous layer a minimum of 12 inches (150 mm) in each direction.
- D. Trim surface of insulation where necessary at roof drains so completed surface is flush and does not restrict flow of water.
- E. Install insulation with long joints of insulation in a continuous straight line with end joints staggered between rows, abutting edges and ends between boards. Fill gaps exceeding 1/4 inch (6 mm) with insulation.
- F. Install recovery board over the insulation, staggering joints a minimum of 12" in all directions. Mechanically attach to the deck.
- G. Wood decks:
1. Specified rigid insulation shall be mechanically fastened to the wood deck meeting ASCE 7-16 wind uplift requirements as dictated by wind zone applicable to location of project.
 2. Fasteners and fastening patterns shall be determined by building height, location, and geographical area of the United States.
 3. It is the contractor's responsibility to consult current publications, literature, and bulletins of current codes and the Manufacturer that are in effect at the time of this project.

3.6 INSTALLATION OF THERMOPLASTIC MEMBRANE

- A. General: Install in strict accordance with Manufacturer's latest published requirements, instructions, specifications, and details and approved shop drawings.
- B. Over the properly installed and prepared substrate, adhesive shall be installed per manufacturer instruction.
- C. For application of hot asphalt as an adhesive for the membrane, refer to Manufacturer's recommendations.
- D. For application of cold asphalt or other adhesive, refer to Manufacturer's recommendations.
- E. Install membrane per manufacturer instruction.

3.7 SEAM INSTALLATION

- A. Clean seam areas, overlap sheets, and weld side and end laps of sheets and flashings according to Manufacturer's written instructions to ensure a watertight seam installation.
Weld seam as follows:
 - 1. Weld Method: Hot Air
- B. Test lap edges with probe to verify seam weld continuity on a daily basis.
- C. Repair tears, voids, and lapped seams in roofing that does not meet requirements.
- D. Apply T-Joints at all required locations.
- E. At tie-in to existing, provide cover strip for welded seams, detail in accordance with existing warranty requirements where existing.

3.8 FLASHING INSTALLATION

- A. Install sheet flashings and pre-formed flashing accessories and adhere to substrate according to roofing system Manufacturer's written instructions.
- B. Apply bonding adhesive to substrate and underside of flashing sheet at required rate and allow to partially dry. Do not apply bonding adhesive to seam area of flashing.
- C. Flash penetrations and field-formed inside and outside corners with sheet flashing as recommended by Manufacturer.
- D. Clean seam areas, overlap seams, and firmly roll flashings into the adhesive. Weld side and end laps to ensure a watertight seam installation.
- E. Test lap edges with probe to verify seam weld continuity. Apply lap sealant, if required by roofing Manufacturer, and seal exposed edges of sheet flashing terminations per Manufacturer's requirements.
- F. Terminate and seal top sheet flashings and mechanically anchor to substrate through termination bars.
- G. Apply T-Joints at all required locations.

3.9 ROOF SYSTEM INTERFACE WITH RELATED COMPONENTS

- A. Sealant: Seal all exposed finish ply edges at gravel stops, waste stacks, pitch pans, vent stacks, etc., with a smooth continuous bead of approved sealant.
- B. Sheet Metal: Refer to Section 07 62 00, ROOF RELATED SHEET METAL.

3.10 WALKWAY INSTALLATION

Flexible Walkways: Install walkway products in locations indicated. Heat weld to substrate according to roofing system manufacturer's written instructions. Leave 3 inches of space between adjacent walkway.

3.11 DRAINS AND DRAINAGE

- A. Check plumbing at drains, scuppers, downspouts, etc.

- B. Check roof drains, overflow drains, and scuppers for proper installation and function.
- C. Confirm that plumbing is sound, does not leak, and is proper.
- D. Confirm that plumbing is functional and provides for complete drainage.
- E. Replace plastic drain baskets with new cast iron strainers.

3.12 MECHANICAL UNITS, SHEET METAL, AND ROOFTOP FIXTURES

- A. Rejuvenate and renew sealants. Remove embrittled and/or otherwise ineffective sealants.
- B. Remove unused or otherwise “dead” equipment and fixtures, including CMU blocks, wood/lumber, satellite dishes, etc.
- C. Repair electrical conduit and couples.
- D. Repair electrical fixtures including conduit, electrical boxes, outlets, etc.
- E. Install proper storm collar at mechanical flues. Seal with heat-resistant sealant.
- F. Install proper penetration flashings at duct penetrations.
- G. Route errant wires and cables through conduit.
- H. Provide new engineered conduit & pipe supports, hangers, and clamps. Provide protection beneath sleepers and supports. Supports by Erico (Caddy Pyramid Supports), Mapa Products, Miro Industries, PHP Systems, or approved equal.
- I. Replace conduit insulation wrap.
- J. Prepare and Coat conduit lines with acrylic coating by National Coatings or approved equal
 - 1. Gas Lines – coat Red
 - 2. Copper condensate lines – coat White
 - 3. Electrical Lines – coat Green
 - 4. Drain Screens – coat Blue
 - 5. Legs of sheet metal curb flashings – coat Red
 - 6. Immediately clean any spills!

3.13 RESTORATION OF SHEET METAL FIXTURES

- A. Restoration of Sheet Metal Fixtures including (but not limited to) Sheet Metal Flashings, Sheet Metal Trim, Hoods, Caps, Enclosures, Penetrations, and Ductwork
 - 1. All rooftop exposed sheet metal is included in this Work.
 - 2. Basis for the Design: National Coatings
 - a) Clean and prepare all sheet metal fixtures and flashings.
 - b) Clean and clear oxidation from sheet metal fixtures and flashings. Use mechanical means as necessary.
 - c) Prime (rust-inhibitive primer) bare sheet metal caps and ancillary sheet metal flashings. This shall be completed prior to any detailing and 3-coursing.
 - d) Detail & 3-course all joints using trowel-grade acrylic mastic (A150) and polyester OR with Glenkote Seal Flex Duct Sealant (at ducts). Coat with two coats of A400 Tan or Gray acrylic to match new coatings and roofing system.
 - e) Coat sheet metal caps, sheet metal fixtures, and ancillary sheet metal flashings with a 2-Coat white acrylic system (A400 + A400). Color to match roofing.

- f) Follow all manufacturer's guidelines for a proper application.

3.14 ROOF ACCESS

- A. Install new SafePro Roof Hatch Safety Rail and Ladder Extension with self-closing access gate.

3.15 MISCELLANEOUS WORK

- A. Repair any leaks at the roofs included in this Work.
- B. Trim trees back from making contact with building and roof. Coordinate with School District and onsite Custodial Staff.
- C. Wood blocking to match thickness of roofing for flush termination and/or free-flowing drainage.
- D. Renew joint sealants along interior of walls at roof, if any.
- E. Renew sealants. All sealant applications shall be tooled.
- F. Under no circumstance shall flashings be secured through the top plane of the flashing fixture. Do not "top nail" flashings. This will not be acceptable, and flashing shall be replaced and properly installed.
- G. Remove unused, abandoned, or otherwise "dead" equipment and fixtures, including CMU blocks, wood/lumber, satellite dishes, conduit, etc.
- H. Repair electrical fixtures including conduit, couples, electrical boxes, outlets, etc.
- I. Remove pitch pans from the roof so that new, warrantable, pre-manufactured units Liquid-Applied Flashing System may be used to flash penetrations. Install for warrantable application/installation consistent with roofing manufacturer.

3.16 METAL FLASHINGS, COPINGS, EDGE TRIM AND ACCESSORIES INSTALLATION

- A. General: Secure metal flashings accessories at roof edges according to FM Loss Prevention Data Sheet 1-49 for specified wind zone.

3.17 OVERNIGHT SEAL / WATER CUT-OFF

- A. Overnight Seal: Shall be performed according to accepted roofing practice as outlined in the NRCA Roofing Manual.
- B. Water Cut-Off: At the end of day's work or when precipitation is imminent, construct a water cut-off at all open edges. Cut-offs can be built using asphalt or plastic cement and roofing felts, constructed to withstand protracted periods of service. Cut-offs must be completely removed prior to resumption of roofing.

3.18 SPIRIT OF THE ROOF

- A. The intent of the design is as important as the design itself.
- B. In the spirit of construction, we expect nothing less than "Good Roofing Practice."

- C. Code compliance is the worst roof we can install.
- D. All terminations shall have an element of redundancy.
- E. Seal roof terminations with termination bar and 3-courses of sealant...1 each Butyl Tape, 1 each Butyl Tape or Sealant, and 1-each fillet of sealant.
- F. All Terminations include termination bar with sealant behind membrane, behind bar, and atop bar + Sheet Metal Counterflashing with sealed terminations. Surface mounted CF will have sealant behind the sheet metal leg and atop the sealant lip.
- G. Details are common and typical. Some are specific, but for the most part, the details are common and typical. Their intent is what's important. It is difficult to match exactly every detail on a retrofit operation. Some show details specific to existing conditions, while others cannot. In retrofit work, knowing existing conditions is difficult sometimes...that's why we have "allowances." That's why details are shown as "Typical" or "Common". Our intention is to provide long term serviceable roofing for our clients and your customer.
- H. All terminations have an element of redundancy.

3.19 FIELD QUALITY CONTROL

- A. Owner's Inspector of Record to inspect substrate conditions, surface preparation, membrane application, flashings, protection, and drainage components, and furnish reports to Architect prior to install of finished roof materials. If conditions are not met, contractor to repair and request re-inspection for verification.
- B. Final Roof Inspection: Arrange for roofing system manufacturer's technical personnel to inspect roofing installation on completion.
- C. Repair or remove and replace components of roofing system where inspections indicate that they do not comply with specified requirements.
- D. Additional testing and inspecting, at Contractor's expense, will be performed to determine if replaced or additional work complies with specified requirements.
- E. Manufacturer's Quality Control Inspection: The Manufacturer's Technical Representative shall review the on-going work on a minimum of one time every 10 working days. All defects noted non-compliance with the specifications or the recommendations of the thermoplastic Manufacturer should be itemized in a punch list. These items must be corrected immediately by the contractor to the satisfaction of the owner's representative and the thermoplastic Manufacturer.

3.20 PROTECTING AND CLEANING

- A. Protect roofing system from damage and wear during remainder of construction period. When remaining construction does 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. Immediately remove all spots, smears, stains, residues, adhesives, etc., from the Work of this Section and / or upon adjacent areas or surfaces, which result from the Work of this Section.

- C. Upon completion of the Work of this Section, dispose of, away from the Site, all debris, trash, containers, residue, roofing remnants and scraps which result from the Work of this Section.
- D. Correct deficiencies in or remove roofing that does not comply with requirements, repair substrates, reinstall roofing, and repair sheet flashings to a condition free of damage and deterioration at the time of Substantial Completion and according to warranty requirements.
- E. All warranties, as required for the project by this specification, shall be submitted for approval prior to final payment.
- F. Clean overspray and spillage from adjacent construction using cleaning agents and procedures recommended by manufacturer of affected construction.

3.21 ACCEPTANCE AND CLOSEOUT

- A. Prior to demobilization from the site, the Owner / Project Manager, Architect and installer shall review the work. All defects and noted noncompliance with the specifications or the recommendations of the thermoplastic Manufacturer should be itemized in a punch list. These items must be corrected immediately by the contractor prior to demobilization to the satisfaction of the Owner / Project Manager and the thermoplastic Manufacturer.
- B. Notify Architect and Owner 48 hours in advance of the date and time of inspection.
- C. All warranties, as required for the project by this specification, shall be submitted for approval prior to final payment.
- D. Provide all Closeout Submittals as required in Part 1 of this Section.

END OF SECTION 07 54 19

SECTION 07 62 00

SHEET METAL FLASHING AND TRIM

1. PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Flashings.
- B. Counter flashing at piping penetrations, vent pipes, and conduits.
- C. Counterflashings over bituminous base flashings.
- D. Counterflashings at roof mounted equipment, curbs and supports.

1.2 REFERENCES

- A. ANSI / SPRI ES-1 Wind Design Standard for Edge Systems Used with Low Slope Roofing Systems.
- B. ASTM A653 - Steel Sheet, Zinc-Coated, (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.
- C. ASTM A755 - Steel Sheet, Metallic Coated by the Hot-Dip Process and Prepainted by the Coil-Coating Process for Exterior Exposed Building Products.
- D. ASTM A792 – Steel Sheet, Aluminum-Zinc Alloy. Coated by the Hot-Dip Process, General Requirements.
- E. ASTM A924 - General Requirements for Steel Sheet, Zinc-Coated (Galvanized) by the Hot-Dip Process.
- F. ASTM B32 - Solder Metal.
- G. ASTM B101 - Standard Specifications for Lead-Coated Copper Sheet and Strip for Building Construction.
- H. ASTM D4586 - Asphalt Roof Cement, Asbestos Free.
- I. SMACNA - Architectural Sheet Metal Manual.

1.3 SYSTEM DESCRIPTION

- A. Work of this Section is to physically protect membrane roofing, and base flashings, from damage that would permit water leakage to building interior.

1.4 QUALITY ASSURANCE

- A. Applicator: Company specializing in sheet metal flashing work with five years minimum experience.
- B. Perform work in accordance with SMACNA standard details and requirements.
- C. Copings and roof edge flashings shall conform to SPRI ES-1 testing and shall be in compliance with SMACNA Technical Resource Bulletin #5-09.
- D. SPRI Wind Design Standard: Manufacture and install copings and roof edge flashings capable of resisting an ultimate design wind speed of 115 miles per hour.

1.5 SUBMITTALS

- A. Submit shop drawings, product data, and samples under provisions of Section 01 33 00.
- B. Submit shop drawings of sheet metal items indicating profiles, jointing, terminations and installation details. Indicate type and spacing of fasteners.

- C. Submittal of specific plates from the SMACNA Architectural Sheet Metal Manual constitutes acceptable documentation of installation details.
- D. Submit product data for pre-coated galvanized steel.
- E. Submit two samples, 4 x 4 inch in size illustrating metal finish color for pre-coated steel.
- F. Submit product data for flashing accessories.
- G. Submit warranty for water tightness.
- H. Submit warranty for metal finish.

1.6 STORAGE AND HANDLING

- A. Store products under provisions of Section 01 61 00.
- B. Stack preformed material to prevent twisting, bending, or abrasion, and to provide ventilation.
- C. Prevent contact with materials during storage which may cause discoloration, staining, or damage.

1.7 WARRANTY

- A. Provide warranty under provisions of Section 01 77 00.
- B. Provide 2-year warranty coverage for degradation of water tightness and integrity of seals.
- C. Provide 20-year warranty coverage for metal finish from all defects.

2. PART 2 PRODUCTS

2.1 SHEET MATERIALS

- A. Galvanized Steel: ASTM A653, Grade 33, G90 zinc coating in accordance with ASTM A924, 0.0299 inch thick core steel.

2.2 ACCESSORIES

- A. Lead-Coated Copper: ASTM B101, Temper H00 and H01, cold-rolled copper sheet, coated both sides with lead weighing not less than 12 lb/100 sq. ft. or more than 15 lb./100 sq. ft. total weight of copper sheet with lead applied to both sides.
- B. Fastener: Galvanized steel or stainless steel with soft neoprene washers at exposed fasteners.
- C. Underlayment: Spunbound reinforced polypropylene coated fabric sheet.
 - 1. Premium Grade Feltex as manufactured by SystemComponents Corp., www.systemcomponents.net.
 - 2. Premium Summit Synthetic Underlayment as manufactured by Atlas Roofing Corp., www.atlasroofing.com.
 - 3. Roof Top Guard II Underlayment as manufactured by Underlayment Specialties Plus, www.uspunderlayment.com.
 - 4. Substitutions: Under provisions of Section 01 25 13.
- D. Metal Primer: As specified in Section 09 90 00.
- E. Protective Backing Paint: Zinc chromate alkyd.
- F. Slip Sheet: 0.05 lb./sq. ft., rosin sized building paper.

- G. Sealant: Type specified in Section 07 92 00.
- H. Bedding Compound: Rubber-asphalt type.
- I. Plastic Cement: ASTM D4586, Type I.
- J. Metal Flashing System: Two piece pre-coated galvanized steel similar to Springlok Flashing System, manufactured by Fry Reglet, www.fryreglet.com, type as indicated. Include fabricated end closures and mitered corners.
- K. Solder for Lead-Coated Copper: ASTM B32, Grade SN 60 percent tin, 40 percent lead.
- L. Solder for Zinc: ASTM B32; 50/50 tin/lead type, with rosin flux.

2.3 FABRICATION

- A. Form sections true to shape, accurate in size, square, and free from distortion or defects.
- B. Fabricate concealed cleats of galvanized steel, ASTM A653, Grade 33, G90 zinc coating, 0.0478 inch thickness, interlockable with sheet.
- C. Fabricate exposed cleats and coverplates of same material as sheet, interlockable with sheet.
- D. Form pieces in longest practical lengths.
- E. Hem exposed edges on underside 1/2 inch. Miter and seam corners.
- F. Form material with flat lock seam.
- G. Solder and seal metal joints. After soldering, remove flux. Wipe and wash solder joints clean.
- H. Fabricate corners from one piece with minimum 18 inch long legs; seam for rigidity, seal with sealant.
- I. Fabricate vertical faces with bottom edge formed outward 1/4 inch and hemmed to form drip.
- J. Fabricate flashings to allow toe to extend 2 inches over roofing surface. Return and brake edges.
- K. Fabricate vent pipe and roof penetration flashings of lead-coated copper with clamping ring.

3. PART 3 EXECUTION

3.1 INSPECTION

- A. Verify roof openings, curbs, pipes, sleeves, ducts, or vents through roof are solidly set, cant strips and reglets are in place, and nailing strips located.
- B. Verify membrane termination and base flashings are in place, sealed, and secure.
- C. Beginning of installation means acceptance of existing conditions.

3.2 PREPARATION

- A. Field measure site conditions prior to fabricating work.
- B. Install starter and edge strips, and cleats before starting installation.
- C. Install surface mounted reglets true to line and level. Seal top with sealant.
- D. Install underlayment with protective slip sheet over parapets, caps, copings, gravel stops and curbs.

3.3 INSTALLATION

- A. Conform to indicated details on the drawings and the recommendations included in the SMACNA Architectural Sheet Metal Manual.
- B. Provide for thermal expansion of exposed sheet metal work. Space movement joints at 10 feet - 0 inches o.c. maximum with no joints within 2 feet - 0 inches of corners.
- C. Form expansion joints of intermeshing hooked flanges filled with sealant.
- D. Insert flashings into reglets to form tight fit. Secure in place with lead wedges at maximum 12 inches on center. Pack remaining spaces with lead wool. Seal flashings into reglets with sealant.
- E. Secure flashings in place using concealed fasteners. Use exposed fasteners only where indicated.
- F. Lap, lock, seam and seal all joints.
- G. Apply plastic cement compound between metal flashings and felt flashings. Apply bituminous coating between dissimilar metals where occurs.
- H. Fit flashings tight in place. Make corners square, surfaces true and straight in planes, and lines accurate to profiles.
- I. Roof-Penetration, Vent Pipe Flashing: Turn lead flashing down inside vent piping. Clamp flashing to other pipes penetrating roof except for vent piping. Seal with elastomeric sealant.
- J. Solder metal joints watertight for full metal surface contact. After soldering, wash metal clean with neutralizing solution and rinse with water.
- K. Seal metal joints watertight.

3.4 FIELD QUALITY CONTROL

- A. Conform to SMACNA Architectural Sheet Metal Manual.
- B. Field observation will involve surveillance of Work during installation to ascertain compliance with specified requirements.

END OF SECTION

SECTION 07 92 00

JOINT SEALANTS

1. PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Preparing sealant substrate surfaces.
- B. Sealant and backing.

1.2 SUMMARY OF SEALANT LOCATIONS

- A. Joints in horizontal surfaces.
 - 1. Expansion and isolation joints in cast-in-place concrete slabs.
 - 2. Expansion and isolation joints in masonry paving.
 - 3. Joints in precast concrete paving units.
 - 4. Joints in stone paving units.
 - 5. Control and expansion joints in ceramic and quarry tile.
 - 6. Control and expansion joints in soffits, ceilings and overhead surfaces.
 - 7. Joints on underside of precast beams and planks.
 - 8. Perimeter joints in exterior openings.
 - 9. Joints between ceiling surfaces and frames for doors and windows.
 - 10. Joints in flashing and sheet metal.
 - 11. Perimeter joints of plumbing fixtures.
 - 12. Acoustical isolation joints between head and sill of walls and floor and ceiling surfaces.
 - 13. Joints between countertops and wall surfaces.
 - 14. Joints in skylights and framing.
 - 15. Joints between thresholds and floors.
 - 16. Isolation joints in plaster soffits and ceilings.
 - 17. Joints between dissimilar materials and those listed above.
 - 18. Other joints as indicated.
- B. Joints in vertical surfaces:
 - 1. Expansion and isolation joints in cast-in-place concrete.
 - 2. Expansion and isolation joints in masonry.
 - 3. Joints in precast concrete.
 - 4. Expansion and isolation joints in stonework.

5. Control and expansion joints in ceramic and quarry tile.
6. Perimeter joints in exterior openings.
7. Joints in flashing and sheet metal.
8. Perimeter joints of plumbing fixtures.
9. Acoustical isolation joints of walls.
10. Joints between cabinets and walls.
11. Joints between wall surfaces and door and window frames.
12. Joints in skylights and framing.
13. Isolation joints in plaster walls.
14. Joints between dissimilar materials and those listed above.
15. Other joints as indicated.

1.3 REFERENCES

- A. ASTM C834 - Latex Sealing Compounds.
- B. ASTM C919 - Practices for Use of Sealants in Acoustical Applications.
- C. ASTM C920 - Elastomeric Joint Sealants.
- D. ASTM C1193 - Standard Guide for Use of Joint Sealants.
- E. ASTM D1056 - Flexible Cellular Materials - Sponge or Expanded Rubber.
- F. FS TT-S-001657 - Sealing Compound, Single Component, Butyl Rubber Based, Solvent Release Type.
- G. SWRI - (Sealant, Waterproofing and Restoration Institute) - Sealant and Caulking Guide Specification.

1.4 SUBMITTALS

- A. Submit product data under provisions of Section 01 33 00.
- B. Submit product data indicating sealant chemical characteristics, performance criteria, limitations, and color availability.
- C. Submit samples under provisions of Section 01 33 00.
- D. Submit two samples 4 inches long in size illustrating colors selected.

1.5 QUALITY ASSURANCE

- A. Manufacturer: Company specializing in manufacturing the products specified in this Section with minimum five years documented experience.
- B. Applicator: Company specializing in applying the Work of this Section with minimum three years documented experience, approved by sealant manufacturer.
- C. Conform to Sealant, Waterproofing, and Restoration Institute (SWRI) requirements for materials and installation.
- D. Perform Work in accordance with ASTM C1193.

- E. Perform acoustical sealant application work to provide maximum STC values in accordance with ASTM C919.

1.6 ENVIRONMENTAL REQUIREMENTS

- A. Do not install solvent curing sealants in enclosed building spaces.
- B. Do not install sealant when temperature is less than 40 degrees F.
- C. Maintain temperature and humidity recommended by the sealant manufacturer during and after installation.

1.7 OPERATION AND MAINTENANCE DATA

- A. Submit maintenance data under the provisions of Section 01 77 00.
- B. Submit recommended inspection intervals for sealant joints.
- C. Submit instructions for repairing and replacing failed sealant joints.

1.8 WARRANTY

- A. Provide 5 year warranty under provisions of Section 01 77 00.
- B. Include coverage for installed sealants and accessories which fail to achieve air and water seal and exhibit loss of adhesion or cohesion or do not cure.

2. PART 2 PRODUCTS

2.1 MATERIALS

- A. Compatibility: Provide joint sealants, backings, and other related materials that are compatible with one another and with joint substrates under conditions of service and application, as demonstrated by sealant manufacturer, based on testing and field experience.
- B. VOC Content of Interior Sealants: Provide interior sealants and sealant primers that comply with the following limits for VOC content limits when calculated according to South Coast Air Quality Management District (SCAQMD) Rule 1168, and must meet or exceed the requirements for the Bay Area Quality Management District Regulation 8, Rule 5.
 - 1. Sealants: 250 g/L.
 - 2. Sealant Primers for Nonporous Substrates: 250 g/L.
 - 3. Sealant Primers for Porous Substrates: 775 g/L.

2.2 MANUFACTURERS

- A. Manufacturers and their products are listed for each type of sealant. Acceptable manufacturers include the following:
 - 1. Dow Consumer Solutions, www.consumer.dow.com.
 - 2. General Electric Co., www.gesealants.com.
 - 3. Pecora Corp., www.pecora.com.
 - 4. Sika Corp., www.sikausa.com.
 - 5. Sonneborn/ChemRex, www.chemrex.com.
 - 6. Tremco, Inc., www.tremcosealants.com.

7. United States Gypsum Co., www.usg.com.
8. W.R. Meadows, Inc., www.wrmeadows.com.

B. Substitutions: Under provisions of Section 01 25 13.

2.3 SEALANTS

- A. Type A - Acrylic Latex: One-part, non-sag, mildew resistant acrylic emulsion compound complying with ASTM C834, Type S, Grade NS, formulated to be paintable.
 1. Tremco, Inc., Acrylic Latex Caulk.
 2. Pecora Corporation, AC-20.
 3. Sonneborn, Chemrex, Sonolac.
- B. Type B - Butyl Sealant: One-part, non-sag solvent-release-curing sealant complying with FS TT-S-001657 for Type 1 and formulated with a minimum of 75 percent solids.
 1. Tremco, Inc., Tremco Butyl Sealant.
 2. Pecora Corporation, BC-158.
 3. Sonneborn, Chemrex, Multi-Purpose Sealant.
- C. Type C - Silicone Sealant: One-part nonacid-curing silicone sealant complying with ASTM C920, Type S, Grade NS, Class 25.
 1. Dow Consumer Solutions, Dowsil 790.
 2. General Electric Co., Silpruf.
 3. Tremco, Inc., Spectrem 1.
 4. Pecora Corp., 864 or 890.
 5. Sonneborn/Chemrex, Omniseal.
- D. Type D - Non-Sag Polyurethane Sealant: Single component sealant complying with ASTM C920, Type S, Grade NS, Class 25:
 1. Pecora Corp., Dynatrol I-XL.
 2. Tremco, Inc., Vulkem 921.
 3. Sika Corp., Sikaflex 1a.
 4. Sonneborn/ChemRex, Sonolastic NP-1.
- E. Type E - Neutral-Curing Silicone Sealant: One part medium modulus neutral-curing silicone sealant complying with ASTM C920, Type S, Grade NS, Class 25.
 1. Dow Consumer Solutions, Dowsil 795.
 2. General Electric Co., Ultraglaze 4000.
 3. Tremco, Inc., Spectrum 3.
 4. Pecora Corp., 895.

- F. Type F - One-Part Mildew-Resistant Silicone Sealant: Complying with ASTM C920, Type S, Grade NS, Class 25.
 - 1. Dow Consumer Solutions, Dowsil 786.
 - 2. General Electric Co., Sanitary 1700.
 - 3. Tremco, Inc., Tremsil 200.
 - 4. Pecora Corp., 863 or 898 White.
- G. Type G - Multi-Part Pourable Sealant: Complying with ASTM C920, Type M, Grade P, Class 25. Shore A hardness +40.
 - 1. Tremco, Inc., THC900/901.
 - 2. Pecora Corp., Dynatred or Urexpan NR-200.
 - 3. Sika Corporation, Sikaflex 2c NS TG.
 - 4. W.R. Meadows, Pourthane NS/SL.
- H. Type H - Acoustical Sealant: Nondrying, nonhardening permanently flexible conforming to ASTM C834.
 - 1. Pecora Corp., AIS-919 Acoustical Sealant.
 - 2. Tremco, Inc., Tremco Acoustical Sealant.
 - 3. United States Gypsum Co., Sheetrock Acoustical Sealant.

2.4 ACCESSORIES

- A. Primer: Non-staining type, recommended by sealant manufacturer to suit application.
- B. Joint Cleaner: Non-corrosive and non-staining type, recommended by sealant manufacturer; compatible with joint forming materials.
- C. Joint Backing: ASTM D1056; round, closed cell polyethylene foam rod; oversized 30 to 50 percent larger than joint width.
- D. Bond Breaker: Pressure sensitive tape recommended by sealant manufacturer to suit application.

3. PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify that joint openings are ready to receive Work and field measurements are as shown on Drawings and recommended by the manufacturer.
- B. Beginning of installation means installer accepts existing substrate.

3.2 PREPARATION

- A. Clean and prime joints in accordance with manufacturer's instructions. Prime if recommended by manufacturer.
- B. Remove loose materials and foreign matter which might impair adhesion of sealant.
- C. Verify that joint backing and release tapes are compatible with sealant.
- D. Perform preparation in accordance with ASTM C1193.

- E. Protect elements surrounding the Work of this Section from damage or disfiguration.

3.3 INSTALLATION

- A. Install sealant in accordance with manufacturer's instructions.
- B. Measure joint dimensions and size materials to achieve required width/depth ratios.
- C. Install joint backing to achieve a neck dimension no greater than 1/3 the joint width.
- D. Install bond breaker where joint backing is not used.
- E. Apply sealant within recommended application temperature ranges. Consult manufacturer when sealant cannot be applied within these temperature ranges.
- F. Install sealant free of air pockets, foreign embedded matter, ridges, and sags.
- G. Tool joints concave unless otherwise detailed.

3.4 CLEANING AND REPAIRING

- A. Clean work under provisions of Section 01 77 00.
- B. Clean adjacent soiled surfaces.
- C. Repair or replace defaced or disfigured finishes caused by Work of this Section.

3.5 PROTECTION OF FINISHED WORK

- A. Protect sealants until cured.
- B. Sprinkler fine silica sand on sealant of exterior concrete paving joints to reduce tracking of sealant.

3.6 SCHEDULE

<u>Type</u>	<u>Location</u>	<u>Color</u>
A. Type C - One-Part Nonacid Curing Silicone	Prefinished metal flashing	To match adjacent material
B. Type D - Non-Sag Polyurethane Sealant	Painted metal flashing.	To match adjacent surface.

END OF SECTION

SECTION 09 51 13

ACOUSTICAL PANEL CEILINGS

1. PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Suspended metal grid ceiling system.
- B. Acoustical panels.
- C. Non-fire rated assembly.
- D. Perimeter trim.

1.2 REFERENCES

- A. ASTM A513 - Electric-Resistance-Welded Carbon and Alloy Steel Mechanical Tubing.
- B. ASTM A641 - Zinc-Coated (Galvanized) Carbon Steel Wire.
- C. ASTM C635 - Metal Suspension Systems for Acoustical Tile and Lay-in Panel Ceilings.
- D. ASTM C636 - Installation of Metal Ceiling Suspension Systems for Acoustical Tile and Lay-in Panels.
- E. ASTM D3273 - Standard Test Method for Resistance to Growth of Mold on the Surface of Interior Coatings in an Environmental Chamber.
- F. ASTM E84 - Test Methods for Surface Burning Characteristics of Building Materials.
- G. ASTM E580 - Application of Ceiling Suspension Systems for Acoustic Tile and Lay-in Panels in Areas Requiring Seismic Restraint.
- H. ASTM E1264 - Classification of Acoustical Ceiling Products.
- I. DSA - Division of the State Architect.
- J. CBC - California Building Code, (CCR) California Code of Regulations, Title 24, Part 2.
- K. ICC - ES - International Code Council Evaluation Service, Inc.
- L. UL - Underwriters' Laboratories Building Material Directory.

1.3 QUALITY ASSURANCE

- A. Manufacturer: Company specializing in manufacture of ceiling suspension system and ceiling panels with five years minimum experience.
- B. Installer: Company with five years minimum documented experience, approved by manufacturer.

1.4 REGULATORY REQUIREMENTS

- A. Conform to CBC, California Building Code (CCR) California Code of Regulations, Title 24, Part 2, Chapter 16A for suspension system requirements and DSA IR 25-2.
- B. Conform to applicable UL and CBC combustibility requirements for materials.

1.5 SUBMITTALS

- A. Provide product data on metal grid system components and acoustic units.
- B. Submit samples under provisions of Section 01 33 00.

1.6 ENVIRONMENTAL REQUIREMENTS

- A. Maintain uniform temperature of minimum 60 degrees F, and humidity of 50 percent prior to, during, and after installation.

1.7 SEQUENCING/SCHEDULING

- A. Do not install acoustical ceilings until building is enclosed, sufficient heat is provided, dust generating activities have terminated, and overhead work is completed, tested, and approved.
- B. Schedule installation of acoustic units after interior wet work is dry.

1.8 EXTRA STOCK

- A. Provide extra quantity of acoustic units to Owner under provisions of Section 01 77 00.
- B. Provide quantity equal to 2 percent of units installed.

2. PART 2 PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS - SUSPENSION SYSTEM

- A. Armstrong Ceiling Systems, www.armstrongceilings.com. ICC-ES No. ESR-1308.
- B. Certainteed, www.certainteed.com ICC-ES No. ESR-3336.
- C. Chicago Metallic Corporation, www.chicagometallic.com. ICC-ES No. ESR-2631.
- D. USG Interior Systems, (DONN), www.usg.com. ICC-ES No. ESR-1222.
- E. Substitutions: Under provisions of Section 01 25 13.

2.2 SUSPENSION SYSTEM MATERIALS

- A. Grid: ASTM C635, heavy duty, non-fire rated, exposed T; components die cut and interlocking. Catalog numbers of acceptable manufacturer are indicated on drawings.
- B. Accessories: Stabilizer bars, clips, splices, and edge moldings required for suspended grid system.
- C. Grid Materials: Commercial quality cold rolled steel with galvanized coating.
- D. Grid Finish: White color, baked enamel.
- E. Support Channels and Hangers: Galvanized steel; size and type to suit application, to rigidly secure acoustic ceiling system including integral mechanical and electrical components, as detailed on drawings.
- F. Compression Strut: As detailed on drawings. ASTM A513, telescoping tube design, galvanized 3/4 inch diameter 14 gage rigid steel tubing with crimped end attached to roof framing and secured to 1/2 inch diameter 14 gage rigid steel tubing with crimped end to main runners. Equivalent pre-manufactured compression post supplied by ceiling grid manufacturer.
- G. Hanger Wire: ASTM A641, Class 1 coating (galvanized), soft temper, No. 12 gage.

2.3 ACCEPTABLE MANUFACTURERS - ACOUSTIC UNITS

- A. Armstrong Ceiling Systems, www.armstrongceilings.com.
- B. Certainteed, www.certainteed.com.
- C. USG Interiors, Inc., www.usg.com.
- D. Substitutions: Under provisions of Section 01 25 13.

2.4 ACOUSTIC UNIT MATERIALS

- A. Acoustic Panels: ASTM E1264, conforming to the following:

- 1. Equivalent to Ultima manufactured by Armstrong.

- | | | | |
|-----|-----------------------|---|--|
| (a) | Size | : | 24 x 24 inches |
| (b) | Thickness | : | 7/8 inches |
| (c) | Light Reflectance | : | 0.87 percent |
| (d) | NRC Range | : | 0.80 |
| (e) | CAC Range | : | 35 |
| (f) | Edge | : | Square |
| (g) | Surface Color | : | White |
| (h) | Flame Spread | : | ASTM E-84 (0-25) Class A, UL 25 or under |
| (i) | Smoke Density | : | Not to exceed 450 when tested in accordance with CBC Standard No. 12-8-1 |
| (j) | Mold/Mildew Inhibitor | : | Biocide treatment that inhibits mold and mildew when tested according to ASTM D3273. |

3. PART 3 EXECUTION

3.1 INSPECTION

- A. Verify that existing conditions are ready to receive work.
- B. Verify that layout of hangers will not interfere with other work.
- C. Beginning of installation means acceptance of existing conditions.

3.2 INSTALLATION - GRID SYSTEM

- A. Install system in accordance with ASTM C636 and ASTM E580 as supplemented in this Section and with notes on the drawing entitled Metal Suspension Systems for Lay In Panel Ceilings.
- B. Install after major above ceiling work is complete. Coordinate the location of hangers with other work.
- C. Hang system independent of columns, ducts, pipes and conduit. Where carrying members are spliced, avoid visible displacement of face plane of adjacent members.
- D. Where ducts or other equipment prevent the regular spacing of hangers, reinforce the nearest affected hangers and related carrying channels to span the extra distance.

- E. Compression struts to be installed at each main runner not exceeding 12'- 0" o.c. in both directions and not more than 8 inches from end of main runner. Insert main 3/4 inch tube over 1/2 inch tube with a minimum 6 inch lap. Secure crimped end of main 3/4 inch tube to structural framing with wood screws and 1/2 inch tube to main runner with metal screws. Secure tube sections together with 2 set screws. Install prefabricated compression post according to manufacturer's recommendations.
- F. Locate system on room axis according to reflected plan.
- G. Do not eccentrically load system, or produce rotation of runners.
- H. Install edge molding at intersection of ceiling and vertical surfaces, using longest practical lengths. Miter corners. Provide edge moldings at junctions with other interruptions.

3.3 INSTALLATION - ACOUSTIC UNITS

- A. Field rabbet cut edge of perimeter tiles to match factory rabbeted edge. Paint cut surface if necessary to match surface of tile.
- B. Fit acoustic units in place, free from damaged edges or other defects detrimental to appearance and function.
- C. Lay directional patterned units one way in room. Fit border neatly against abutting surfaces.
- D. Install acoustic units level, in uniform plane, and free from twist, warp and dents.

3.4 TOLERANCES

- A. Maintain tolerances in accordance with Section 01 43 00.
- B. Variation from flat and level surface: 1/8 inch in 10 feet.
- C. Variation from plumb of grid members caused by eccentric loads: Two degrees maximum.

END OF SECTION

SECTION 22 05 00

COMMON WORK RESULTS FOR PLUMBING

1. PART 1 GENERAL

1.1 SUMMARY

A. This Section includes the following:

1. Piping materials and installation instructions common to most piping systems.
2. Dielectric fittings.
3. Mechanical sleeve seals.
4. Sleeves.
5. Escutcheons.
6. Equipment installation requirements common to equipment sections.
7. Concrete bases.
8. Supports and anchorages.

1.2 DEFINITIONS

- A. Finished Spaces: Spaces other than plumbing and electrical equipment rooms, furred spaces, pipe chases, unheated spaces immediately below roof, spaces above ceilings, unexcavated spaces, crawlspace, and tunnels.
- B. Exposed, Interior Installations: Exposed to view indoors. Examples include finished occupied spaces and plumbing equipment rooms.
- C. Exposed, Exterior Installations: Exposed to view outdoors or subject to outdoor ambient temperatures and weather conditions. Examples include rooftop locations.
- D. Concealed, Interior Installations: Concealed from view and protected from physical contact by building occupants. Examples include above ceilings and in chases.
- E. Concealed, Exterior Installations: Concealed from view and protected from weather conditions and physical contact by building occupants but subject to outdoor ambient temperatures. Examples include installations within unheated shelters.

1.3 SUBMITTALS

- A. Welding certificates.

1.4 QUALITY ASSURANCE

- A. Steel Support Welding: Qualify processes and operators according to AWS D1.1, "Structural Welding Code--Steel."
- B. Steel Pipe Welding: Qualify processes and operators according to ASME Boiler and Pressure Vessel Code: Section IX, "Welding and Brazing Qualifications."
1. Comply with provisions in ASME B31 Series, "Code for Pressure Piping."

2. Certify that each welder has passed AWS qualification tests for welding processes involved and that certification is current.
- C. Electrical Characteristics for Plumbing Equipment: Equipment of higher electrical characteristics may be furnished provided such proposed equipment is approved in writing and connecting electrical services, circuit breakers, and conduit sizes are appropriately modified. If minimum energy ratings or efficiencies are specified, equipment shall comply with requirements.

2. PART 2 PRODUCTS

2.1 PIPE, TUBE, AND FITTINGS

- A. Refer to individual Division 22 piping Sections for pipe, tube, and fitting materials and joining methods.
- B. Pipe Threads: ASME B1.20.1 for factory-threaded pipe and pipe fittings.

2.2 JOINING MATERIALS

- A. Refer to individual Division 22 piping Sections for special joining materials not listed below.
- B. Pipe-Flange Gasket Materials: ASME B16.21, nonmetallic, flat, asbestos-free, 1/8-inch maximum thickness unless thickness or specific material is indicated.
- C. Solder Filler Metals: ASTM B 32, lead-free alloys. Include water-flushable flux according to ASTM B 813.
- D. Brazing Filler Metals: AWS A5.8, BCuP Series or BAg1, unless otherwise indicated.
- E. Welding Filler Metals: Comply with AWS D10.12.

2.3 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.
- D. Dielectric Couplings: Galvanized-steel coupling with inert and noncorrosive, thermoplastic lining; threaded ends; and 300-psig minimum working pressure at 225 deg F.
- 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.

2.4 MECHANICAL SLEEVE SEALS

- A. Description: Modular sealing element unit, designed for field assembly, to fill annular space between pipe and sleeve.
- B. Sealing Elements: EPDM interlocking links shaped to fit surface of pipe. Include type and number required for pipe material and size of pipe.

- C. Pressure Plates: Carbon steel. Include two for each sealing element.
- D. Connecting Bolts and Nuts: Carbon steel with corrosion-resistant coating of length required to secure pressure plates to sealing elements. Include one for each sealing element.

2.5 SLEEVES

- A. Galvanized-Steel Sheet: 0.0239-inch minimum thickness; round tube closed with welded longitudinal joint.
- B. Steel Pipe: ASTM A 53, Type E, Grade B, Schedule 40, galvanized, plain ends.
- C. Cast Iron: Cast or fabricated "wall pipe" equivalent to ductile-iron pressure pipe, with plain ends and integral waterstop, unless otherwise indicated.
- D. Stack Sleeve Fittings: Manufactured, cast-iron sleeve with integral clamping flange. Include clamping ring and bolts and nuts for membrane flashing.
 - 1. Underdeck Clamp: Clamping ring with set screws.
- E. Molded PVC: Permanent, with nailing flange for attaching to wooden forms.
- F. PVC Pipe: ASTM D 1785, Schedule 40.
- G. Molded PE: Reusable, PE, tapered-cup shaped, and smooth-outer surface with nailing flange for attaching to wooden forms.

2.6 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.

3. PART 3 EXECUTION

3.1 PLUMBING 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 plumbing 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. Equipment to Be Removed: Disconnect and cap services and remove equipment.
 - 4. Equipment to Be Removed and Reinstalled: Disconnect and cap services and remove, clean, and store equipment; when appropriate, reinstall, reconnect, and make equipment operational.
 - 5. 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.

3.2 PIPING SYSTEMS - COMMON REQUIREMENTS

- A. Install piping according to the following requirements and Division 22 Sections specifying piping systems.
- B. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems. Indicated locations and arrangements were used to size pipe and calculate friction loss, expansion, pump sizing, and other design considerations. Install piping as indicated unless deviations to layout are approved on Coordination Drawings.
- C. Install piping in concealed locations, unless otherwise indicated and except in equipment rooms and service areas.
- D. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.
- E. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal.
- F. Install piping to permit valve servicing.
- G. Install piping at indicated slopes.
- H. Install piping free of sags and bends.
- I. Install fittings for changes in direction and branch connections.
- J. Install piping to allow application of insulation.
- K. Select system components with pressure rating equal to or greater than system operating pressure.
- L. Install escutcheons for penetrations of walls, ceilings, and floors.
- M. Install sleeves for pipes passing through concrete and masonry walls, gypsum-board partitions, and concrete floor and roof slabs.

- N. Aboveground, Exterior-Wall Pipe Penetrations: Seal penetrations using sleeves and mechanical sleeve seals. Select sleeve size to allow for 1-inch annular clear space between pipe and sleeve for installing mechanical sleeve seals.
1. Install steel pipe for sleeves smaller than 6 inches in diameter.
 2. Install cast-iron "wall pipes" for sleeves 6 inches and larger in diameter.
 3. Mechanical Sleeve Seal Installation: Select type and number of sealing elements required for pipe material and size. Position pipe in center of sleeve. Assemble mechanical sleeve seals and install in annular space between pipe and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.
- O. Underground, Exterior-Wall Pipe Penetrations: Install cast-iron "wall pipes" for sleeves. Seal pipe penetrations using mechanical sleeve seals. Select sleeve size to allow for 1-inch annular clear space between pipe and sleeve for installing mechanical sleeve seals.
1. 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.
- P. 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.
- Q. Verify final equipment locations for roughing-in.
- R. Refer to equipment specifications in other Sections of these Specifications for roughing-in requirements.

3.3 PIPING JOINT CONSTRUCTION

- A. Join pipe and fittings according to the following requirements and Division 22 Sections specifying piping systems.
- B. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.
- C. Remove scale, slag, dirt, and debris from inside and outside of pipe and fittings before assembly.
- D. Soldered Joints: Apply ASTM B 813, water-flushable flux, unless otherwise indicated, to tube end. Construct joints according to ASTM B 828 or CDA's "Copper Tube Handbook," using lead-free solder alloy complying with ASTM B 32.
- E. Brazed Joints: Construct joints according to AWS's "Brazing Handbook," "Pipe and Tube" Chapter, using copper-phosphorus brazing filler metal complying with AWS A5.8.
- F. Threaded Joints: Thread pipe with tapered pipe threads according to ASME B1.20.1. Cut threads full and clean using sharp dies. Ream threaded pipe ends to remove burrs and restore full ID. Join pipe fittings and valves as follows:
1. Apply appropriate tape or thread compound to external pipe threads unless dry seal threading is specified.
 2. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged. Do not use pipe sections that have cracked or open welds.

- G. Welded Joints: Construct joints according to AWS D10.12, using qualified processes and welding operators according to Part 1 "Quality Assurance" Article.
- H. Flanged Joints: Select appropriate gasket material, size, type, and thickness for service application. Install gasket concentrically positioned. Use suitable lubricants on bolt threads.

3.4 PIPING CONNECTIONS

- A. Make connections according to the following, unless otherwise indicated:
 - 1. Install unions, in piping NPS 2 and smaller, adjacent to each valve and at final connection to each piece of equipment.
 - 2. Install flanges, in piping NPS 2-1/2 and larger, adjacent to flanged valves and at final connection to each piece of equipment.
 - 3. Dry Piping Systems: Install dielectric unions and flanges to connect piping materials of dissimilar metals.
 - 4. Wet Piping Systems: Install dielectric coupling and nipple fittings to connect piping materials of dissimilar metals.

3.5 EQUIPMENT INSTALLATION - COMMON REQUIREMENTS

- A. Install equipment to allow maximum possible headroom unless specific mounting heights are not indicated.
- B. Install equipment level and plumb, parallel and perpendicular to other building systems and components in exposed interior spaces, unless otherwise indicated.
- C. Install plumbing equipment to facilitate service, maintenance, and repair or replacement of components. Connect equipment for ease of disconnecting, with minimum interference to other installations. Extend grease fittings to accessible locations.
- D. Install equipment to allow right of way for piping installed at required slope.

3.6 CONCRETE BASES

- A. Concrete Bases: Anchor equipment to concrete base according to equipment manufacturer's written instructions and according to seismic codes at Project.
 - 1. Construct concrete bases of dimensions indicated, but not less than 4 inches larger in both directions than supported unit.
 - 2. Install dowel rods to connect concrete base to concrete floor. Unless otherwise indicated, install dowel rods on 18-inch centers around the full perimeter of the base.
 - 3. Install epoxy-coated anchor bolts for supported equipment that extend through concrete base, and anchor into structural concrete floor.
 - 4. Place and secure anchorage devices. Use supported equipment manufacturer's setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
 - 5. Install anchor bolts to elevations required for proper attachment to supported equipment.
 - 6. Install anchor bolts according to anchor-bolt manufacturer's written instructions.
 - 7. Use 3000-psi, 28-day compressive-strength concrete and reinforcement as specified in Division 03 Section "Cast-in-Place Concrete."

3.7 ERECTION OF METAL SUPPORTS AND ANCHORAGES

- A. Refer to Division 05 Section "Metal Fabrications" for structural steel.
- B. Cut, fit, and place miscellaneous metal supports accurately in location, alignment, and elevation to support and anchor plumbing materials and equipment.
- C. Field Welding: Comply with AWS D1.1.

3.8 ERECTION OF WOOD SUPPORTS AND ANCHORAGES

- A. Cut, fit, and place wood grounds, nailers, blocking, and anchorages to support, and anchor plumbing 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 22 05 00

SECTION 22 05 23

GENERAL-DUTY VALVES FOR PLUMBING PIPING

1. PART 1 GENERAL

1.1 SUMMARY

- A. This Section includes the following general-duty valves:
 - 1. Copper-alloy ball valves.
 - 2. Bronze gate valves.
- B. See Division 21 fire-suppression piping and fire pump Sections for fire-protection valves.
- C. See Division 22 piping Sections for specialty valves applicable to those Sections only.

1.2 SUBMITTALS

- A. Product Data: For each type of valve indicated. Include body, seating, and trim materials; valve design; pressure and temperature classifications; end connections; arrangement; dimensions; and required clearances. Include list indicating valve and its application. Include rated capacities; furnished specialties; and accessories.

1.3 QUALITY ASSURANCE

- A. ASME Compliance for Ferrous Valves: ASME B16.10 and ASME B16.34 for dimension and design criteria.
- B. NSF Compliance: NSF 61 for valve materials for potable-water service.

2. PART 2 PRODUCTS

2.1 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.

2.2 VALVES, GENERAL

- A. Refer to Part 3 "Valve Applications" Article for applications of valves.
- B. Bronze Valves: NPS 2 and Smaller: Threaded ends, unless otherwise indicated.
- C. Valve Pressure and Temperature Ratings: Not less than indicated and as required for system pressures and temperatures.
- D. Valve Sizes: Same as upstream pipe, unless otherwise indicated.

- E. Valve Actuators:
 - 1. Handwheel: For valves other than quarter-turn types.
 - 2. Lever Handle: For quarter-turn valves NPS 6 and smaller, except plug valves.
- F. Extended Valve Stems: On insulated valves.
- G. Valve Flanges: ASME B16.1 for cast-iron valves, ASME B16.5 for steel valves, and ASME B16.24 for bronze valves.
- H. Valve Grooved Ends: AWWA C606.
 - 1. Solder Joint: With sockets according to ASME B16.18.
 - a. Caution: Use solder with melting point below 840 deg F for angle, check, gate, and globe valves; below 421 deg F for ball valves.
 - 2. Threaded: With threads according to ASME B1.20.1.
- I. Valve Bypass and Drain Connections: MSS SP-45.

2.3 COPPER-ALLOY BALL VALVES

- A. Manufacturers:
 - 1. Two-Piece, Copper-Alloy Ball Valves:
 - a. Conbraco Industries, Inc.; Apollo Div.
 - b. Crane Co.; Crane Valve Group; Crane Valves.
 - c. Hammond Valve.
 - d. Milwaukee Valve Company.
 - e. NIBCO INC.
 - f. Watts Industries, Inc.; Water Products Div.
- B. Copper-Alloy Ball Valves, General: MSS SP-110.
- C. Two-Piece, Copper-Alloy Ball Valves: Bronze body with full-port, chrome-plated bronze ball; PTFE or TFE seats; and 600-psig minimum CWP rating and blowout-proof stem.

2.4 BRONZE GATE VALVES

- A. Manufacturers:
 - 1. Type 2, Bronze, Rising-Stem, Solid-Wedge Gate Valves:
 - a. Crane Co.; Crane Valve Group; Crane Valves.
 - b. Hammond Valve.
 - c. Milwaukee Valve Company.
 - d. NIBCO INC.
- B. Bronze Gate Valves, General: MSS SP-80, with ferrous-alloy handwheel.
- C. Type 2, Class 150, Bronze Gate Valves: Bronze body with rising stem and bronze solid wedge and union-ring bonnet.

3. PART 3 EXECUTION

3.1 VALVE APPLICATIONS

- A. Refer to piping Sections for specific valve applications. If valve applications are not indicated, use the following:
 - 1. Shutoff Service: Ball or gate valves.
 - 2. Throttling Service: Ball valves.
- B. If valves with specified CWP ratings are not available, the same types of valves with higher CWP ratings may be substituted.
- C. Domestic Water Piping: Use the following types of valves:
 - 1. Ball Valves, NPS 2 and Smaller: Two-piece, 600-psig CWP rating, copper alloy.
 - 2. Gate Valves, NPS 2 and Smaller: Type 2, Class 150, bronze.
- D. Select valves, except wafer and flangeless types, with the following end connections:
 - 1. For Copper Tubing, NPS 2 and Smaller: Solder-joint or threaded ends.
 - 2. For Copper Tubing, NPS 2-1/2 to NPS 4: Flanged or threaded ends.
 - 3. For Steel Piping, NPS 2 and Smaller: Threaded ends.
 - 4. For Steel Piping, NPS 2-1/2 to NPS 4: Flanged or threaded ends.

3.2 VALVE INSTALLATION

- A. Piping installation requirements are specified in other Division 22 Sections. Drawings indicate general arrangement of piping, fittings, and specialties.
- B. Install valves with unions or flanges at each piece of equipment arranged to allow service, maintenance, and equipment removal without system shutdown.
- C. Locate valves for easy access and provide separate support where necessary.
- D. Install valves in horizontal piping with stem at or above center of pipe.
- E. Install valves in position to allow full stem movement.
- F. Install check valves for proper direction of flow and as follows:
 - 1. Swing Check Valves: In horizontal position with hinge pin level.
 - 2. Dual-Plate Check Valves: In horizontal or vertical position, between flanges.
 - 3. Lift Check Valves: With stem upright and plumb.

3.3 JOINT CONSTRUCTION

- A. Refer to Division 22 Section "Common Work Results for Plumbing" for basic piping joint construction.
- B. Grooved Joints: Assemble joints with keyed coupling housing, gasket, lubricant, and bolts according to coupling and fitting manufacturer's written instructions.
- C. Soldered Joints: Use ASTM B 813, water-flushable, lead-free flux; ASTM B 32, lead-free-alloy solder; and ASTM B 828 procedure, unless otherwise indicated.

3.4 ADJUSTING

- A. Adjust or replace valve packing after piping systems have been tested and put into service but before final adjusting and balancing. Replace valves if persistent leaking occurs.

END OF SECTION 22 05 23

SECTION 22 05 29

HANGERS AND SUPPORTS FOR PLUMBING PIPING AND EQUIPMENT

1. PART 1 GENERAL

1.1 SUMMARY

- A. This Section includes the following:
 - 1. Steel pipe hangers and supports.
 - 2. Trapeze pipe hangers.
 - 3. Metal framing systems.
 - 4. Thermal-hanger shield inserts.
 - 5. Fastener systems.
 - 6. Equipment supports.
- B. See Division 05 Section "Metal Fabrications" for structural-steel shapes and plates for trapeze hangers for pipe and equipment supports.
- C. See Division 21 Section "Water-Based Fire-Suppression Systems" for pipe hangers for fire-suppression piping.

1.2 DEFINITIONS

- A. Terminology: As defined in MSS SP-90, "Guidelines on Terminology for Pipe Hangers and Supports."

1.3 PERFORMANCE REQUIREMENTS

- A. Design supports for multiple pipes 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.

1.4 SUBMITTALS

- A. Product Data: For the following:
 - 1. Steel pipe hangers and supports.
 - 2. Thermal-hanger shield inserts.
- 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. Equipment supports.
- C. Welding certificates.

1.5 QUALITY ASSURANCE

- A. Welding: Qualify procedures and personnel according to ASME Boiler and Pressure Vessel Code: Section IX.

2. PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. In other Part 2 articles where titles below introduce lists, the following requirements apply to 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, manufacturers specified.
 - 2. Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers specified.

2.2 STEEL 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.
- C. Galvanized, Metallic Coatings: Pregalvanized or hot dipped.
- D. Nonmetallic Coatings: Plastic coating, jacket, or liner.
- E. Padded Hangers: Hanger with fiberglass or other pipe insulation pad or cushion for support of bearing surface of piping.

2.3 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.

2.4 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. Tolco Inc.
 - 3. Unistrut Corp.; Tyco International, Ltd.

C. Coatings: Pregalvanized or hot dipped.

D. Nonmetallic Coatings: Plastic coating, jacket, or liner.

2.5 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 Cold Piping: Water-repellent treated, ASTM C 533, Type I calcium silicate or ASTM C 552, Type II cellular glass with vapor barrier.

D. Insulation-Insert Material for Hot Piping: Water-repellent treated, ASTM C 533, Type I calcium silicate or ASTM C 552, Type II cellular glass.

E. For Trapeze or Clamped Systems: Insert and shield shall cover entire circumference of pipe.

F. For Clevis or Band Hangers: Insert and shield shall cover lower 180 degrees of pipe.

G. Insert Length: Extend 2 inches beyond sheet metal shield for piping operating below ambient air temperature.

2.6 FASTENER SYSTEMS

A. Mechanical-Expansion Anchors: Insert-wedge-type zinc-coated 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. Hilti, Inc.
- c. ITW Ramset/Red Head.

2.7 EQUIPMENT SUPPORTS

A. Description: Welded, shop- or field-fabricated equipment support made from structural-steel shapes.

2.8 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.

3. PART 3 EXECUTION

3.1 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. Yoke-Type Pipe Clamps (MSS Type 2): For suspension of 120 to 450 deg F pipes, NPS 4 to NPS 16, requiring up to 4 inches of insulation.
 3. Carbon- or Alloy-Steel, Double-Bolt Pipe Clamps (MSS Type 3): For suspension of pipes, NPS 3/4 to NPS 24, requiring clamp flexibility and up to 4 inches of insulation.
 4. Adjustable, Steel Band Hangers (MSS Type 7): For suspension of noninsulated stationary pipes, NPS 1/2 to NPS 8.
 5. U-Bolts (MSS Type 24): For support of heavy pipes, NPS 1/2 to NPS 30.
 6. Pipe Saddle Supports (MSS Type 36): For support of pipes, NPS 4 to NPS 36, with steel pipe base stanchion support and cast-iron floor flange.
 7. 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.
 8. Complete Pipe Rolls (MSS Type 44): For support of pipes, NPS 2 to NPS 42, if longitudinal movement caused by expansion and contraction might occur but vertical adjustment is not necessary.
- G. Vertical-Piping Clamps: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
1. Extension Pipe or Riser Clamps (MSS Type 8): For support of pipe risers, NPS 3/4 to NPS 20.
 2. Carbon- or Alloy-Steel Riser Clamps (MSS Type 42): For support of pipe risers, NPS 3/4 to NPS 20, if longer ends are required for riser clamps.
- H. Hanger-Rod Attachments: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
1. Steel Turnbuckles (MSS Type 13): For adjustment up to 6 inches for heavy loads.
 2. Steel Clevises (MSS Type 14): For 120 to 450 deg F piping installations.

- I. Building Attachments: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
 1. Steel or Malleable Concrete Inserts (MSS Type 18): For upper attachment to suspend pipe hangers from concrete ceiling.
 2. Top-Beam C-Clamps (MSS Type 19): For use under roof installations with bar-joist construction to attach to top flange of structural shape.
 3. Side-Beam or Channel Clamps (MSS Type 20): For attaching to bottom flange of beams, channels, or angles.
 4. Center-Beam Clamps (MSS Type 21): For attaching to center of bottom flange of beams.
 5. Welded Beam Attachments (MSS Type 22): For attaching to bottom of beams if loads are considerable and rod sizes are large.
 6. C-Clamps (MSS Type 23): For structural shapes.
 7. 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.
 8. Side-Beam Brackets (MSS Type 34): For sides of steel or wooden beams.
 9. Plate Lugs (MSS Type 57): For attaching to steel beams if flexibility at beam is required.
- J. 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.
- K. Spring Hangers and Supports: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
 1. Spring Cushions (MSS Type 48): For light loads if vertical movement does not exceed 1-1/4 inches.
 2. Spring-Cushion Roll Hangers (MSS Type 49): For equipping Type 41 roll hanger with springs.
 3. Variable-Spring Base Supports (MSS Type 52): Preset to indicated load and limit variability factor to 25 percent to absorb expansion and contraction of piping system from base support.
- L. Comply with MSS SP-69 for trapeze pipe hanger selections and applications that are not specified in piping system Sections.
- M. Comply with MFMA-102 for metal framing system selections and applications that are not specified in piping system Sections.
- N. Use mechanical-expansion anchors instead of building attachments where required in concrete construction.

3.2 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. Metal Framing System Installation: Arrange for grouping of parallel runs of piping and support together on field-assembled metal framing systems.
- D. Thermal-Hanger Shield Installation: Install in pipe hanger or shield for insulated piping.
- E. Fastener System Installation:
1. Install powder-actuated fasteners 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.
- F. Install hangers and supports complete with necessary inserts, bolts, rods, nuts, washers, and other accessories.
- G. Equipment Support Installation: Fabricate from welded-structural-steel shapes.
- H. 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.
- I. Install lateral bracing with pipe hangers and supports to prevent swaying.
- J. 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.
- K. Load Distribution: Install hangers and supports so piping live and dead loads and stresses from movement will not be transmitted to connected equipment.
- L. Pipe Slopes: Install hangers and supports to provide indicated pipe slopes and so maximum pipe deflections allowed by ASME B31.9 (for building services piping) are not exceeded.
- M. 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 B31.9 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.
 3. Install MSS SP-58, Type 40, protective shields on cold piping with vapor barrier. Shields shall span an arc of 180 degrees.

4. Shield Dimensions for Pipe: Not less than the following:
 - a. NPS 1/4 to NPS 3-1/2: 12 inches long and 0.048 inch thick.
 - b. NPS 4: 12 inches long and 0.06 inch thick.
 - c. NPS 5 and NPS 6: 18 inches long and 0.06 inch thick.
 - d. NPS 8 to NPS 14: 24 inches long and 0.075 inch thick.
 - e. NPS 16 to NPS 24: 24 inches long and 0.105 inch thick.
5. Pipes NPS 8 and Larger: Include wood inserts.
6. Insert Material: Length at least as long as protective shield.
7. Thermal-Hanger Shields: Install with insulation same thickness as piping insulation.

3.3 EQUIPMENT SUPPORTS

- A. Fabricate structural-steel stands to suspend equipment from structure overhead or to support equipment above floor.
- B. Grouting: Place grout under supports for equipment and make smooth bearing surface.
- C. Provide lateral bracing, to prevent swaying, for equipment supports.

3.4 METAL FABRICATIONS

- A. Cut, drill, and fit miscellaneous metal fabrications for trapeze pipe hangers and 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.

3.5 ADJUSTING

- A. Hanger Adjustments: Adjust hangers to distribute loads equally on attachments and to achieve indicated slope of pipe.

3.6 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. Galvanized Surfaces: Clean welds, bolted connections, and abraded areas and apply galvanizing-repair paint to comply with ASTM A 780.

END OF SECTION 22 05 29

SECTION 22 05 53

IDENTIFICATION FOR PLUMBING PIPING AND EQUIPMENT

1. PART 1 GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes:
 - 1. Equipment labels.
 - 2. Warning signs and labels.
 - 3. Pipe labels.
 - 4. Stencils.
 - 5. Valve tags.
 - 6. Warning tags.

1.3 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.
- D. Valve numbering scheme.
- E. Valve Schedules: For each piping system to include in maintenance manuals.

1.4 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.

2. PART 2 PRODUCTS

2.1 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 self-tapping screws.
 5. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.
- 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: White Yellow Insert color.
 3. Background Color: Black.
 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 self-tapping screws.
 8. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.
- C. Label Content: Include equipment's Drawing designation or unique equipment number, Drawing numbers where equipment is indicated (plans, details, and schedules), 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.

2.2 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: Black.
- C. Background Color: Red.
- 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 self-tapping screws.
- H. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.
- I. Label Content: Include caution and warning information, plus emergency notification instructions.

2.3 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.

2.4 STENCILS

- A. Stencils: Prepared with letter sizes according to ASME A13.1 for piping; and minimum letter height of 3/4 inch for access panel and door labels, equipment labels, and similar operational instructions.
 - 1. Stencil Material: Fiberboard.
 - 2. Stencil Paint: Exterior, gloss, acrylic enamel black unless otherwise indicated. Paint may be in pressurized spray-can form.
 - 3. Identification Paint: Exterior, acrylic enamel in colors according to ASME A13.1 unless otherwise indicated.

2.5 VALVE TAGS

- A. Valve Tags: Stamped or engraved with 1/4-inch letters for piping system abbreviation and 1/2-inch numbers.
 - 1. Tag Material: Brass, 0.032-inch minimum thickness, and having predrilled or stamped holes for attachment hardware.
 - 2. Fasteners: Brass wire-link or beaded chain; or S-hook.
- B. Valve Schedules: For each piping system, on 8-1/2-by-11-inch bond paper. Tabulate valve number, piping system, system abbreviation (as shown on valve tag), location of valve (room or space), normal-operating position (open, closed, or modulating), and variations for identification. Mark valves for emergency shutoff and similar special uses.
 - 1. Valve-tag schedule shall be included in operation and maintenance data.

2.6 WARNING TAGS

- A. Warning Tags: Preprinted or partially preprinted, accident-prevention tags, of plasticized card stock with matte finish suitable for writing.
 - 1. Size: 3 by 5-1/4 inches minimum.
 - 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.

3. PART 3 EXECUTION

3.1 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.

3.2 EQUIPMENT LABEL INSTALLATION

- A. Install or permanently fasten labels on each major item of mechanical equipment.
- B. Locate equipment labels where accessible and visible.

3.3 PIPE LABEL INSTALLATION

- A. Piping Color-Coding: Painting of piping is specified in Division 9 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.
- D. Pipe Label Color Schedule:
 - 1. Condensate Piping:
 - a. Background Color: Yellow.
 - b. Letter Color: Black.
 - 2. Natural Gas Piping:
 - a. Background Color: Yellow.
 - b. Letter Color: Black.
 - 3. Domestic Water Piping:
 - a. Background Color: Black.
 - b. Letter Color: Yellow.

4. Sanitary Waste, Vent and Storm Drainage Piping:

- a. Background Color: Yellow.
- b. Letter Color: Black.

3.4 VALVE-TAG INSTALLATION

A. Install tags on valves and control devices in piping systems, except check valves; valves within factory-fabricated equipment units; shutoff valves; faucets; convenience and lawn-watering hose connections; and similar roughing-in connections of end-use fixtures and units. List tagged valves in a valve schedule.

B. Valve-Tag Application Schedule: Tag valves according to size, shape, and color scheme and with captions similar to those indicated in the following subparagraphs:

1. Valve-Tag Size and Shape:

- a. Cold Water: 2 inches, round.
- b. Hot Water: 2 inches, round.

2. Valve-Tag Color:

- a. Cold Water: Natural.
- b. Hot Water: Natural.

3. Letter Color:

- a. Cold Water: Black.
- b. Hot Water: Black.

3.5 WARNING-TAG INSTALLATION

A. Write required message on, and attach warning tags to, equipment and other items where required.

END OF SECTION 22 05 53

SECTION 22 11 16

DOMESTIC WATER PIPING

1. PART 1 GENERAL

1.1 SUMMARY

- A. This Section includes domestic water piping inside the building.
- B. Water meters will be furnished and installed by utility company.
- C. See Division 22 Section "Meters and Gages for Plumbing Piping" for thermometers, pressure gages, and fittings.
- D. See Division 22 Section "Domestic Water Piping Specialties" for water distribution piping specialties.

1.2 SUBMITTALS

- A. Field quality-control test reports.

1.3 QUALITY ASSURANCE

- A. Comply with NSF 61, "Drinking Water System Components - Health Effects; Sections 1 through 9," for potable domestic water piping and components.

2. PART 2 PRODUCTS

2.1 PIPING MATERIALS

- A. Refer to Part 3 "Pipe and Fitting Applications" Article for applications of pipe, tube, fitting, and joining materials.
- B. Transition Couplings for Aboveground Pressure Piping: Coupling or other manufactured fitting the same size as, with pressure rating at least equal to and ends compatible with, piping to be joined.
- C. Soft Copper Tube: ASTM B 88, Types K and L, water tube, annealed temper.
 - 1. Copper Pressure Fittings: ASME B16.18, cast-copper-alloy or ASME B16.22, wrought-copper, solder-joint fittings. Furnish wrought-copper fittings if indicated.
 - 2. Bronze Flanges: ASME B16.24, Class 150, with solder-joint ends. Furnish Class 300 flanges if required to match piping.
 - 3. Copper Unions: MSS SP-123, cast-copper-alloy, hexagonal-stock body, with ball-and-socket, metal-to-metal seating surfaces, and solder-joint or threaded ends.

2.2 VALVES

- A. Bronze and cast-iron, general-duty valves are specified in Division 22 Section "General-Duty Valves for Plumbing Piping."
- B. Balancing and drain valves are specified in Division 22 Section "Domestic Water Piping Specialties."

3. PART 3 EXECUTION

3.1 EXCAVATION

- A. Excavating, trenching, and backfilling are specified in Division 31 Section "Earth Moving."

3.2 PIPE AND FITTING APPLICATIONS

- A. Transition and special fittings with pressure ratings at least equal to piping rating may be used in applications below, unless otherwise indicated.
- B. Flanges may be used on aboveground piping, unless otherwise indicated.
- C. Fitting Option: Extruded-tee connections and brazed joints may be used on aboveground copper tubing.
- D. Under-Building-Slab, Water-Service Piping on Service Side of Water Meter: Refer to Division 22 Section "Facility Water Distribution Piping."
- E. Domestic Water Piping on Service Side of Water Meter inside the Building: Use the following piping materials for each size range:
 - 1. NPS 4 to NPS 6: Hard copper tube, Type L; copper pressure fittings; and soldered joints.
- F. Under-Building-Slab, Domestic Water Piping on House Side of Water Meter, NPS 4 and Smaller: Hard copper tube, Type K; copper pressure fittings; and soldered joints.
- G. Aboveground Domestic Water Piping: Use the following piping materials for each size range:
 - 1. NPS 1 and Smaller: Hard copper tube, Type L; copper pressure fittings; and soldered joints.

3.3 VALVE APPLICATIONS

- A. Drawings indicate valve types to be used. Where specific valve types are not indicated, the following requirements apply:
 - 1. Shutoff Duty: Use bronze ball valves for piping NPS 2 and smaller. Use cast-iron butterfly or gate valves with flanged ends for piping NPS 2-1/2 and larger.
 - 2. Throttling Duty: Use bronze ball valves for piping NPS 2 and smaller. Use cast-iron butterfly valves with flanged ends for piping NPS 2-1/2 and larger.
 - 3. Hot-Water-Piping, Balancing Duty: Calibrated balancing valves.
 - 4. Drain Duty: Hose-end drain valves.
- B. Install shutoff valve close to water main on each branch and riser serving plumbing fixtures or equipment, on each water supply to equipment, and on each water supply to plumbing fixtures that do not have supply stops. Use ball valves for piping NPS 2 and smaller. Use butterfly or gate valves for piping NPS 2-1/2 and larger.
- C. Install drain valves for equipment at base of each water riser, at low points in horizontal piping, and where required to drain water piping.
 - 1. Install hose-end drain valves at low points in water mains, risers, and branches.
 - 2. Install stop-and-waste drain valves where indicated.
- D. Install calibrated balancing valves in each hot-water circulation return branch and discharge side of each pump and circulator. Set calibrated balancing valves partly open to restrict but not stop flow. Calibrated balancing valves are specified in Division 22 Section "Domestic Water Piping Specialties."

3.4 PIPING INSTALLATION

- A. Basic piping installation requirements are specified in Division 22 Section "Common Work Results for Plumbing."
- B. Install under-building-slab copper tubing according to CDA's "Copper Tube Handbook."
- C. Install cast-iron sleeve with water stop and mechanical sleeve seal at each service pipe penetration through foundation wall. Select number of interlocking rubber links required to make installation watertight. Sleeves and mechanical sleeve seals are specified in Division 22 Section "Common Work Results for Plumbing."
- D. Install shutoff valve, hose-end drain valve, strainer, pressure gage, and test tee with valve, inside the building at each domestic water service entrance. Pressure gages are specified in Division 22 Section "Meters and Gages for Plumbing Piping," and drain valves and strainers are specified in Division 22 Section "Domestic Water Piping Specialties."
- E. Install domestic water piping level with 0.25 percent slope downward toward drain and plumb.
- F. Rough-in domestic water piping for water-meter installation according to utility company's requirements.

3.5 JOINT CONSTRUCTION

- A. Basic piping joint construction requirements are specified in Division 22 Section "Common Work Results for Plumbing."
- B. Soldered Joints: Use ASTM B 813, water-flushable, lead-free flux; ASTM B 32, lead-free-alloy solder; and ASTM B 828 procedure, unless otherwise indicated.

3.6 ROUGHING-IN FOR WATER METERS

- A. Rough-in domestic water piping for water meter installation according to utility company's requirements.
- B. Water meters will be furnished and installed by utility.

3.7 HANGER AND SUPPORT INSTALLATION

- A. Pipe hanger and support devices are specified in Division 22 Section "Hangers and Supports for Plumbing Piping and Equipment." Install the following:
 - 1. Vertical Piping: MSS Type 8 or Type 42, clamps.
 - 2. Individual, Straight, Horizontal Piping Runs: According to the following:
 - a. 100 Feet and Less: MSS Type 1, adjustable, steel clevis hangers.
 - b. Longer Than 100 Feet: MSS Type 43, adjustable roller hangers.
 - c. Longer Than 100 Feet: MSS Type 49, spring cushion rolls, if indicated.
 - 3. Multiple, Straight, Horizontal Piping Runs 100 Feet or Longer: MSS Type 44, pipe rolls. Support pipe rolls on trapeze.
 - 4. Base of Vertical Piping: MSS Type 52, spring hangers.
- B. Install supports according to Division 22 Section "Hangers and Supports for Plumbing Piping and Equipment."
- C. Support vertical piping and tubing at base and at each floor.
- D. Rod diameter may be reduced 1 size for double-rod hangers, to a minimum of 3/8 inch.

- E. Install hangers for copper tubing with the following maximum horizontal spacing and minimum rod diameters:
 - 1. NPS 3/4 and Smaller: 60 inches with 3/8-inch rod.
 - 2. NPS 1 and NPS 1-1/4: 72 inches with 3/8-inch rod.
 - 3. NPS 1-1/2 and NPS 2: 96 inches with 3/8-inch rod.
 - 4. NPS 2-1/2: 108 inches with 1/2-inch rod.
 - 5. NPS 3 to NPS 5: 10 feet with 1/2-inch rod.
 - 6. NPS 6: 10 feet with 5/8-inch rod.
- F. Install supports for vertical copper tubing every 10 feet.
- G. Support piping and tubing not listed above according to MSS SP-69 and manufacturer's written instructions.

3.8 CONNECTIONS

- A. Install piping adjacent to equipment and machines to allow service and maintenance.
- B. Connect domestic water piping to exterior water-service piping. Use transition fitting to join dissimilar piping materials.
- C. Connect domestic water piping to water-service piping with shutoff valve, and extend and connect to the following:
 - 1. Booster Pumps: Cold-water suction and discharge piping.
 - 2. Water Heaters: Cold-water supply and hot-water outlet piping in sizes indicated, but not smaller than sizes of water heater connections.
 - 3. Plumbing Fixtures: Cold- and hot-water supply piping in sizes indicated, but not smaller than required by plumbing code. Refer to Division 22 Section "Plumbing Fixtures."
 - 4. Equipment: Cold- and hot-water supply piping as indicated, but not smaller than equipment connections. Provide shutoff valve and union for each connection. Use flanges instead of unions for NPS 2-1/2 and larger.

3.9 FIELD QUALITY CONTROL

- A. Inspect domestic water piping as follows:
 - 1. Do not enclose, cover, or put piping into operation until it has been inspected and approved by authorities having jurisdiction.
 - 2. During installation, notify authorities having jurisdiction at least 24 hours before inspection must be made. Perform tests specified below in presence of authorities having jurisdiction:
 - a. Roughing-in Inspection: Arrange for inspection of piping before concealing or closing-in after roughing-in and before setting fixtures.
 - b. Final Inspection: Arrange final inspection for authorities having jurisdiction to observe tests specified below and to ensure compliance with requirements.
 - 3. Reinspection: If authorities having jurisdiction find that piping will not pass test or inspection, make required corrections and arrange for reinspection.
 - 4. Reports: Prepare inspection reports and have them signed by authorities having jurisdiction.
- B. Test domestic water piping as follows:
 - 1. Fill domestic water piping. Check components to determine that they are not air bound and that piping is full of water.
 - 2. Test for leaks and defects in new piping and parts of existing piping that have been altered, extended, or repaired. If testing is performed in segments, submit separate report for each test, complete with diagram of portion of piping tested.

3. Leave new, altered, extended, or replaced domestic water piping uncovered and unconcealed until it has been tested and approved. Expose work that was covered or concealed before it was tested.
4. Cap and subject piping to static water pressure of 50 psig above operating pressure, without exceeding pressure rating of piping system materials. Isolate test source and allow to stand for four hours. Leaks and loss in test pressure constitute defects that must be repaired.
5. Repair leaks and defects with new materials and retest piping or portion thereof until satisfactory results are obtained.
6. Prepare reports for tests and required corrective action.

3.10 CLEANING

- A. Clean and disinfect potable domestic water piping using purging and disinfecting procedures prescribed by authorities having jurisdiction.
- B. Submit water samples in sterile bottles to authorities having jurisdiction. Repeat procedures if biological examination shows contamination.
- C. Prepare and submit reports of purging and disinfecting activities.

END OF SECTION 22 11 16

SECTION 22 11 19

DOMESTIC WATER PIPING SPECIALTIES

1. PART 1 GENERAL

1.1 SUMMARY

- A. This Section includes the following domestic water piping specialties:
 - 1. Vacuum breakers.
 - 2. Hose bibbs.
 - 3. Water hammer arresters.
 - 4. Trap-seal primer valves.
- B. See Division 22 Section "Domestic Water Piping" for water meters.
- C. See Division 22 Section "Drinking Fountains and Water Coolers" for water filters for water coolers.

1.2 PERFORMANCE REQUIREMENTS

- A. Minimum Working Pressure for Domestic Water Piping Specialties: 125 psig, unless otherwise indicated.

1.3 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Field quality-control test reports.
- C. Operation and maintenance data.

1.4 QUALITY ASSURANCE

- A. NSF Compliance:
 - 1. Comply with NSF 14, "Plastics Piping Components and Related Materials," for plastic domestic water piping components.
 - 2. Comply with NSF 61, "Drinking Water System Components - Health Effects; Sections 1 through 9."

2. PART 2 PRODUCTS

2.1 VACUUM BREAKERS

- A. Hose-Connection Vacuum Breakers:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Chicago Faucets
 - b. Arrowhead Brass Products, Inc.
 - c. MIFAB, Inc.
 - d. Watts Industries, Inc.; Water Products Div.
 - e. Zurn Plumbing Products Group; Light Commercial Operation.
 - f. Zurn Plumbing Products Group; Wilkins Div.

2. Standard: ASSE 1001.
3. Body: Bronze, non-removable, with manual drain.
4. Outlet Connection: Garden-hose threaded complying with ASME B1.20.7.
5. Finish: Chrome or nickel plated.

2.2 HOSE BIBBS

A. Hose Bibbs HB-1 and HB-2:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following: (Refer to plans for model number)
 - a. Acorn Engineering
 - b. MIFAB, Inc.
 - c. Smith, Jay R. Mfg. Co.; Divisions of Smith Industries, Inc.
 - d. Zurn Plumbing Products Group; Light Commercial Operation.
2. Standard: ASME A112.18.1 for sediment faucets.
3. Body Material: Bronze.
4. Seat: Bronze, replaceable.
5. Supply Connections: NPS 1/2 or NPS 3/4 threaded or solder-joint inlet.
6. Outlet Connection: Garden-hose thread complying with ASME B1.20.7.
7. Pressure Rating: 125 psig.
8. Vacuum Breaker: Integral non-removable, drainable, hose-connection vacuum breaker complying with ASSE 1011.
9. Finish for Equipment Rooms: Rough chrome finish.
10. Finish for Service Areas: Rough chrome finish.
11. Finish for Finished Rooms: Polished chrome finish.
12. Operation for Equipment Rooms: Operating key.
13. Operation for Service Areas: Operating key.
14. Operation for Finished Rooms: Operating key.
15. Include operating key with each operating-key hose bibb.
16. Include wall flange with each chrome- or nickel-plated hose bibb.

2.3 WATER HAMMER ARRESTERS

A. Water Hammer Arresters WHA-1:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following: (Refer to plans for model number)
 - a. Smith, Jay R. Mfg. Co.; Division of Smith Industries, Inc.
 - b. MIFAB, Inc.
 - c. AMTROL, Inc.
 - d. Josam Company.
 - e. Watts Drainage Products Inc.
 - f. Zurn Plumbing Products Group; Specification Drainage Operation
2. Standard: ASSE 1010 or PDI-WH 201.
3. Type: Copper tube with piston.
4. Size: ASSE 1010, Sizes AA and A through F or PDI-WH 201, Sizes A through F.

2.4 TRAP-SEAL PRIMER VALVES

A. Supply-Type, Trap-Seal Primer Valves TP-1:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following: (Refer to plans for model number)
 - a. Smith, Jay R. Mfg. Co.; Division of Smith Industries, Inc.

- b. MIFAB, Inc.
 - c. Watts Industries, Inc.; Water Products Div.
 - d. PPP, Inc.
2. Standard: ASSE 1018.
 3. Pressure Rating: 125 psig minimum.
 4. Body: Bronze.
 5. Inlet and Outlet Connections: NPS 1/2 threaded, union, or solder joint.
 6. Gravity Drain Outlet Connection: NPS 1/2 threaded or solder joint.
 7. Finish: Chrome plated, or rough bronze for units used with pipe or tube that is not chrome finished.

3. PART 3 EXECUTION

3.1 INSTALLATION

- A. Refer to Division 22 Section "Common Work Results for Plumbing" for piping joining materials, joint construction, and basic installation requirements.
- B. Install backflow preventers in each water supply to mechanical equipment and systems and to other equipment and water systems that may be sources of contamination. Comply with authorities having jurisdiction.
 1. Locate backflow preventers in same room as connected equipment or system.
 2. Install drain for backflow preventers with atmospheric-vent drain connection with air-gap fitting, fixed air-gap fitting, or equivalent positive pipe separation of at least two pipe diameters in drain piping and pipe to floor drain. Locate air-gap device attached to or under backflow preventer. Simple air breaks are not acceptable for this application.
 3. Do not install bypass piping around backflow preventers.
- C. Install water regulators with inlet and outlet shutoff valves. Install pressure gages on inlet and outlet.
- D. Install temperature-actuated water mixing valves with check stops or shutoff valves on inlets and with shutoff valve on outlet.
 1. Install thermometers and water regulators if specified.
 2. Install cabinet-type units recessed in or surface mounted on wall as specified.
- E. Install Y-pattern strainers for water on supply side of each water pressure-reducing valve,.
- F. Install water hammer arresters in water piping according to PDI-WH 201.
- G. Install supply-type, trap-seal primer valves with outlet piping pitched down toward drain trap a minimum of 1 percent, and connect to floor-drain body, trap, or inlet fitting. Adjust valve for proper flow.
- H. Piping installation requirements are specified in other Division 22 Sections. Drawings indicate general arrangement of piping and specialties.
- I. Equipment Nameplates and Signs: Install engraved plastic-laminate equipment nameplate or sign on or near each of the following:
 1. Reduced-pressure-principle backflow preventers.
 2. Double-check backflow-prevention assemblies.
 3. Water pressure-reducing valves.
 4. Primary, thermostatic, water mixing valves.
 5. Supply-type, trap-seal primer valves.

- J. Distinguish among multiple units, inform operator of operational requirements, indicate safety and emergency precautions, and warn of hazards and improper operations, in addition to identifying unit. Nameplates and signs are specified in Division 22 Section "Identification for Plumbing Piping and Equipment."

3.2 FIELD QUALITY CONTROL

- A. Perform the following tests and prepare test reports:
 - 1. Test each reduced-pressure-principle backflow preventer and double-check backflow-prevention assembly according to authorities having jurisdiction and the device's reference standard.
- B. Remove and replace malfunctioning domestic water piping specialties and retest as specified above.

3.3 ADJUSTING

- A. Set field-adjustable pressure set points of water pressure-reducing valves.
- B. Set field-adjustable flow of balancing valves.
- C. Set field-adjustable temperature set points of temperature-actuated water mixing valves.

END OF SECTION 22 11 19

SECTION 22 13 16

SANITARY WASTE AND VENT PIPING

1. PART 1 GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. This Section includes the following for soil, waste, vent and condensate piping inside the building:
 - 1. Pipe, tube, and fittings.
 - 2. Special pipe fittings.
 - 3. Encasement for underground metal piping.

- B. Video taped sanitary waste piping

1.3 DEFINITIONS

- A. PVC: Polyvinyl chloride plastic.
- B. Flat Work: Concrete walks, concrete driveways, and asphalt paving.

1.4 PERFORMANCE REQUIREMENTS

- A. Components and installation shall be capable of withstanding the following minimum working pressure, unless otherwise indicated:
 - 1. Soil, Waste, and Vent Piping: 5 P.S.I.
- B. Seismic Performance: Soil, waste, and vent piping and support and installation shall be capable of withstanding the effects of seismic events determined according to ASCE 7, "Minimum Design Loads for Buildings and Other Structures."

1.5 SUBMITTALS

- A. Product Data: For pipe, tube, fittings, and couplings.
- B. Field quality-control inspection and test reports.

1.6 QUALITY ASSURANCE

- A. Piping materials shall bear label, stamp, or other markings of specified testing agency.
- B. Comply with NSF 14, "Plastics Piping Systems Components and Related Materials," for plastic piping components. Include marking with "NSF-dwv" for plastic drain, waste, and vent piping; "NSF-drain" for plastic drain piping; "NSF-tubular" for plastic continuous waste piping; and "NSF-sewer" for plastic sewer piping.

2. PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. In other Part 2 articles where titles below introduce lists, the following requirements apply to 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, manufacturers specified.
 - 2. Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers specified.

2.2 PIPING MATERIALS

- A. Refer to Part 3 "Piping Applications" Article for applications of pipe, tube, fitting, and joining materials.

2.3 HUBLESS CAST-IRON SOIL PIPE AND FITTINGS

- A. Pipe and Fittings: ASTM A888-13 including Annex A1 from accredited ANSI inspection agency or CISPI 301-12 including Annex A1 from accredited ANSI inspection agency.
 - 1. Hubless Cast-Iron Soil Pipe
 - a. Manufacturers:
 - 1) A, B & I Foundry.
 - 2) Tyler Pipe & Coupling
 - 3) Charlotte Pipe and Foundry Company
 - 2. Heavy-Duty, Shielded, Stainless-Steel Couplings (Above Ground Use): With stainless-steel shield, stainless-steel bands and tightening devices, and ASTM C 564, rubber sleeve.
 - a. Manufacturers:
 - 1) ANACO-HUSKY.
 - 2) Tyler Pipe; Soil Pipe Div.
 - 3) Mission Rubber Co.
 - 4) Clamp-All Corp.
 - 3. Heavy -Duty, Cast-Iron Couplings (Below Grade Use): ASTM A 48/A 48M, two-piece, cast-iron housing; stainless-steel bolts and nuts; and ASTM C 564, rubber sleeve.
 - a. Manufacturers:
 - 1) ANACO-HUSKY.

2.4 COPPER PIPE AND FITTINGS

- A. Hard Copper Tube: ASTM B 88, Types L tube, drawn temper.
 - 1. Copper Pressure Fittings: ASME B16.18, cast-copper-alloy or ASME B16.22, wrought-copper, solder-joint fittings.

2.5 PVC PIPE AND FITTINGS:

- A. Comply with NSF 14, "Plastic Piping Systems Components and Related Materials" for plastic piping components. Include markings with "NSF-DWV" for plastic drain, waste and vent, and "NSF=sewer" for plastic sewer piping

- B. Solid-Wall PVC Pipe: ASTM D2665, drain, waste and vent.
- C. Cellular-Core PVC Pipe: ASTM F891, Schedule 40.
- D. PCV Socket Fittings: ASTM D2665, made of ASTM D3311, drain, waste, and vent patterns and fit to Schedule 40 pipe.
- E. Adhesive Primer: ASTM F656.
- F. Solvent Cement: ASTM D2564

2.6 SPECIAL PIPE FITTINGS

- A. Shielded Nonpressure Pipe Couplings: ASTM C 1460, elastomeric or rubber sleeve with full-length, corrosion-resistant outer shield and corrosion-resistant-metal tension band and tightening mechanism on each end.
 - 1. Manufacturers:
 - a. Cascade Waterworks Mfg. Co.
 - b. Mission Rubber Co.
- B. Rigid, Unshielded, Nonpressure Pipe Couplings: ASTM C 1461, sleeve-type reducing- or transition-type mechanical coupling molded from ASTM C 1440, TPE material with corrosion-resistant-metal tension band and tightening mechanism on each end.
 - 1. Manufacturers:
 - a. ANACO.
- C. Wall-Penetration Fittings: Compound, ductile-iron coupling fitting with sleeve and flexing sections for up to 20-degree deflection, gaskets, and restrained-joint ends complying with AWWA C110 or AWWA C153. Include AWWA C111, ductile-iron glands, rubber gaskets, and steel bolts.
 - 1. Manufacturers:
 - a. SIGMA Corp.

2.7 ENCASEMENT FOR UNDERGROUND METAL PIPING

- A. Description: ASTM A 674 or AWWA C105, high-density, crosslaminated PE film of 0.004-inch minimum thickness.
- B. Form: Sheet.
- C. Color: Black.
- D. Corrosion Control: Refer to Soil Corrosivity Study and Report for further requirements.

3. PART 3 EXECUTION

3.1 EXCAVATION

- A. Refer to Division 31 Section for excavating, trenching, and backfilling.

3.2 PIPING APPLICATIONS

- A. Aboveground, soil and waste piping NPS 4 and smaller shall be the following:
 - 1. Hubless cast-iron soil pipe and fittings; heavy-duty shielded, stainless-steel couplings; and hubless-coupling joints.
 - 2. Steel pipe, drainage fittings, and threaded joints.
- B. Aboveground, soil and waste piping NPS 5 and larger shall be the following:
 - 1. Service class, cast-iron soil pipe and fittings; gaskets; and gasketed joints.
 - 2. Hubless cast-iron soil pipe and fittings; heavy-duty shielded, stainless-steel couplings; and hubless-coupling joints.
 - 3. Steel pipe, drainage fittings, and threaded joints.
- C. Aboveground, vent piping NPS 4 and smaller shall be the following:
 - 1. Service class, cast-iron soil pipe and fittings; gaskets; and gasketed joints.
 - 2. Hubless cast-iron soil pipe and fittings; heavy-duty shielded, stainless-steel couplings; and hubless-coupling joints.
 - 3. Steel pipe, drainage fittings, and threaded joints.
- D. Aboveground, vent piping NPS 5 and larger shall be the following:
 - 1. Service class, cast-iron soil pipe and fittings; gaskets; and gasketed joints.
 - 2. Hubless cast-iron soil pipe and fittings; heavy-duty shielded, stainless-steel couplings; and hubless-coupling joints.
 - 3. Steel pipe, drainage fittings, and threaded joints.
- E. Underground, soil, waste, and vent piping NPS 4 and smaller shall be the following:
 - 1. Hubless cast-iron soil pipe and fittings; heavy-duty shielded, cast-iron couplings; and hubless-coupling joints.
- F. Underground, soil and waste piping NPS 5 and larger shall be the following:
 - 1. Hubless cast-iron soil pipe and fittings; heavy-duty shielded, cast-iron couplings; and hubless-coupling joints.
- G. Condensate Piping: Type L hard drawn copper pipe with wrought copper solder fittings and couplings.

3.3 PIPING INSTALLATION

- A. Sanitary sewer piping outside the building is specified in Division 33.
- B. Basic piping installation requirements are specified in Division 22 Section "Common Work Results for Plumbing."
- C. Install seismic restraints on piping. In accordance with Mason Seismic restraints guidelines.
- D. Install cleanouts at grade and extend to where building sanitary drains connect to building sanitary sewers.
- E. Install cast-iron sleeve with water stop and mechanical sleeve seal at each service pipe penetration through foundation wall. Select number of interlocking rubber links required to make installation watertight. Sleeves and mechanical sleeve seals are specified in Division 22 Section "Common Work Results for Plumbing."

- F. Install wall-penetration fitting at each service pipe penetration through foundation wall. Make installation watertight.
- G. Install cast-iron soil piping according to CISPI's "Cast Iron Soil Pipe and Fittings Handbook," Chapter IV, "Installation of Cast Iron Soil Pipe and Fittings."
 - 1. Install encasement on underground piping according to ASTM A 674 or AWWA C105.
- H. Make changes in direction for soil and waste drainage and vent piping using appropriate branches, bends, and long-sweep bends. Sanitary tees and short-sweep 1/4 bends may be used on vertical stacks if change in direction of flow is from horizontal to vertical. Use long-turn, double Y-branch and 1/8-bend fittings if 2 fixtures are installed back to back or side by side with common drain pipe. Straight tees, elbows, and crosses may be used on vent lines. Do not change direction of flow more than 90 degrees. Use proper size of standard increasers and reducers if pipes of different sizes are connected. Reducing size of drainage piping in direction of flow is prohibited.
- I. Lay buried building drainage piping beginning at low point of each system. Install true to grades and alignment indicated, with unbroken continuity of invert. Install required gaskets according to manufacturer's written instructions for use of lubricants, cements, and other installation requirements. Maintain swab in piping and pull past each joint as completed.
- J. Install soil and waste drainage and vent piping at the following minimum slopes, unless otherwise indicated:
 - 1. Building Sanitary Drain: 2 percent downward in direction of flow for piping NPS 3 and smaller; 1 percent downward in direction of flow for piping NPS 4 and larger.
 - 2. Horizontal Sanitary Drainage Piping: 2 percent downward in direction of flow.
 - 3. Vent Piping: 1 percent down toward vertical fixture vent or toward vent stack.
- K. Install engineered soil and waste drainage and vent piping systems as follows:
 - 1. Combination Waste and Vent: Comply with standards of authorities having jurisdiction.
- L. Sleeves are not required for cast-iron soil piping passing through concrete slabs-on-grade if slab is without membrane waterproofing.
- M. Do not enclose, cover, or put piping into operation until it is inspected and approved by authorities having jurisdiction.
- N. All interior condensate piping shall be insulated with closed cell foam insulation: with FHC 25/50 composite rating.

3.4 JOINT CONSTRUCTION

- A. Basic piping joint construction requirements are specified in Division 22 Section "Common Work Results for Plumbing."
- B. Join hubless cast-iron soil piping according to CISPI 310 and CISPI's "Cast Iron Soil Pipe and Fittings Handbook" for hubless-coupling joints.
- C. All joints of buried hubless cast iron pipe and cast iron couplings shall be field wrapped.
 - 1. Prior to wrapping, fittings and field joints shall be washed with a non-oily solvent and then cleaned with a wire brush. After cleaning, fittings and field joints shall be coated and wrapped as follows:
 - a. Coat of Koppers "Jet-Set" coal tar primer, applied uniformly to dry surfaces.
 - b. Two layers of 2" wide 35 mils thick Polyken 931 black butyl rubber molding tape with 1" lap, covered with one layer of 3/4" wide 15 mils thick Polyken 930 black polyethylene pressure sensitive tape with 1/4" lap.

- c. Field wrapping shall extend 3 inches beyond joint.

3.5 HANGER AND SUPPORT INSTALLATION

- A. Seismic-restraint devices are specified in Division 22 Section "Vibration and Seismic Controls for Plumbing Piping and Equipment."
- B. Pipe hangers and supports are specified in Division 22 Section "Hangers and Supports for Plumbing Piping and Equipment." Install the following:
 - 1. Vertical Piping: MSS Type 8 or Type 42, clamps.
 - 2. Install individual, straight, horizontal piping runs according to the following:
 - a. 100 Feet and Less: MSS Type 1, adjustable, steel clevis hangers.
 - b. Longer Than 100 Feet: MSS Type 43, adjustable roller hangers.
 - c. Longer Than 100 Feet, if Indicated: MSS Type 49, spring cushion rolls.
 - 3. Multiple, Straight, Horizontal Piping Runs 100 Feet or Longer: MSS Type 44, pipe rolls. Support pipe rolls on trapeze.
 - 4. Base of Vertical Piping: MSS Type 52, spring hangers.
- C. Install supports according to Division 22 Section "Hangers and Supports for Plumbing Piping and Equipment."
- D. Support vertical piping at base and at each floor.
- E. Rod diameter may be reduced 1 size for double-rod hangers, with 3/8-inch minimum rods.
- F. Install hangers for cast-iron soil piping with the following maximum horizontal spacing and minimum rod diameters:
 - 1. NPS 1-1/2 and NPS 2: 60 inches with 3/8-inch rod.
 - 2. NPS 3: 60 inches with 1/2-inch rod.
 - 3. NPS 4 and NPS 5: 60 inches with 5/8-inch rod.
 - 4. NPS 6: 60 inches with 3/4-inch rod.
 - 5. NPS 8 to NPS 12: 60 inches with 7/8-inch rod.
- G. Install supports for vertical cast-iron soil piping every 15 feet.
- H. Install hangers for steel piping with the following maximum horizontal spacing and minimum rod diameters:
 - 1. NPS 1-1/4: 84 inches with 3/8-inch rod.
 - 2. NPS 1-1/2: 108 inches with 3/8-inch rod.
 - 3. NPS 2: 10 feet with 3/8-inch rod.
 - 4. NPS 2-1/2: 11 feet with 1/2-inch rod.
 - 5. NPS 3: 12 feet with 1/2-inch rod.
 - 6. NPS 4 and NPS 5: 12 feet with 5/8-inch rod.
 - 7. NPS 6: 12 feet with 3/4-inch rod.
 - 8. NPS 8 to NPS 12: 12 feet with 7/8-inch rod.
- I. Install supports for vertical steel piping every 15 feet.
- J. Support piping and tubing not listed above according to MSS SP-69 and manufacturer's written instructions.

3.6 CONNECTIONS

- A. Interruption of Existing Sanitary Waste System: Do not interrupt Existing Sanitary Waste System to facilities occupied by Owner or others unless permitted under the following conditions:
 - 1. Notify Architect, Construction Manager, and Owner no fewer than seven (7) days in advance of proposed interruption.
 - 2. Do not proceed with interruption without Architect's Construction Manager's and Owner's written permission.
- B. Drawings indicate general arrangement of piping, fittings, and specialties.
- C. Connect soil and waste piping to exterior sanitary sewerage piping. Use transition fitting to join dissimilar piping materials.
- D. Connect drainage and vent piping to the following:
 - 1. Plumbing Fixtures: Connect drainage piping in sizes indicated, but not smaller than required by plumbing code.
 - 2. Plumbing Fixtures and Equipment: Connect atmospheric vent piping in sizes indicated, but not smaller than required by authorities having jurisdiction.
 - 3. Plumbing Specialties: Connect drainage and vent piping in sizes indicated, but not smaller than required by plumbing code.
- E. Connect condensate to equipment with pipe sizes as indicated, but in no case shall the piping be smaller than the equipment condensate pipe size.

3.7 FIELD QUALITY CONTROL

- A. During installation, notify authorities having jurisdiction at least 24 hours before inspection must be made. Perform tests specified below in presence of authorities having jurisdiction.
 - 1. Roughing-in Inspection: Arrange for inspection of piping before concealing or closing-in after roughing-in and before setting fixtures.
 - 2. Final Inspection: Arrange for final inspection by authorities having jurisdiction to observe tests specified below and to ensure compliance with requirements.
- B. Reinspection: If authorities having jurisdiction find that piping will not pass test or inspection, make required corrections and arrange for reinspection.
- C. Reports: Prepare inspection reports and have them signed by authorities having jurisdiction.
- D. Test sanitary drainage and vent piping according to procedures of authorities having jurisdiction or, in absence of published procedures, as follows:
 - 1. Test for leaks and defects in new piping and parts of existing piping that have been altered, extended, or repaired. If testing is performed in segments, submit separate report for each test, complete with diagram of portion of piping tested.
 - 2. Leave uncovered and unconcealed new, altered, extended, or replaced drainage and vent piping until it has been tested and approved. Expose work that was covered or concealed before it was tested.
 - 3. Roughing-in Plumbing Test Procedure: Test drainage and vent piping, except outside leaders, on completion of roughing-in for not less than one hour. Close openings in piping system and fill with water to point of overflow, but not less than 5 P.S.I.; water level must not drop. Inspect joints for leaks.

4. Finished Plumbing Test Procedure: After plumbing fixtures have been set and traps filled with water, test connections and prove they are gastight and watertight. Plug vent-stack openings on roof and building drains where they leave building. Introduce air into piping system equal to pressure of 1-inch wg. Use U-tube or manometer inserted in trap of water closet to measure this pressure. Air pressure must remain constant without introducing additional air throughout period of inspection. Inspect plumbing fixture connections for gas and water leaks.
5. Repair leaks and defects with new materials and retest piping, or portion thereof, until satisfactory results are obtained.
6. Prepare reports for tests and required corrective action.

3.8 CLEANING

- A. Clean interior of piping. Remove dirt and debris as work progresses.
- B. Protect drains during remainder of construction period to avoid clogging with dirt and debris and to prevent damage from traffic and construction work.
- C. Place plugs in ends of uncompleted piping at end of day and when work stops.

3.9 VIDEO TAPED SANITARY WASTE PIPING

- A. Video taping shall include new and existing waste piping, and limited to the path of travel of the waste from the new construction to where the street main connection occurs.
- B. All three (3) inch and larger piping shall be subjected to video taping.
- C. The video taping shall occur after all testing of sanitary waste piping has been completed, and before flat work, such as concrete walks, and asphalt, has been installed.
- D. Film: The taping shall be provided on high resolution color film that can be displayed on a common VHS recorder.
- E. Record Drawings: The Contractor shall obtain a reproducible drawing from the Architect. The drawing shall provide accurate dimensioned record of routing of the system piping with invert elevations. Irregularities encountered such as obstructions in the pipe, broken pipe or piping that were installed differently from that shown on the drawings shall be identified, dimensioned and provided with invert elevations.
 1. Encountered irregularities shall be reported to the plumbing Contractor for rectification. After encountered irregularities have been corrected the Architect shall have the right to request one additional visit from the contractor performing the video recording.
 2. The video and the drawing are deemed to be complementary.
 3. Before formal acceptance of the video tape and the drawing, both items shall be delivered to the On-Site Inspector for his review. The drawings will be signed by the Inspector before being delivered to the Architect.
 4. If in the opinion of the Architect the record drawing is not legible or the video and the drawing are not complementary the Video Taping Contractor shall employ a satisfactory draftsman to properly perform this work.

END OF SECTION 22 13 16

SECTION 22 13 19

SANITARY WASTE PIPING SPECIALTIES

1. PART 1 GENERAL

1.1 SUMMARY

A. This Section includes the following sanitary drainage piping specialties:

1. Cleanouts.
2. Floor drains.
3. Miscellaneous sanitary drainage piping specialties.

1.2 SUBMITTALS

A. Product Data: For each type of product indicated. Include rated capacities, operating characteristics, and accessories for grease interceptors.

1.3 QUALITY ASSURANCE

A. Drainage piping specialties shall bear label, stamp, or other markings of specified testing agency.

2. PART 2 PRODUCTS

2.1 CLEANOUTS

A. Exposed Cast-Iron Cleanouts:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Smith, Jay R. Mfg. Co.; Division of Smith Industries, Inc.
 - b. Zurn Plumbing Products Group; Specification Drainage Operation.
 - c. MIFAB, Inc.
2. Standard: ASME A112.36.2M for cast iron for cleanout test tee.
3. Size: Same as connected drainage piping
4. Body Material: Hubless, cast-iron soil pipe test tee as required to match connected piping.
5. Closure: Countersunk, brass plug.
6. Closure Plug Size: Same as or not more than one size smaller than cleanout size.

B. Cast-Iron Floor Cleanouts:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Smith, Jay R. Mfg. Co.; Division of Smith Industries, Inc.
 - b. Zurn Plumbing Products Group; Specification Drainage Operation.
 - c. MIFAB
2. Standard: ASME A112.36.2M for threaded, adjustable housing cleanout.
3. Size: Same as connected branch.
4. Type: Threaded, adjustable housing.
5. Body or Ferrule: Cast iron.
6. Clamping Device: Required.
7. Outlet Connection: Threaded.

8. Closure: Brass plug with tapered threads.
9. Adjustable Housing Material: Cast iron with threads.
10. Frame and Cover Material and Finish: Polished bronze.
11. Frame and Cover Shape: Round.
12. Top Loading Classification: Light Duty.
13. Riser: ASTM A 74, Service class, cast-iron drainage pipe fitting and riser to cleanout.

C. Cast-Iron Wall Cleanouts:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Smith, Jay R. Mfg. Co.; Division of Smith Industries, Inc.
 - b. Zurn Plumbing Products Group; Specification Drainage Operation.
 - c. MIFAB, Inc.
2. Standard: ASME A112.36.2M. Include wall access.
3. Size: Same as connected drainage piping.
4. Body: Hubless, cast-iron soil pipe test tee as required to match connected piping.
5. Closure: Countersunk, drilled-and-threaded plug.
6. Closure Plug Size: Same as or not more than one size smaller than cleanout size.
7. Wall Access: Round, flat, chrome-plated brass or stainless-steel cover plate with screw.

2.2 FLOOR DRAINS

A. Cast-Iron Floor Drains FD-1:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following: (Refer to plans for model number)
 - a. Smith, Jay R. Mfg. Co.; Division of Smith Industries, Inc.
 - b. Zurn Plumbing Products Group; Specification Drainage Operation.
 - c. MIFAB, Inc.
2. Standard: ASME A112.6.3.
3. Pattern: Floor drain.
4. Body Material: Gray iron.
5. Seepage Flange: Required.
6. Anchor Flange: Required.
7. Clamping Device: Required.
8. Outlet: Bottom.
9. Top or Strainer Material: Nickel bronze.
10. Top of Body and Strainer Finish: Nickel bronze.
11. Top Shape: Round.
12. Top Loading Classification: Light Duty.
13. Inlet Fitting: Gray iron, with threaded inlet and threaded or spigot outlet, and trap-seal primer valve connection.
14. Trap Material: Cast iron.
15. Trap Pattern: Standard P-trap.

3. PART 3 EXECUTION

3.1 INSTALLATION

- A. Refer to Division 22 Section "Common Work Results for Plumbing" for piping joining materials, joint construction, and basic installation requirements.

- B. Install cleanouts in aboveground piping and building drain piping according to the following, unless otherwise indicated:
 - 1. Size same as drainage piping up to NPS 4. Use NPS 4 for larger drainage piping unless larger cleanout is indicated.
 - 2. Locate at each change in direction of piping greater than 45 degrees.
 - 3. Locate at minimum intervals of 50 feet for piping NPS 4 and smaller and 100 feet for larger piping.
 - 4. Locate at base of each vertical soil and waste stack.
- C. For floor cleanouts for piping below floors, install cleanout deck plates with top flush with finished floor.
- D. For cleanouts located in concealed piping, install cleanout wall access covers, of types indicated, with frame and cover flush with finished wall.
- E. Install wall cleanouts above urinal fixtures, install cleanout wall access covers, of types indicated, with frame and cover flush with finished wall
- F. Install floor drains at low points of surface areas to be drained. Set grates of drains flush with finished floor, unless otherwise indicated.
 - 1. Position floor drains for easy access and maintenance.
 - 2. Set floor drains below elevation of surrounding finished floor to allow floor drainage. Set with grates depressed according to the following drainage area radii:
 - a. Radius, 30 Inches or Less: Equivalent to 1 percent slope, but not less than 1/4-inch total depression.
 - b. Radius, 30 to 60 Inches: Equivalent to 1 percent slope.
 - c. Radius, 60 Inches or Larger: Equivalent to 1 percent slope, but not greater than 1-inch total depression.
 - 3. Install floor-drain flashing collar or flange so no leakage occurs between drain and adjoining flooring. Maintain integrity of waterproof membranes where penetrated.
 - 4. Install individual traps for floor drains connected to sanitary building drain, unless otherwise indicated.
- G. Install floor-drain, trap-seal primer fittings on inlet to floor drains that require trap-seal primer connection.
 - 1. Exception: Fitting may be omitted if trap has trap-seal primer connection.
 - 2. Size: Same as floor drain inlet.
- H. Install escutcheons at wall, floor, and ceiling penetrations in exposed finished locations and within cabinets and millwork. Use deep-pattern escutcheons if required to conceal protruding pipe fittings.

3.2 CONNECTIONS

- A. Piping installation requirements are specified in other Division 22 Sections. Drawings indicate general arrangement of piping, fittings, and specialties.
- B. Install piping adjacent to equipment to allow service and maintenance.

3.3 PROTECTION

- A. Protect drains during remainder of construction period to avoid clogging with dirt or debris and to prevent damage from traffic or construction work.
- B. Place plugs in ends of uncompleted piping at end of each day or when work stops.
- C. Corrosion Control: Refer to Soil Corrosivity Study and Report for further requirements.

END OF SECTION 22 13 19

SECTION 23 05 00

COMMON WORK RESULTS FOR HVAC

1.1 PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes the following:

1. Piping materials and installation instructions common to most piping systems.
2. Equipment installation requirements common to equipment sections.
3. Concrete bases.
4. Supports and anchorages.

1.2 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.

1.3 SUBMITTALS

- A. Welding certificates.

1.4 QUALITY ASSURANCE

- A. Steel Support Welding: Qualify processes and operators according to AWS D1.1, "Structural Welding Code--Steel."
- B. Steel Pipe Welding: Qualify processes and operators according to ASME Boiler and Pressure Vessel Code: Section IX, "Welding and Brazing Qualifications."
1. Comply with provisions in ASME B31 Series, "Code for Pressure Piping."
 2. Certify that each welder has passed AWS qualification tests for welding processes involved and that certification is current.
- C. Electrical Characteristics for 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.

2. PART 2 - PRODUCTS

2.1 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.

2.2 JOINING MATERIALS

- A. Refer to individual Division 23 piping Sections for special joining materials not listed below.
- B. Pipe-Flange Gasket Materials: ASME B16.21, nonmetallic, flat, asbestos-free, 1/8-inch maximum thickness unless thickness or specific material is indicated.
- C. Plastic, Pipe-Flange Gasket, Bolts, and Nuts: Type and material recommended by piping system manufacturer, unless otherwise indicated.
- D. Solder Filler Metals: ASTM B 32, lead-free alloys. Include water-flushable flux according to ASTM B 813.
- E. Brazing Filler Metals: AWS A5.8, BCuP Series or BAg1, unless otherwise indicated.
- F. Welding Filler Metals: Comply with AWS D10.12.

3. PART 3 - EXECUTION

3.1 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. Indicated locations and arrangements were used to size pipe and calculate friction loss, expansion, pump sizing, and other design considerations. Install piping as indicated unless deviations to layout are approved on Coordination Drawings.
- C. Install piping in concealed locations, unless otherwise indicated and except in equipment rooms and service areas.
- D. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.
- E. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal.
- F. Install piping to permit valve servicing.
- G. Install piping at indicated slopes.
- H. Install piping free of sags and bends.
- I. Install fittings for changes in direction and branch connections.
- J. Install piping to allow application of insulation.

- K. Select system components with pressure rating equal to or greater than system operating pressure.
- L. 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.
- M. Verify final equipment locations for roughing-in.
- N. Refer to equipment specifications in other Sections of these Specifications for roughing-in requirements.

3.2 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.
- F. Threaded Joints: Thread pipe with tapered pipe threads according to ASME B1.20.1. Cut threads full and clean using sharp dies. Ream threaded pipe ends to remove burrs and restore full ID. Join pipe fittings and valves as follows:
 - 1. Apply appropriate tape or thread compound to external pipe threads unless dry seal threading is specified.
 - 2. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged. Do not use pipe sections that have cracked or open welds.
- G. Welded Joints: Construct joints according to AWS D10.12, using qualified processes and welding operators according to Part 1 "Quality Assurance" Article.
- H. Flanged Joints: Select appropriate gasket material, size, type, and thickness for service application. Install gasket concentrically positioned. Use suitable lubricants on bolt threads.

3.3 PIPING CONNECTIONS

- A. Make connections according to the following, unless otherwise indicated:
 - 1. Install unions, in piping NPS 2 and smaller, adjacent to each valve and at final connection to each piece of equipment.
 - 2. Install flanges, in piping NPS 2-1/2 and larger, adjacent to flanged valves and at final connection to each piece of equipment.
 - 3. Dry Piping Systems: Install dielectric unions and flanges to connect piping materials of dissimilar metals.
 - 4. Wet Piping Systems: Install dielectric coupling and nipple fittings to connect piping materials of dissimilar metals.

3.4 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.

3.5 CONCRETE BASES

- A. Concrete Bases: Anchor equipment to concrete base as detailed.
 - 1. Construct concrete bases of dimensions indicated, but not less than 4 inches larger in both directions than supported unit. See Detail 13 on S0.3.
 - 2. Place and secure anchorage devices. Use supported equipment manufacturer's setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
 - 3. Install anchor bolts to elevations required for proper attachment to supported equipment.
 - 4. Install anchor bolts according to anchor-bolt manufacturer's written instructions.

3.6 ERECTION OF METAL SUPPORTS AND ANCHORAGES

- A. Refer to Division 05 Section "Metal Fabrications" for structural steel.
- B. Cut, fit, and place miscellaneous metal supports accurately in location, alignment, and elevation to support and anchor HVAC materials and equipment.
- C. Field Welding: Comply with AWS D1.1.

3.7 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 23 05 00

SECTION 23 05 13

COMMON MOTOR REQUIREMENTS FOR HVAC EQUIPMENT

1. PART 1 - GENERAL

1.1 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.

1.2 COORDINATION

- B. Coordinate features of motors, installed units, and accessory devices to be compatible with the following:
 - 1. Motor controllers.
 - 2. Torque, speed, and horsepower requirements of the load.
 - 3. Ratings and characteristics of supply circuit and required control sequence.
 - 4. Ambient and environmental conditions of installation location.

2. PART 2 - PRODUCTS

2.1 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.

2.2 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.

2.3 POLYPHASE MOTORS

- A. Description: NEMA MG 1, Design B, medium induction motor.
- B. Efficiency: Energy efficient, as defined in NEMA MG 1.
- C. Service Factor: 1.15.
- D. Multispeed Motors: Variable torque.
 - 1. For motors with 2:1 speed ratio, consequent pole, single winding.
 - 2. For motors with other than 2:1 speed ratio, separate winding for each speed.
- E. Rotor: Random-wound, squirrel cage.

- F. Bearings: Regreasable, shielded, antifriction ball bearings suitable for radial and thrust loading.
- G. Temperature Rise: Match insulation rating.
- H. Insulation: Class F.
- I. Code Letter Designation:
 - 1. Motors 15 HP and Larger: NEMA starting Code F or Code G.
 - 2. Motors Smaller than 15 HP: Manufacturer's standard starting characteristic.
- J. Enclosure Material: Cast iron for motor frame sizes 324T and larger; rolled steel for motor frame sizes smaller than 324T.

2.4 POLYPHASE MOTORS WITH ADDITIONAL REQUIREMENTS

- A. Motors Used with Reduced-Voltage and Multispeed Controllers: Match wiring connection requirements for controller with required motor leads. Provide terminals in motor terminal box, suited to control method.
- B. Motors Used with Variable Frequency Controllers: Ratings, characteristics, and features coordinated with and approved by controller manufacturer.
 - 1. Windings: Copper magnet wire with moisture-resistant insulation varnish, designed and tested to resist transient spikes, high frequencies, and short time rise pulses produced by pulse-width modulated inverters.
 - 2. Energy- and Premium-Efficient Motors: Class B temperature rise; Class F insulation.
 - 3. Inverter-Duty Motors: Class F temperature rise; Class H insulation.
 - 4. Thermal Protection: Comply with NEMA MG 1 requirements for thermally protected motors.

2.5 SINGLE-PHASE MOTORS

- A. Motors larger than 1/20 hp shall be one of the following, to suit starting torque and requirements of specific motor application:
 - 1. Permanent-split capacitor.
 - 2. Split phase.
 - 3. Capacitor start, inductor run.
 - 4. Capacitor start, capacitor run.
- B. Multispeed Motors: Variable-torque, permanent-split-capacitor type.
- C. Bearings: Prelubricated, antifriction ball bearings or sleeve bearings suitable for radial and thrust loading.
- D. Motors 1/20 HP and Smaller: Shaded-pole type.
- E. Thermal Protection: Internal protection to automatically open power supply circuit to motor when winding temperature exceeds a safe value calibrated to temperature rating of motor insulation. Thermal-protection device shall automatically reset when motor temperature returns to normal range.

PART 3 - EXECUTION (Not Applicable)

END OF SECTION 23 05 13

SECTION 23 05 29

HANGERS AND SUPPORTS FOR HVAC PIPING AND EQUIPMENT

1. PART 1 GENERAL

1.1 SUMMARY

- A. This Section includes the following:
 - 1. Steel pipe hangers and supports.
 - 2. Trapeze pipe hangers.
 - 3. Metal framing systems.
 - 4. Fastener systems.
 - 5. Equipment supports.
- B. See Division 05 Section "Metal Fabrications" for structural-steel shapes and plates for trapeze hangers for pipe and equipment supports.
- C. See Division 21 Section "Water-Based Fire-Suppression Systems" for pipe hangers for fire-protection piping.
- D. See Division 23 Section(s) "Metal Ducts" for duct hangers and supports.

1.2 DEFINITIONS

- A. Terminology: As defined in MSS SP-90, "Guidelines on Terminology for Pipe Hangers and Supports."

1.3 PERFORMANCE REQUIREMENTS

- A. Design supports for multiple pipes capable of supporting combined weight of supported systems, system contents, in accordance with approved documents.
- B. Design seismic-restraint hangers and supports for piping and equipment in accordance with approved documents.

1.4 SUBMITTALS

- A. Product Data: For the following:
 - 1. Steel pipe hangers and supports.
 - 2. Mechanical expansion anchors.
- B. Welding certificates.

1.5 QUALITY ASSURANCE

- A. Welding: Qualify procedures and personnel according to ASME Boiler and Pressure Vessel Code: Section IX.

2. PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. In other Part 2 articles where titles below introduce lists, the following requirements apply to 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, manufacturers specified.
 - 2. Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers specified.

2.2 STEEL 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.
- C. Galvanized, Metallic Coatings: Pregalvanized or hot dipped.
- D. Nonmetallic Coatings: Plastic coating, jacket, or liner.
- E. Padded Hangers: Hanger with fiberglass or other pipe insulation pad or cushion for support of bearing surface of piping.

2.3 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.

2.4 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: Pregalvanized or hot dipped for outdoors. Manufacturers standard finish indoors.

D. Nonmetallic Coatings: Plastic coating, jacket, or liner.

2.5 FASTENER SYSTEMS

A. 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.

2.6 EQUIPMENT SUPPORTS

A. Description: Welded, shop- or field-fabricated equipment support made from structural-steel shapes.

2.7 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.

3. PART 3 - EXECUTION

3.1 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. Yoke-Type Pipe Clamps (MSS Type 2): For suspension of 120 to 450 deg F pipes, NPS 4 to NPS 16, requiring up to 4 inches of insulation.
 3. Carbon- or Alloy-Steel, Double-Bolt Pipe Clamps (MSS Type 3): For suspension of pipes, NPS 3/4 to NPS 24, requiring clamp flexibility and up to 4 inches of insulation.
 4. Adjustable, Steel Band Hangers (MSS Type 7): For suspension of noninsulated stationary pipes, NPS 1/2 to NPS 8.
 5. U-Bolts (MSS Type 24): For support of heavy pipes, NPS 1/2 to NPS 30.
 6. Pipe Saddle Supports (MSS Type 36): For support of pipes, NPS 4 to NPS 36, with steel pipe base stanchion support and cast-iron floor flange.
 7. 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.
 8. Complete Pipe Rolls (MSS Type 44): For support of pipes, NPS 2 to NPS 42, if longitudinal movement caused by expansion and contraction might occur but vertical adjustment is not necessary.
- G. Vertical-Piping Clamps: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
1. Extension Pipe or Riser Clamps (MSS Type 8): For support of pipe risers, NPS 3/4 to NPS 20.
 2. Carbon- or Alloy-Steel Riser Clamps (MSS Type 42): For support of pipe risers, NPS 3/4 to NPS 20, if longer ends are required for riser clamps.
- H. Hanger-Rod Attachments: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
1. Steel Turnbuckles (MSS Type 13): For adjustment up to 6 inches for heavy loads.
 2. Steel Clevises (MSS Type 14): For 120 to 450 deg F piping installations.
- I. Building Attachments: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
1. Steel or Malleable Concrete Inserts (MSS Type 18): For upper attachment to suspend pipe hangers from concrete ceiling.
 2. Top-Beam C-Clamps (MSS Type 19): For use under roof installations with bar-joint 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. 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.
 8. Side-Beam Brackets (MSS Type 34): For sides of steel or wooden beams.
 9. Plate Lugs (MSS Type 57): For attaching to steel beams if flexibility at beam is required.

- J. 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.
- K. Spring Hangers and Supports: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
 - 1. Spring Cushions (MSS Type 48): For light loads if vertical movement does not exceed 1-1/4 inches.
 - 2. Spring-Cushion Roll Hangers (MSS Type 49): For equipping Type 41 roll hanger with springs.
 - 3. Variable-Spring Base Supports (MSS Type 52): Preset to indicated load and limit variability factor to 25 percent to absorb expansion and contraction of piping system from base support.
- L. Comply with MSS SP-69 for trapeze pipe hanger selections and applications that are not specified in piping system Sections.
- M. Comply with MFMA-102 for metal framing system selections and applications that are not specified in piping system Sections.
- N. Use mechanical-expansion anchors instead of building attachments where required in concrete construction.

3.2 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. Metal Framing System Installation: Arrange for grouping of parallel runs of piping and support together on field-assembled metal framing systems.
- D. Fastener System Installation:
 - 1. Install mechanical-expansion anchors in concrete after concrete is placed and completely cured. Install fasteners according to manufacturer's written instructions.
- E. Install hangers and supports complete with necessary inserts, bolts, rods, nuts, washers, and other accessories.
- F. Equipment Support Installation: Fabricate from welded-structural-steel shapes.
- 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.
 - 3. Install MSS SP-58, Type 40, protective shields on cold piping with vapor barrier. Shields shall span an arc of 180 degrees.
 - 4. Shield Dimensions for Pipe: Not less than the following:
 - a. NPS 1/4 to NPS 3-1/2: 12 inches long and 0.048 inch thick.
 - b. NPS 4: 12 inches long and 0.06 inch thick.
 - c. NPS 5 and NPS 6: 18 inches long and 0.06 inch thick.
 - d. NPS 8 to NPS 14: 24 inches long and 0.075 inch thick.
 - e. NPS 16 to NPS 24: 24 inches long and 0.105 inch thick.
 - 5. Pipes NPS 8 and Larger: Include wood inserts.
 - 6. Insert Material: Length at least as long as protective shield.

3.3 EQUIPMENT SUPPORTS

- A. Fabricate structural-steel stands to suspend equipment from structure overhead or to support equipment above floor.
- B. Grouting: Place grout under supports for equipment and make smooth bearing surface.
- C. Provide lateral bracing, to prevent swaying, for equipment supports.

3.4 METAL FABRICATIONS

- A. Cut, drill, and fit miscellaneous metal fabrications for 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.

3.5 ADJUSTING

- A. Hanger Adjustments: Adjust hangers to distribute loads equally on attachments and to achieve indicated slope of pipe.

3.6 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. Galvanized Surfaces: Clean welds, bolted connections, and abraded areas and apply galvanizing-repair paint to comply with ASTM A 780.

END OF SECTION 23 05 29

SECTION 23 05 53

IDENTIFICATION FOR HVAC PIPING AND EQUIPMENT

1. PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Equipment labels.
2. Warning signs and labels.
3. Pipe labels.
4. Duct labels.

1.2 SUBMITTAL

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

2. PART 2 - PRODUCTS

2.1 EQUIPMENT LABELS

A. 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: White.
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.

B. 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.

C. 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.

2.2 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: Black.

C. Background Color: Yellow or Orange.

- 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. Label Content: Include caution and warning information, plus emergency notification instructions.

2.3 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 partially cover 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.

2.4 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.

3.3 PART 3 - EXECUTION

3.1 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.

3.2 EQUIPMENT LABEL INSTALLATION

- A. Install or permanently fasten labels on each major item of mechanical equipment.
- B. Locate equipment labels where accessible and visible.

3.3 PIPE LABEL INSTALLATION

- A. 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.
- B. Pipe Label Color Schedule:
 1. Refrigerant Piping:
 - a. Background Color: Yellow.
 - b. Letter Color: Black.

3.4 DUCT LABEL INSTALLATION

- A. Install plastic-laminated duct labels with permanent adhesive on air ducts in the following color codes:
 1. Blue: For cold-air supply ducts.
 2. Yellow: For hot-air supply ducts.
 3. Green: For exhaust-, outside-, relief-, return-, and mixed-air ducts.
 4. ASME A13.1 Colors and Designs: For hazardous material exhaust.
- B. 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.

END OF SECTION 23 05 53

SECTION 23 05 93

TESTING, ADJUSTING, AND BALANCING FOR HVAC

1. PART 1 GENERAL

1.1 SUMMARY

- A. This Section includes TAB to produce design objectives for the following:
 - 1. Air Systems:
 - a. Constant-volume air systems.
 - 2. HVAC equipment quantitative-performance settings.
 - 3. Verifying that automatic control devices are functioning properly.
 - 4. Reporting results of activities and procedures specified in this Section.

1.2 SUBMITTALS

- A. Certified TAB Reports: Submit two copies of reports prepared, as specified in this Section, on approved forms certified by TAB firm.
- B. Warranties specified in this Section.

1.3 QUALITY ASSURANCE

- A. TAB Firm Qualifications: Engage a TAB firm certified by AABC.
- B. 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.
- C. TAB Report Forms: Use standard forms from AABC's "National Standards for Testing and Balancing Heating, Ventilating, and Air Conditioning Systems."

1.4 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. Perform TAB after leakage and pressure tests on air and water distribution systems have been satisfactorily completed.

1.5 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:

2. PART 2 PRODUCTS (Not Applicable)

3. PART 3 - EXECUTION

3.1 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. Verify that balancing devices, such as test ports, gage cocks, thermometer wells, flow-control devices, balancing valves and fittings, 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 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.
- D. 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.
- E. 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.
- F. Examine system and equipment test reports.
- G. Examine HVAC system and equipment installations to verify that indicated balancing devices, such as test ports, gage cocks, thermometer wells, flow-control devices, balancing valves and fittings, 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.
- H. Examine systems for functional deficiencies that cannot be corrected by adjusting and balancing.
- I. 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.
- J. Examine plenum ceilings used for supply air to verify that they are airtight. Verify that pipe penetrations and other holes are sealed.
- 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, valves, and other controlled devices are operated by the intended controller.
 - 2. Dampers and valves are in the position indicated by the controller.
 - 3. Integrity of valves and dampers for free and full operation and for tightness of fully closed and fully open positions. This includes dampers in multizone units, mixing boxes, and variable-air-volume terminals.

4. Automatic modulating and shutoff valves, including two-way valves and three-way mixing and diverting valves, are properly connected.
 5. Thermostats and humidistats are located to avoid adverse effects of sunlight, drafts, and cold walls.
 6. Sensors are located to sense only the intended conditions.
 7. Sequence of operation for control modes is according to the Contract Documents.
 8. Controller set points are set at indicated values.
 9. Interlocked systems are operating.
 10. Changeover from heating to cooling mode occurs according to indicated values.
- N. 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.

3.2 PREPARATION

- A. 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. Isolating and balancing valves are open and control valves are operational.
 6. Ceilings are installed in critical areas where air-pattern adjustments are required and access to balancing devices is provided.
 7. Windows and doors can be closed so indicated conditions for system operations can be met.

3.3 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, pipes, 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.

3.4 GENERAL PROCEDURES FOR BALANCING AIR SYSTEMS

- A. Prepare test reports for both fans and outlets. Obtain manufacturer's outlet factors and recommended testing procedures. Crosscheck the summation of required outlet volumes with required fan volumes.
- B. Prepare schematic diagrams of systems' "as-built" duct layouts.
- C. Determine the best locations in main and branch ducts for accurate duct airflow measurements.
- D. Check airflow patterns from the outside-air louvers and dampers and the return- and exhaust-air dampers, through the supply-fan discharge and mixing dampers.
- E. Locate start-stop and disconnect switches, electrical interlocks, and motor starters.
- F. Verify that motor starters are equipped with properly sized thermal protection.
- G. Check dampers for proper position to achieve desired airflow path.

- H. Check for airflow blockages.
- I. Check condensate drains for proper connections and functioning.
- J. Check for proper sealing of air-handling unit components.
- K. Check for proper sealing of air duct system.

3.5 PROCEDURES FOR CONSTANT-VOLUME AIR SYSTEMS

- A. Adjust fans to deliver total indicated airflows within the maximum allowable fan speed listed by fan manufacturer.
 - 1. Measure fan static pressures to determine actual static pressure as follows:
 - a. Measure outlet static pressure as far downstream from the fan as practicable and upstream from restrictions in ducts such as elbows and transitions.
 - b. Measure static pressure directly at the fan outlet or through the flexible connection.
 - c. Measure inlet static pressure of single-inlet fans in the inlet duct as near the fan as possible, upstream from flexible connection and downstream from duct restrictions.
 - d. Measure inlet static pressure of double-inlet fans through the wall of the plenum that houses the fan.
 - 2. Measure static pressure across each component that makes up an air-handling unit, rooftop unit, and other air-handling and -treating equipment.
 - a. Simulate dirty filter operation and record the point at which maintenance personnel must change filters.
 - 3. Measure static pressures entering and leaving other devices such as sound traps, heat recovery equipment, and air washers, under final balanced conditions.
 - 4. Compare design data with installed conditions to determine variations in design static pressures versus actual static pressures. Compare actual system effect factors with calculated system effect factors to identify where variations occur. Recommend corrective action to align design and actual conditions.
 - 5. Obtain approval from Architect for adjustment of fan speed higher or lower than indicated speed. Make required adjustments to pulley sizes, motor sizes, and electrical connections to accommodate fan-speed changes.
 - 6. Do not make fan-speed adjustments that result in motor overload. Consult equipment manufacturers about fan-speed safety factors. Modulate dampers and measure fan-motor amperage to ensure that no overload will occur. Measure amperage in full cooling, full heating, economizer, and any other operating modes to determine the maximum required brake horsepower.
- B. Adjust volume dampers for main duct, submain ducts, and major branch ducts to indicated airflows within specified tolerances.
 - 1. Measure static pressure at a point downstream from the balancing damper and adjust volume dampers until the proper static pressure is achieved.
 - a. Where sufficient space in submain and branch ducts is unavailable for Pitot-tube traverse measurements, measure airflow at terminal outlets and inlets and calculate the total airflow for that zone.
 - 2. Remeasure each submain and branch duct after all have been adjusted. Continue to adjust submain and branch ducts to indicated airflows within specified tolerances.

3.6 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.

3.7 PROCEDURES FOR CONDENSING UNITS

- A. Verify proper rotation of fans.
- B. Measure entering- and leaving-air temperatures.
- C. Record compressor data.

3.8 PROCEDURES FOR HEAT-TRANSFER COILS

A. Refrigerant Coils: Measure the following data for each coil:

1. Dry-bulb temperature of entering and leaving air.
2. Wet-bulb temperature of entering and leaving air.
3. Airflow.
4. Air pressure drop.
5. Refrigerant suction pressure and temperature.

3.9 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.

3.10 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 nongrounded power supply.
- K. Note operation of electric actuators using spring return for proper fail-safe operations.

3.11 TOLERANCES

- A. Set HVAC system airflow and water flow rates within the following tolerances:
 - 1. Supply, Return, and Exhaust Fans and Equipment with Fans: Plus 5 to plus 10 percent.
 - 2. Air Outlets and Inlets: 0 to minus 10 percent.

3.12 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. Fan curves.
 - 2. Manufacturers' test data.
 - 3. Field test reports prepared by system and equipment installers.
 - 4. 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 exhaust-air dampers.
 - b. Conditions of filters.

- c. Cooling coil, wet- and dry-bulb conditions.
 - d. Face and bypass damper settings at coils.
 - e. Fan drive settings including settings and percentage of maximum pitch diameter.
 - f. Settings for supply-air, static-pressure controller.
 - g. Other system operating conditions that affect performance.
- E. System Diagrams: Include schematic layouts of air and hydronic distribution systems. Present each system with single-line diagram and include the following:
 - 1. Quantities of outside, supply, return, and exhaust airflows.
 - 2. Duct, outlet, and inlet sizes.
 - 3. Balancing stations.
 - 4. Position of balancing devices.

3.13 ADDITIONAL TESTS

- A. Within 90 days of completing TAB, perform additional testing and balancing to verify that balanced conditions are being maintained throughout and to correct unusual conditions.
- B. Seasonal Periods: If initial TAB procedures were not performed during near-peak summer and winter conditions, perform additional testing, inspecting, and adjusting during near-peak summer and winter conditions.

END OF SECTION 23 05 93

SECTION 23 07 13

DUCT INSULATION

1. PART 1 GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section includes insulating the following duct services:
 - 1. Indoor, concealed supply, return, and outdoor air.
- B. Related Sections:
 - 1. Section 230719 "HVAC Piping Insulation."
 - 2. Section 233113 "Metal Ducts" for duct liners.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated. Include thermal conductivity, water-vapor permeance thickness, and jackets (both factory- and field-applied if any).
- B. Shop Drawings: Include plans, elevations, sections, details, and attachments to other work.
 - 1. Detail application of protective shields, saddles, and inserts at hangers for each type of insulation and hanger.
 - 2. Detail insulation application at elbows, fittings, dampers, specialties and flanges for each type of insulation.
 - 3. Detail application of field-applied jackets.
 - 4. Detail application at linkages of control devices.

1.4 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For qualified Installer.
- B. Material Test Reports: From a qualified testing agency acceptable to authorities having jurisdiction indicating, interpreting, and certifying test results for compliance of insulation materials, sealers, attachments, cements, and jackets, with requirements indicated. Include dates of tests and test methods employed.

1.5 QUALITY ASSURANCE

- A. Installer Qualifications: Skilled mechanics who have successfully completed an apprenticeship program or another craft training program certified by the Department of Labor, Bureau of Apprenticeship and Training.
- B. Surface-Burning Characteristics: For insulation and related materials, as determined by testing identical products according to ASTM E 84, by a testing agency acceptable to authorities having jurisdiction. Factory label insulation and jacket materials and adhesive, mastic, tapes, and cement material containers, with appropriate markings of applicable testing agency.
 - 1. Insulation Installed Indoors: Flame-spread index of 25 or less, and smoke-developed index of 50 or less.

2. Insulation Installed Outdoors: Flame-spread index of 75 or less, and smoke-developed index of 150 or less.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Packaging: Insulation material containers shall be marked by manufacturer with appropriate ASTM standard designation, type and grade, and maximum use temperature.

1.7 COORDINATION

- A. Coordinate sizes and locations of supports, hangers, and insulation shields specified in Section 230529 "Hangers and Supports for HVAC Piping and Equipment."
- B. Coordinate clearance requirements with duct Installer for duct insulation application. Before preparing ductwork Shop Drawings, establish and maintain clearance requirements for installation of insulation and field-applied jackets and finishes and for space required for maintenance.

1.8 SCHEDULING

- A. Schedule insulation application after pressure testing systems. 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.

2. PART 2 PRODUCTS

2.1 INSULATION MATERIALS

- A. Comply with requirements in "Duct Insulation Schedule, General," "Indoor Duct and Plenum Insulation Schedule," and "Aboveground, Outdoor Duct and Plenum Insulation 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 Blanket Insulation: Mineral or glass fibers bonded with a thermosetting resin. Comply with ASTM C 553, Type II and ASTM C 1290, Type III with factory-applied FSK jacket. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.
 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. CertainTeed Corporation.
 - b. Johns Manville; a Berkshire Hathaway company.
 - c. Knauf Insulation.
 - d. Owens Corning.

2.2 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. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Childers Brand; H. B. Fuller Construction Products.
 - b. Eagle Bridges - Marathon Industries.
 - c. Foster Brand; H. B. Fuller Construction Products.
 - d. Mon-Eco Industries, Inc.
 - 2. For indoor applications, adhesive shall have a VOC content of 80 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
 - 3. Adhesive shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."
- C. ASJ Adhesive, and FSK Jacket Adhesive: Comply with MIL-A-3316C, Class 2, Grade A for bonding insulation jacket lap seams and joints.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Childers Brand; H. B. Fuller Construction Products.
 - b. Eagle Bridges - Marathon Industries.
 - c. Foster Brand; H. B. Fuller Construction Products.
 - 2. For indoor applications, adhesive shall have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
 - 3. Adhesive shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

2.3 MASTICS

- A. Materials shall be compatible with insulation materials, jackets, and substrates; comply with MIL-PRF-19565C, Type II.
 - 1. For indoor applications, use mastics that have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
- B. Vapor-Barrier Mastic: Water based; suitable for indoor use on below ambient services.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Foster Brand; H. B. Fuller Construction Products.
 - b. Vimasco Corporation.
 - 2. Water-Vapor Permeance: ASTM E 96/E 96M, Procedure B, 0.013 perm at 43-mil dry film thickness.
 - 3. Service Temperature Range: Minus 20 to plus 180 deg F.
 - 4. Solids Content: ASTM D 1644, 58 percent by volume and 70 percent by weight.
 - 5. Color: White.

- C. Vapor-Barrier Mastic: Solvent based; suitable for outdoor use on below ambient services.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Childers Brand; H. B. Fuller Construction Products.
 - b. Eagle Bridges - Marathon Industries.
 - c. Foster Brand; H. B. Fuller Construction Products.
 2. Water-Vapor Permeance: ASTM F 1249, 0.05 perm at 30-mil dry film thickness.
 3. Service Temperature Range: Minus 50 to plus 220 deg F.
 4. Solids Content: ASTM D 1644, 33 percent by volume and 46 percent by weight.
 5. Color: White.

2.4 LAGGING ADHESIVES

- A. Description: Comply with MIL-A-3316C, Class I, Grade A and shall be compatible with insulation materials, jackets, and substrates.
1. For indoor applications, use lagging adhesives that have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
 2. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Childers Brand; H. B. Fuller Construction Products.
 - b. Foster Brand; H. B. Fuller Construction Products.
 - c. Vamasco Corporation.
 3. Fire-resistant, water-based lagging adhesive and coating for use indoors to adhere fire-resistant lagging cloths over duct insulation.
 4. Service Temperature Range: 0 to plus 180 deg F.
 5. Color: White.

2.5 SEALANTS

- A. FSK Flashing Sealants:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Childers Brand; H. B. Fuller Construction Products.
 - b. Eagle Bridges - Marathon Industries.
 - c. Foster Brand; H. B. Fuller Construction Products.
 2. Materials shall be compatible with insulation materials, jackets, and substrates.
 3. Fire- and water-resistant, flexible, elastomeric sealant.
 4. Service Temperature Range: Minus 40 to plus 250 deg F.
 5. Color: Aluminum.
 6. For indoor applications, sealants shall have a VOC content of 420 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
 7. Sealants shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

2.6 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. FSK Jacket: Aluminum-foil, fiberglass-reinforced scrim with kraft-paper backing; complying with ASTM C 1136, Type II.

2.7 FIELD-APPLIED FABRIC-REINFORCING MESH

- A. Woven Glass-Fiber Fabric: Approximately 6 oz./sq. yd. with a thread count of 5 strands by 5 strands/sq. in. for covering ducts.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by the following:
 - a. Childers Brand; H. B. Fuller Construction Products.
- B. Woven Polyester Fabric: Approximately 1 oz./sq. yd. with a thread count of 10 strands by 10 strands/sq. in., in a Leno weave, for ducts.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Foster Brand; H. B. Fuller Construction Products.
 - b. Vimasco Corporation.

2.8 FIELD-APPLIED CLOTHS

- A. Woven Glass-Fiber Fabric: Comply with MIL-C-20079H, Type I, plain weave, and presized a minimum of 8 oz./sq. yd..
 - 1. Manufacturers: Subject to compliance with requirements, provide products by the following:
 - a. Alpha Associates, Inc.

2.9 TAPES

- A. FSK Tape: Foil-face, vapor-retarder tape matching factory-applied jacket with acrylic adhesive; complying with ASTM C 1136.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Avery Dennison Corporation, Specialty Tapes Division.
 - b. Ideal Tape Co., Inc.; an American Biltrite company.
 - c. Venture Tape.
 - 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.

2.10 SECUREMENTS

A. Insulation Pins and Hangers:

1. 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. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1) AGM Industries, Inc.
 - 2) Gemco.
 - 3) Midwest Fasteners, Inc.
 - 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.

B. Staples: Outward-clinching insulation staples, nominal 3/4-inch- wide, stainless steel or Monel.

C. Wire: 0.080-inch nickel-copper alloy.

1. Manufacturers: Subject to compliance with requirements, provide products by the following:
 - a. C & F Wire.

2.11 CORNER ANGLES

- A. 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.

3. PART 3 EXECUTION

3.1 EXAMINATION

- A. Examine substrates and conditions for compliance with requirements for installation tolerances and other conditions affecting performance of insulation application.
 1. Verify that systems to be insulated have been tested and are free of defects.
 2. Verify that surfaces to be insulated are clean and dry.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Surface Preparation: Clean and dry surfaces to receive insulation. Remove materials that will adversely affect insulation application.

3.3 GENERAL INSTALLATION REQUIREMENTS

- A. Install insulation materials, accessories, and finishes with smooth, straight, and even surfaces; free of voids throughout the length of ducts and fittings.
- B. Install insulation materials, vapor barriers or retarders, jackets, and thicknesses required for each item of duct 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. Keep insulation materials dry during application and finishing.
- G. Install insulation with tight longitudinal seams and end joints. Bond seams and joints with adhesive recommended by insulation material manufacturer.
- H. Install insulation with least number of joints practical.
- I. 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.
- J. Apply adhesives, mastics, and sealants at manufacturer's recommended coverage rate and wet and dry film thicknesses.
- K. 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. Clean and dry surface to receive self-sealing lap. Staple laps with outward clinching staples along edge at 2 inches o.c.
 - a. For below ambient services, apply vapor-barrier mastic over staples.
 - 4. Cover joints and seams with tape, according to insulation material manufacturer's written instructions, to maintain vapor seal.
 - 5. Where vapor barriers are indicated, apply vapor-barrier mastic on seams and joints and at ends adjacent to duct flanges and fittings.
- L. Cut insulation in a manner to avoid compressing insulation more than 75 percent of its nominal thickness.
- M. Finish installation with systems at operating conditions. Repair joint separations and cracking due to thermal movement.

- N. Repair damaged insulation facings by applying same facing material over damaged areas. Extend patches at least 4 inches beyond damaged areas. Adhere, staple, and seal patches similar to butt joints.

3.4 PENETRATIONS

- A. Insulation Installation at Roof Penetrations: Install insulation continuously through roof penetrations.
 - 1. Seal penetrations with flashing sealant.
 - 2. For applications requiring only indoor insulation, terminate insulation above roof surface and seal with joint sealant. For applications requiring indoor and outdoor insulation, install insulation for outdoor applications tightly joined to indoor insulation ends. Seal joint with joint sealant.
 - 3. Extend jacket of outdoor insulation outside roof flashing at least 2 inches below top of roof flashing.
 - 4. Seal jacket to roof flashing with flashing sealant.
- B. Insulation Installation at Aboveground Exterior Wall Penetrations: Install insulation continuously through wall penetrations.
 - 1. Seal penetrations with flashing sealant.
 - 2. For applications requiring only indoor insulation, terminate insulation inside wall surface and seal with joint sealant. For applications requiring indoor and outdoor insulation, install insulation for outdoor applications tightly joined to indoor insulation ends. Seal joint with joint sealant.
 - 3. Extend jacket of outdoor insulation outside wall flashing and overlap wall flashing at least 2 inches.
 - 4. Seal jacket to wall flashing with flashing sealant.
- C. Insulation Installation at Interior Wall and Partition Penetrations (That Are Not Fire Rated): Install insulation continuously through walls and partitions.
- D. Insulation Installation at Fire-Rated Wall and Partition Penetrations: 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 Section 078400 "Firestopping".
- E. Insulation Installation at Floor Penetrations:
 - 1. Duct: For penetrations through fire-rated assemblies, terminate insulation at fire damper sleeves and externally insulate damper sleeve beyond floor to match adjacent duct insulation. Overlap damper sleeve and duct insulation at least 2 inches.
 - 2. Seal penetrations through fire-rated assemblies. Comply with requirements in Section 078400 "Firestopping."

3.5 INSTALLATION OF MINERAL-FIBER INSULATION

- A. Blanket Insulation Installation on Ducts and Plenums: Secure with adhesive and insulation pins.
 - 1. Apply adhesives according to manufacturer's recommended coverage rates per unit area, for 50 percent coverage of duct and plenum surfaces.
 - 2. Apply adhesive to entire circumference of ducts and to all surfaces of fittings and transitions.
 - 3. Install pins and washers on sides and bottom of horizontal ducts and sides of vertical ducts as follows:
 - a. On duct sides with dimensions 18 inches and smaller, place pins along longitudinal centerline of duct. Space 3 inches maximum from insulation end joints, and 16 inches o.c.

- b. On duct sides with dimensions larger than 18 inches, place pins 16 inches o.c. each way, and 3 inches maximum from insulation joints. Install additional pins to hold insulation tightly against surface at cross bracing.
 - c. Pins may be omitted from top surface of horizontal, rectangular ducts and plenums.
 - d. Do not overcompress insulation during installation.
 - e. Impale insulation over pins and attach speed washers.
 - f. Cut excess portion of pins extending beyond washers or bend parallel with insulation surface. Cover exposed pins and washers with tape matching insulation facing.
- 4. For ducts and plenums with surface temperatures below ambient, install a continuous unbroken vapor barrier. Create a facing lap for longitudinal seams and end joints with insulation by removing 2 inches from one edge and one end of insulation segment. Secure laps to adjacent insulation section with 1/2-inch outward-clinching staples, 1 inch o.c. Install vapor barrier consisting of factory- or field-applied jacket, adhesive, vapor-barrier mastic, and sealant at joints, seams, and protrusions.
 - a. Repair punctures, tears, and penetrations with tape or mastic to maintain vapor-barrier seal.
- 5. Overlap unfaced blankets a minimum of 2 inches on longitudinal seams and end joints. At end joints, secure with steel bands spaced a maximum of 18 inches o.c.
- 6. Install insulation on rectangular duct elbows and transitions with a full insulation section for each surface. Install insulation on round and flat-oval duct elbows with individually mitered gores cut to fit the elbow.
- 7. Insulate duct stiffeners, hangers, and flanges that protrude beyond insulation surface with 6-inch- wide strips of same material used to insulate duct. Secure on alternating sides of stiffener, hanger, and flange with pins spaced 6 inches o.c.

3.6 FIELD QUALITY CONTROL

- A. Perform tests and inspections.
- B. 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.
- C. All insulation applications will be considered defective Work if sample inspection reveals noncompliance with requirements.

3.7 DUCT INSULATION SCHEDULE, GENERAL

- A. Plenums and Ducts Requiring Insulation:
 - 1. Indoor, concealed supply and return.
 - 2. Supply and return.
- B. Items Not Insulated:
 - 1. Fibrous-glass ducts.
 - 2. Metal ducts with duct liner of sufficient thickness to comply with energy code and ASHRAE/IESNA 90.1.
 - 3. Factory-insulated flexible ducts.
 - 4. Factory-insulated plenums and casings.
 - 5. Flexible connectors.
 - 6. Vibration-control devices.
 - 7. Factory-insulated access panels and doors.

3.8 INDOOR DUCT AND PLENUM INSULATION SCHEDULE

- A. Concealed, supply-air, return air, and outside-air duct insulation shall be the following:
 - 1. Mineral-Fiber Blanket: 3 inches thick and 1.5-lb/cu. ft. nominal density, 8.0 installed R-value.
 - 2. Mineral-Fiber Blanket: 3 inches thick and 1.5-lb/cu. Ft, 8.0 installed R-value. nominal density.

3.9 ABOVEGROUND, OUTDOOR DUCT AND PLENUM INSULATION SCHEDULE

- A. Insulation materials and thicknesses are identified below. If more than one material is listed for a duct system, selection from materials listed is Contractor's option.
- B. Supply-air and return-air duct insulation shall be lined as described in 233113 "Metal Ducts":

END OF SECTION 23 07 13

SECTION 23 31 13

METAL DUCTS

1. PART 1 GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

1. Single-wall rectangular ducts and fittings.
2. Single-wall round and flat-oval ducts and fittings.
3. Sheet metal materials.
4. Duct liner.
5. Sealants and gaskets.
6. Hangers and supports.
7. Seismic-restraint devices.

B. Related Sections:

1. Section 230593 "Testing, Adjusting, and Balancing for HVAC" for testing, adjusting, and balancing requirements for metal ducts.
2. Section 233116 "Nonmetal Ducts" for FRP ducts.
3. Section 233300 "Air Duct Accessories" for dampers, sound-control devices, duct-mounting access doors and panels, turning vanes, and flexible ducts.

1.3 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, California Mechanical Code, and design criteria indicated in "Duct Schedule" Article.
- 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", California Mechanical Code, and ASCE/SEI 7.
 1. Seismic Hazard Level A: Refer to structural plans for Seismic force to weight ratio:
- C. Airstream Surfaces: Surfaces in contact with the airstream shall comply with requirements in ASHRAE 62.1.

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of the following products:
 1. Liners and adhesives.
 2. Sealants and gaskets.
 3. Seismic-restraint devices.

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. Penetrations through fire-rated and other partitions.
10. Equipment installation based on equipment being used on Project.
11. Locations for duct accessories, including dampers, turning vanes, and access doors and panels.
12. Hangers and supports, including methods for duct and building attachment, seismic restraints, and vibration isolation.

1.5 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Plans, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of the items involved:

1. 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. Speakers.
 - d. Sprinklers.
 - e. Access panels.

B. Welding certificates.

C. Field quality-control reports.

1.6 QUALITY ASSURANCE

A. 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.

B. ASHRAE Compliance: Applicable requirements in ASHRAE 62.1, Section 5 - "Systems and Equipment" and Section 7 - "Construction and System Start-up."

C. ASHRAE/IESNA Compliance: Applicable requirements in ASHRAE/IESNA 90.1, Section 6.4.4 - "HVAC System Construction and Insulation."

PART 2 - PRODUCTS

2.1 SINGLE-WALL RECTANGULAR DUCTS AND FITTINGS

- A. General Fabrication Requirements: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" based on indicated static-pressure class unless otherwise indicated.
- B. Transverse Joints: Select joint types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 2-1, "Rectangular Duct/Transverse Joints," 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."
- C. Longitudinal Seams: Select seam types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 2-2, "Rectangular Duct/Longitudinal Seams," 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."
- D. Elbows, Transitions, Offsets, Branch Connections, and Other Duct Construction: Select types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Chapter 4, "Fittings and Other Construction," 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."

2.2 SINGLE-WALL ROUND AND FLAT-OVAL 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, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - a. Lindab Inc.
 - b. McGill AirFlow LLC.
 - c. Spiral Manufacturing Co., Inc.
- B. Flat-Oval Ducts: Indicated dimensions are the duct width (major dimension) and diameter of the round sides connecting the flat portions of the duct (minor dimension).
- C. Transverse Joints: Select joint types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-1, "Round Duct Transverse Joints," 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 3-2, "Round Duct Longitudinal Seams," 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 3-5, "90 Degree Tees and Laterals," and Figure 3-6, "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."

2.3 SHEET METAL MATERIALS

- 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. Galvanized Sheet Steel: Comply with ASTM A 653/A 653M.
 - 1. Galvanized Coating Designation: G90.
 - 2. Finishes for Surfaces Exposed to View: Mill phosphatized.
- C. 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.
- D. 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.

2.4 DUCT LINER

- A. Fibrous-Glass Duct Liner: Comply with ASTM C 1071, NFPA 90A, or NFPA 90B; and with NAIMA AH124, "Fibrous Glass Duct Liner Standard."
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. CertainTeed Corporation.
 - b. Johns Manville; a Berkshire Hathaway company.
 - c. Knauf Insulation.
 - d. Owens Corning.
 - 1) Type I, Flexible: 0.27 Btu x in./h x sq. ft. x deg F at 75 deg F mean temperature.
 - 2) Type II, Rigid: 0.23 Btu x in./h x sq. ft. x deg F at 75 deg F mean temperature.
 - 2. Antimicrobial Erosion-Resistant Coating: Apply to the surface of the liner that will form the interior surface of the duct to act as a moisture repellent and erosion-resistant coating. Antimicrobial compound shall be tested for efficacy by an NRTL and registered by the EPA for use in HVAC systems.
 - 3. Water-Based Liner Adhesive: Comply with NFPA 90A or NFPA 90B and with ASTM C 916.
 - a. For indoor applications, adhesive shall have a VOC content of 80 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
 - b. Adhesive shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."
- B. Flexible Elastomeric Duct Liner: Preformed, cellular, closed-cell, sheet materials complying with ASTM C 534, Type II, Grade 1; and with NFPA 90A or NFPA 90B.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Aeroflex USA, Inc.

- b. Armacell LLC.
 - c. Rubatex International, LLC.
- 2. 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.
- 3. Liner Adhesive: As recommended by insulation manufacturer and complying with NFPA 90A or NFPA 90B.
 - a. For indoor applications, adhesive shall have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
 - b. Adhesive shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."
- C. Insulation Pins and Washers:
 - 1. 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.
 - 2. Insulation-Retaining Washers: Self-locking washers formed from 0.016-inch- thick galvanized steel; with beveled edge sized as required to hold insulation securely in place but not less than 1-1/2 inches in diameter.
- D. Shop Application of Duct Liner: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 7-11, "Flexible Duct Liner Installation."
 - 1. Adhere a single layer of indicated thickness of duct liner with at least 90 percent adhesive coverage at liner contact surface area. Attaining indicated thickness with multiple layers of duct liner is prohibited.
 - 2. Apply adhesive to transverse edges of liner facing upstream that do not receive metal nosing.
 - 3. Butt transverse joints without gaps, and coat joint with adhesive.
 - 4. Fold and compress liner in corners of rectangular ducts or cut and fit to ensure butted-edge overlapping.
 - 5. Do not apply liner in rectangular ducts with longitudinal joints, except at corners of ducts, unless duct size and dimensions of standard liner make longitudinal joints necessary.
 - 6. Apply adhesive coating on longitudinal seams in ducts with air velocity of 2500 fpm.
 - 7. Secure liner with mechanical fasteners 4 inches from corners and at intervals not exceeding 12 inches transversely; at 3 inches from transverse joints and at intervals not exceeding 18 inches longitudinally.
 - 8. Secure transversely oriented liner edges facing the airstream with metal nosings that have either channel or "Z" profiles or are integrally formed from duct wall. Fabricate edge facings at the following locations:
 - a. Fan discharges.
 - b. Intervals of lined duct preceding unlined duct.
 - c. Upstream edges of transverse joints in ducts where air velocities are higher than 2500 fpm or where indicated.
 - 9. Secure insulation between perforated sheet metal inner duct of same thickness as specified for outer shell. Use mechanical fasteners that maintain inner duct at uniform distance from outer shell without compressing insulation.
 - a. Sheet Metal Inner Duct Perforations: 3/32-inch diameter, with an overall open area of 23 percent.
 - 10. Terminate inner ducts with buildouts attached to fire-damper sleeves, dampers, turning vane assemblies, or other devices. Fabricated buildouts (metal hat sections) or other buildout means are optional; when used, secure buildouts to duct walls with bolts, screws, rivets, or welds.

2.5 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. 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.
- C. 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.
 - 6. For indoor applications, sealant shall have a VOC content of 250 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
 - 7. Sealant shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."
- D. Flange Gaskets: Butyl rubber, neoprene, or EPDM polymer with polyisobutylene plasticizer.
- E. Round Duct Joint O-Ring Seals:
 - 1. Seal shall provide maximum 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.

2.6 HANGERS AND SUPPORTS

- A. Hanger Rods for Noncorrosive Environments: Electrogalvanized, all-thread rods or galvanized rods and nuts.
- B. Strap and Rod Sizes: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Table 5-1, "Rectangular Duct Hangers Minimum Size," and Table 5-2, "Minimum Hanger Sizes for Round Duct."
- C. Steel Cables for Galvanized-Steel Ducts: Galvanized steel complying with ASTM A 603.
- D. Steel Cables for Stainless-Steel Ducts: Stainless steel complying with ASTM A 492.
- E. Steel Cable End Connections: Galvanized steel assemblies, complying with ASTM A 603, with brackets, swivel, and bolts designed for duct hanger service; with an automatic-locking and clamping device.

- F. Duct Attachments: Sheet metal screws, blind rivets, or self-tapping metal screws; compatible with duct materials.
- G. 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.

2.7 SEISMIC-RESTRAINT DEVICES

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - 1. Mason Industries, 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. 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 or ASTM A 492, stainless-steel cables with end connections made of galvanized or stainless 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: Steel tube or steel slotted-support-system sleeve with internally bolted connections 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.

3. PART 3 - EXECUTION

3.1 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 and flat-oval 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 Section 233300 "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".
- M. Line the first 20 feet length of connected supply and return ducts at each package rooftop A/C unit, for noise attenuation and thermal insulation (unless noted otherwise on drawings).

2.8 DUCT SEALING

- A. Seal ducts for duct static-pressure, seal classes, and leakage classes specified in "Duct Schedule" Article according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

2.9 HANGER AND SUPPORT INSTALLATION

- A. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Chapter 5, "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 5-1, "Rectangular Duct Hangers Minimum Size," and Table 5-2, "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, unless indicated otherwise on drawings.
- 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.

2.10 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 ASCE/SEI 7.
 - 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.

2.11 CONNECTIONS

- A. Make connections to equipment with flexible connectors complying with Section 233300 "Air Duct Accessories."
- B. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" for branch, outlet and inlet, and terminal unit connections.

2.12 FIELD QUALITY CONTROL

- A. Perform tests and inspections.
- B. Leakage Tests:
 - 1. Comply with SMACNA's "HVAC Air Duct Leakage Test Manual." Submit a test report for each test.
 - 2. Test the following systems:
 - a. Ducts with a Pressure Class Higher Than 3-Inch wg:
 - 3. Disassemble, reassemble, and seal segments of systems to accommodate leakage testing and for compliance with test requirements.
 - 4. Test for leaks before applying external insulation.

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 system at maximum system design pressure. Do not pressurize systems above maximum design operating pressure.
 6. 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. If a duct system fails to pass tests and inspections, the entire duct system shall be cleaned and re-tested again at no additional cost to owner.
- E. Prepare test and inspection reports.

2.13 DUCT CLEANING

- A. Clean 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 Section 233300 "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. Air-handling unit internal surfaces and components including mixing box, coil section, condensate drain pans, filters and filter sections, and condensate collectors and drains.
4. Coils and related components.
5. Return-air ducts, dampers, actuators, and turning vanes except in ceiling plenums and mechanical equipment rooms.
6. Supply-air ducts, dampers, actuators, and turning vanes.
7. 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.

2.14 START UP

- A. Air Balance: Comply with requirements in Section 230593 "Testing, Adjusting, and Balancing for HVAC."

2.15 DUCT SCHEDULE

- A. Fabricate ducts with galvanized sheet steel.

B. Supply Ducts:

1. Pressure Class: Positive 2-inch.
2. Minimum SMACNA Leakage Class: 12
3. SMACNA Leakage Class for Rectangular: 12

C. Return Ducts:

1. Pressure Class: Positive or negative 2-inch.
2. Minimum SMACNA Seal Class: A
3. SMACNA Leakage Class for Rectangular: 12.

D. Exhaust Ducts:

1. Ducts Connected to Fans Exhausting (ASHRAE 62.1, Class 1 and 2) Air:
 - a. Pressure Class: Negative 2-inch wg.

- b. Minimum SMACNA Seal Class: B if negative pressure, and A if positive pressure.
 - c. SMACNA Leakage Class for Rectangular: 24.
 - 2. Ducts Connected to Package A/C units.
 - a. Pressure Class: Positive or negative 2-inch wg.
 - b. Minimum SMACNA Seal Class: B if negative pressure, and A if positive pressure.
 - c. SMACNA Leakage Class for Rectangular: 24.
- E. Intermediate Reinforcement:
 - 1. Galvanized-Steel Ducts: Galvanized steel.
- F. Liner:
 - 1. Air Ducts (except ducts serving Food Prep and Cafeteria): Fibrous glass, Type I, 2 inches thick.
 - 2. Fan Plenums (except ducts serving Food Prep and Cafeteria): Fibrous glass, Type II, 2 inches thick.
- G. Elbow Configuration:
 - 1. Rectangular Duct: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 4-2, "Rectangular Elbows."
 - a. Velocity 1000 fpm or Lower:
 - 1) Radius Type RE 1 with minimum 0.5 radius-to-diameter ratio.
 - 2) Mitered Type RE 4 without vanes.
 - b. Velocity 1000 to 1500 fpm:
 - 1) Radius Type RE 1 with minimum 1.0 radius-to-diameter ratio.
 - 2) Radius Type RE 3 with minimum 0.5 radius-to-diameter ratio and two vanes.
 - 3) Mitered Type RE 2 with vanes complying with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 4-3, "Vanes and Vane Runners," and Figure 4-4, "Vane Support in Elbows."
 - c. Velocity 1500 fpm or Higher:
 - 1) Radius Type RE 1 with minimum 1.5 radius-to-diameter ratio.
 - 2) Radius Type RE 3 with minimum 1.0 radius-to-diameter ratio and two vanes.
 - 3) Mitered Type RE 2 with vanes complying with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 4-3, "Vanes and Vane Runners," and Figure 4-4, "Vane Support in Elbows."
 - 2. Rectangular Duct: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 4-2, "Rectangular Elbows."
 - a. Radius Type RE 1 with minimum 1.5 radius-to-diameter ratio.
 - b. Radius Type RE 3 with minimum 1.0 radius-to-diameter ratio and two vanes.
 - c. Mitered Type RE 2 with vanes complying with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 4-3, "Vanes and Vane Runners," and Figure 4-4, "Vane Support in Elbows."

3. Round Duct: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-4, "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.
 - 4) Radius-to Diameter Ratio: 1.5.
 - b. Round Elbows, 12 Inches and Smaller in Diameter: Stamped or pleated.
 - c. Round Elbows, 14 Inches and Larger in Diameter: Standing seam or Welded.

H. Branch Configuration:

1. Rectangular Duct: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 4-6, "Branch Connection."
 - a. Rectangular Main to Rectangular Branch: 45-degree entry.
 - b. Rectangular Main to Round Branch: Spin in.
2. Round and Flat Oval: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-5, "90 Degree Tees and Laterals," and Figure 3-6, "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 23 31 13

SECTION 23 33 00

AIR DUCT ACCESSORIES

1. PART 1 GENERAL

1.1 SUMMARY

A. This Section includes the following:

1. Backdraft dampers.
2. Volume dampers.
3. Turning vanes.
4. Duct-mounting access doors.
5. Flexible connectors.
6. Flexible ducts.
7. Duct accessory hardware.

1.2 SUBMITTALS

A. Product Data: For the following:

1. Backdraft dampers.
2. Volume dampers.
3. Turning vanes.
4. Duct-mounting access doors.
5. Flexible connectors.
6. Flexible ducts.

1.3 QUALITY ASSURANCE

A. Comply with NFPA 90A, "Installation of Air Conditioning and Ventilating Systems," and NFPA 90B, "Installation of Warm Air Heating and Air Conditioning Systems."

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. In other Part 2 articles where titles below introduce lists, the following requirements apply to 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, manufacturers specified.
2. Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers specified.

2.2 SHEET METAL MATERIALS

A. Comply with 2022 California Mechanical Code for acceptable materials, material thicknesses, and duct construction methods, unless otherwise indicated.

B. Galvanized Sheet Steel: Lock-forming quality; complying with ASTM A 653/A 653M and having G90 coating designation; ducts shall have mill-phosphatized finish for surfaces exposed to view.

- C. Reinforcement Shapes and Plates: Galvanized-steel reinforcement where installed on galvanized sheet metal ducts; compatible materials for aluminum and stainless-steel ducts.
- D. 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.

2.3 BACKDRAFT DAMPERS

- A. Manufacturers:
 - 1. Duro Dyne Corp.
 - 2. Greenheck.
 - 3. Ruskin Company.
- B. Description: Multiple-blade, parallel action gravity balanced, with blades of maximum 6-inch width, with sealed edges, assembled in rattle-free manner with 90-degree stop, steel ball bearings, and axles; adjustment device to permit setting for varying differential static pressure.
- C. Frame: 0.052-inch- thick, galvanized sheet steel, with welded corners and mounting flange.
- D. Blades: 0.050-inch- thick aluminum sheet.
- E. Blade Seals: Neoprene.
- F. Blade Axles: Galvanized steel.
- G. Tie Bars and Brackets: Galvanized steel.
- H. Return Spring: Adjustable tension.

2.4 VOLUME DAMPERS

- A. Manufacturers:
 - 1. Flexmaster U.S.A., Inc.
 - 2. METALAIR, Inc.
 - 3. Ruskin Company.
- B. General Description: Factory fabricated, with required hardware and accessories. Stiffen damper blades for stability. Include locking device to hold single-blade dampers in a fixed position without vibration. Close duct penetrations for damper components to seal duct consistent with pressure class.
- C. Standard Volume Dampers: Multiple- or single-blade, parallel- or opposed-blade design as indicated, standard leakage rating, with linkage outside airstream, and suitable for horizontal or vertical applications.
 - 1. Steel Frames: Hat-shaped, galvanized sheet steel channels, minimum of 0.064 inch thick, with mitered and welded corners; frames with flanges where indicated for attaching to walls and flangeless frames where indicated for installing in ducts.
 - 2. Roll-Formed Steel Blades: 0.064-inch- thick, galvanized sheet steel.
 - 3. Blade Axles: Galvanized steel.
 - 4. Bearings: Oil-impregnated bronze.
 - 5. Tie Bars and Brackets: Galvanized steel.
- D. Jackshaft: 1-inch- diameter, galvanized-steel pipe rotating within pipe-bearing assembly mounted on supports at each mullion and at each end of multiple-damper assemblies.
 - 1. Length and Number of Mountings: Appropriate to connect linkage of each damper in multiple-damper assembly.

- E. Damper Hardware: Zinc-plated, die-cast core with dial and handle made of 3/32-inch- thick zinc-plated steel, and a 3/4-inch hexagon locking nut. Include center hole to suit damper operating-rod size. Include elevated platform for insulated duct mounting.

2.5 TURNING VANES

- A. Fabricate to comply with SMACNA's "HVAC Duct Construction Standards--Metal and Flexible" for vanes and vane runners. Vane runners shall automatically align vanes.
- B. Manufactured Turning Vanes: Fabricate 1-1/2-inch- wide, single-vane, curved blades of galvanized sheet steel set 3/4 inch o.c.; support with bars perpendicular to blades set 2 inches o.c.; and set into vane runners suitable for duct mounting.
 - 1. Manufacturers:
 - a. Ductmate Industries, Inc.
 - b. Duro Dyne Corp.
 - c. Ward Industries, Inc.
- C. Acoustic Turning Vanes: Fabricate airfoil-shaped aluminum extrusions with perforated faces and fibrous-glass fill.

2.6 DUCT-MOUNTING ACCESS DOORS

- A. General Description: Fabricate doors airtight and suitable for duct pressure class.
- B. Door: Double wall, duct mounting, and rectangular; fabricated of galvanized sheet metal with insulation fill and thickness as indicated for duct pressure class. Include vision panel where indicated. Include 1-by-1-inch butt or piano hinge and cam latches.
 - 1. Manufacturers:
 - a. Ductmate Industries, Inc.
 - b. Greenheck.
 - c. Nailor Industries Inc.
 - d. Ward Industries, Inc.
 - 2. Frame: Galvanized sheet steel, with bend-over tabs and foam gaskets.
 - 3. Provide number of hinges and locks as follows:
 - a. Less Than 12 Inches Square: Secure with two sash locks.
 - b. Up to 18 Inches Square: Two hinges and two sash locks.
 - c. Up to 24 by 48 Inches: Three hinges and two compression latches with outside and inside handles.
 - d. Sizes 24 by 48 Inches and Larger: One additional hinge.
- C. Seal around frame attachment to duct and door to frame with neoprene or foam rubber.
- D. Insulation: 1-inch- thick, fibrous-glass or polystyrene-foam board.

2.7 FLEXIBLE CONNECTORS

- A. Manufacturers:
 - 1. Ductmate Industries, Inc.
 - 2. Duro Dyne Corp.
 - 3. Ward Industries, Inc.
- B. General Description: Flame-retardant or noncombustible fabrics, coatings, and adhesives complying with UL 181, Class 1.

- C. 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.

2.8 FLEXIBLE DUCTS

- A. Manufacturers:
 - 1. Flexmaster U.S.A., Inc.
 - 2. Hart & Cooley, Inc.
 - 3. McGill AirFlow Corporation.
 - 4. Casco.
- B. Noninsulated-Duct Connectors: UL 181, Class 1, multiple layers of aluminum laminate supported by helically wound, spring-steel wire.
 - 1. Pressure Rating: 10-inch wg positive and 1.0-inch wg negative.
 - 2. Maximum Air Velocity: 4000 fpm.
 - 3. Temperature Range: Minus 20 to plus 210 deg F.
- C. Insulated-Duct Connectors: UL 181, Class 1, 2-ply vinyl film supported by helically wound, spring-steel wire; fibrous-glass insulation; polyethylene vapor barrier film.
 - 1. Pressure Rating: 10-inch wg positive and 1.0-inch wg negative.
 - 2. Maximum Air Velocity: 4000 fpm.
 - 3. Temperature Range: Minus 10 to plus 160 deg F.
- D. Flexible Duct Clamps: Stainless-steel band with stainless steel hex screw to tighten band with a worm-gear action, in sizes 3 through 18 inches to suit duct size.

2.9 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.

3. PART 3 EXECUTION

3.1 APPLICATION AND INSTALLATION

- A. Install duct accessories according to applicable details in SMACNA's "HVAC Duct Construction Standards--Metal and Flexible" for metal ducts.
- B. Provide 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 on exhaust fans or exhaust ducts nearest to outside and where indicated.
- D. Install volume dampers in ducts with liner; avoid damage to and erosion of duct liner.

- E. Provide balancing dampers at points on supply, return, and exhaust systems where branches lead from larger ducts as required for air balancing. Install at a minimum of two duct widths from branch takeoff.
- F. Provide test holes at fan inlets and outlets and elsewhere as indicated.
- G. Install duct access doors to allow for inspecting, adjusting, and maintaining accessories and terminal units as follows:
 - 1. On both sides of duct coils.
 - 2. Downstream from volume dampers, turning vanes, and equipment.
 - 3. Adjacent to fire or smoke dampers, providing access to reset or reinstall fusible links.
 - 4. To interior of ducts for cleaning; before and after each change in direction, at maximum 50-foot spacing.
 - 5. On sides of ducts where adequate clearance is available.
- H. Install the following sizes for duct-mounting, rectangular access doors:
 - 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. Install the following sizes for duct-mounting, round access doors:
 - 1. One-Hand or Inspection Access: 8 inches in diameter.
 - 2. Two-Hand Access: 10 inches in diameter.
 - 3. Head and Hand Access: 12 inches in diameter.
 - 4. Head and Shoulders Access: 18 inches in diameter.
 - 5. Body Access: 24 inches in diameter.
- J. Label access doors according to Division 23 Section "Identification for HVAC Piping and Equipment."
- K. Install flexible connectors immediately adjacent to equipment in ducts associated with fans and motorized equipment supported by vibration isolators.
- L. Connect diffusers or light troffer boots to low pressure ducts with maximum 60-inch lengths of flexible duct clamped or strapped in place.
- M. Connect flexible ducts to metal ducts with draw bands.

3.2 ADJUSTING

- A. Adjust duct accessories for proper settings.
- B. Final positioning of manual-volume dampers is specified in Division 23 Section "Testing, Adjusting, and Balancing for HVAC."

END OF SECTION 23 33 00

SECTION 23 37 13

DIFFUSERS, REGISTERS, AND GRILLES

1. PART 1 GENERAL

1.1 SUMMARY

A. Section Includes:

1. Rectangular and square ceiling diffusers.
2. Louver face diffusers.
3. Fixed face grilles.

B. Related Sections:

1. See architectural drawings 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.

1.2 SUBMITTALS

A. Product Data: For each type of 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. Samples: For each exposed product and for each color and texture specified.

2. PART 2 PRODUCTS

2.1 CEILING DIFFUSERS

A. Rectangular and Square Ceiling Diffusers CD-1:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Price Industries.
 - b. METALAIRE, Inc.
 - c. Titus.
2. Devices shall be specifically designed for variable-air-volume flows.
3. Material: Steel.
4. Finish: Baked enamel, white.
5. Face Size: 24 by 24 inches.
6. Face Style: Plaque.
7. Mounting: As required for ceiling type, concealed hardware.
8. Pattern: Adjustable.
9. Accessories:
 - a. Plaster ring.

B. Louver Face Diffuser SWS:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Price Industries.
 - b. METALAIRE, Inc.
 - c. Titus.
2. Devices shall be specifically designed for variable-air-volume flows.
3. Material: Steel.
4. Finish: Baked enamel, white.
5. Face Size: See plans.
6. Mounting: As required for soffit type, concealed hardware.
7. Pattern: Adjustable core style.

2.2 REGISTERS AND GRILLES

A. Fixed Face Grille RG-1/EG-1/TG-1/SWR

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Price Industries.
 - b. METALAIRE, Inc.
 - c. Titus.
2. Material: Steel.
3. Finish: Baked enamel, white.
4. Face Arrangement: $\frac{3}{4}$ " blades spacing at 30 to 40 degree angle.
5. Frame: 1 inch wide.
6. Mounting: As required for ceiling or soffit type, concealed hardware.
7. Accessories:
 - a. Plaster frame.

2.3 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."

3. PART 3 EXECUTION

3.1 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 practical. 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.

3.2 ADJUSTING

- A. After installation, adjust diffusers, registers, and grilles to air patterns indicated, or as directed, before starting air balancing.

END OF SECTION 23 37 13

SECTION 23 41 00

PARTICULATE AIR FILTRATION

1. PART 1 - GENERAL

1.1 SUMMARY

- A. This Section includes factory-fabricated air-filter devices and media used to remove particulate matter from air for HVAC applications.

1.2 SUBMITTALS

- A. Product Data: Include dimensions; required clearances and access; rated flow capacity, including initial and final pressure drop at rated airflow; efficiency and test method; fire classification; furnished specialties; and accessories for each unit indicated.
- B. Operation and maintenance data.

1.3 QUALITY ASSURANCE

- A. Comply with ARI 850.
- B. Comply with ASHRAE 52.1 and ASHRAE 52.2 for method of testing and rating air-filter units.
- C. Comply with NFPA 90A and NFPA 90B.

2. PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Airguard Industries, Inc.
 - 2. Farr Co.
 - 3. Flanders Filters, Inc.
- B. Disposable Panel Filters: Factory-fabricated, viscous-coated, flat-panel-type, disposable air filters with holding frames.
 - 1. Media: Interlaced glass fibers sprayed with nonflammable adhesive.
 - 2. Frame: Cardboard frame with perforated metal retainer.
 - 3. Duct-Mounting Frames: Welded, galvanized steel with gaskets and fasteners and suitable for bolting together into built-up filter banks.
- C. Extended-Surface, Disposable Panel Filters: Factory-fabricated, dry, extended-surface filters with holding frames.
 - 1. Media: Fibrous material formed into deep-V-shaped pleats and held by self-supporting wire grid.
 - 2. Media and Media-Grid Frame: Nonflammable cardboard.

3. Duct-Mounting Frames: Welded, galvanized steel with gaskets and fasteners, and suitable for bolting together into built-up filter banks.

3. PART 3 - EXECUTION

3.1 INSTALLATION

- A. Position each filter unit with clearance for normal service and maintenance. Anchor filter holding frames to substrate.
- B. Install filters in position to prevent passage of unfiltered air.
- C. Coordinate filter installations with duct and air-handling unit installations.

END OF SECTION 23 41 00

SECTION 23 81 19

ROOFTOP AIR CONDITIONERS

1. PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes the following rooftop air conditioners:

1. Cooling and heating units 6 tons and smaller.

B. Pitched isolation roof curb.

1.2 SUBMITTALS

A. Product Data: For each model indicated.

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. Prepare the following by or under the supervision of a qualified professional engineer:

1. Design Calculations: Calculate requirements for selecting vibration isolators and for designing vibration isolation bases. See Sheet M0.6.
2. Detail mounting, securing, and flashing of roof curb to roof structure. Indicate coordinating requirements with roof membrane system.
3. Wiring Diagrams: Power, signal, and control wiring.

C. Field quality-control test reports.

D. Operation and maintenance data.

E. Warranties: Special warranties specified in this Section.

1.3 QUALITY ASSURANCE

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

B. Fabricate and label refrigeration system to comply with ASHRAE 15, "Safety Code for Mechanical Refrigeration."

C. Energy-Efficiency Ratio: Equal to or greater than prescribed by State of California Title 24, Part 6 Addendum AB-970.

D. Coefficient of Performance: Equal to or greater than prescribed by State of California Title 24, Part 6 Addendum AB-970.

E. Comply with NFPA 54 for gas-fired furnace section.

- F. ARI Compliance for Units with Capacities Less Than 135,000 Btuh: Rate rooftop air-conditioner capacity according to ARI 210/240, "Unitary Air-Conditioning and Air-Source Heat Pump Equipment."
 - 1. Sound Power Level Ratings: Comply with ARI 270, "Sound Rating of Outdoor Unitary Equipment."
- G. ARI Compliance for Units with Capacities 135,000 Btuh and More: Rate rooftop air-conditioner capacity according to ARI 340/360, "Commercial and Industrial Unitary Air-Conditioning and Heat Pump Equipment."
 - 1. Sound Power Level Ratings: Comply with ARI 270, "Sound Rating of Outdoor Unitary Equipment."

1.4 WARRANTY

- A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to replace components of rooftop air conditioners that fail in materials or workmanship within specified warranty period.
 - 1. Warranty Period for Compressors: Manufacturer's standard, but not less than five years from date of Substantial Completion.
 - 2. Warranty Period for Heat Exchangers: Manufacturer's standard, but not less than 10 years from date of Substantial Completion.
 - 3. Warranty Period for Control Boards: Manufacturer's standard, but not less than three years from date of Substantial Completion.
 - 4. Warranty Period for Variable-Speed Fan Motors: Manufacturer's standard, but not less than three years from date of Substantial Completion.

2. PART 2- PRODUCTS

2.1 ROOFTOP AIR CONDITIONERS 6 TONS AND SMALLER

- A. Manufacturers:
 - 1. Carrier
 - 2. Trane
 - 3. Or Equal
- B. Basis of design is Carrier units. If contractor submits on listed alternates, he shall assume responsibility for any and all necessary structural, electrical, plumbing, architectural and HVAC modifications, and coordinate such.
- C. Description: Factory assembled and tested; designed for exterior installation; consisting of compressor, indoor and outside refrigerant coils, indoor fan and outside coil fan, refrigeration and temperature controls, filters, and dampers.
- D. Casing: Galvanized-steel construction with enamel paint finish, removable panels or access doors with neoprene gaskets for inspection and access to internal parts, minimum 1/2-inch- thick thermal insulation, knockouts for electrical and piping connections, exterior condensate drain connection, and lifting lugs.
- E. Indoor Fan: Forward curved, centrifugal, belt driven by single-speed motor.

- F. Outside Coil Fan: Propeller type, directly driven by motor.
- G. Refrigerant Coils: Aluminum-plate fin and seamless copper tube in steel casing with equalizing-type vertical distributor.
- H. Compressor: Hermetic scroll compressor with integral vibration isolators, internal overcurrent and over temperature protection, internal pressure relief, and crankcase heater.
- I. Refrigeration System:
 - 1. Compressor.
 - 2. Outside coil and fan.
 - 3. Indoor coil and fan.
 - 4. Four-way reversing valve and suction line accumulator.
 - 5. Expansion valve with replaceable thermostatic element.
 - 6. Refrigerant dryer.
 - 7. High-pressure switch.
 - 8. Low-pressure switch.
 - 9. Thermostat for coil freeze-up protection during low-ambient temperature operation or loss of air.
 - 10. Low-ambient switch.
 - 11. Brass service valves installed in discharge and liquid lines.
 - 12. Charge of refrigerant.
- J. Filters: 2-inch- thick, fiberglass, pleated, throwaway filters in filter rack. FARR 30/30 Class II. C.S.F.M. No. 3175-0140:006
- K. Heat Exchanger: Aluminized-steel construction for natural-gas-fired burners with the following controls:
 - 1. Redundant single or dual gas valve with manual shutoff.
 - 2. Direct-spark pilot ignition.
 - 3. Electronic flame sensor.
 - 4. Induced-draft blower.
 - 5. Flame rollout switch.
- L. Economizer: Return- and outside-air dampers with neoprene seals, outside-air filter, and hood.
 - 1. Damper Motor: Fully modulating spring return with adjustable minimum position.
 - 2. Control: Electronic-control system uses mixed-air temperature and selects between outside-air and return-air enthalpy to adjust mixing dampers.
 - 3. Relief Damper: Gravity actuated with bird screen and hood.
- M. Power Connection: Provide for single connection of power to unit with control-circuit transformer.
- N. Unit Controls: In accordance with 230593.
- O. Isolation Curb: Rigid upper and lower steel structure with vibration isolation springs having 1-inch static deflection and vertical and horizontal restraints; with elastomeric waterproof membrane
 - 1. Galvanized steel construction with:
 - a. Wood nailer strips.
 - b. Base plate.
 - c. Acoustical package with two layers of gypsum board attached to upper base member.

- d. Flexible duct supports including flexible connections at duct drops.
- 2. Pitched construction, top level.
 - a. Determine pitch from field conditions.
- 3. Match unit base.
 - a. Gaskets between unit and curb.
- 4. Seals:
 - a. Continuous neoprene wind and water seals.
 - b. Seal between base and curb.
 - c. Seal between base and bottom of unit.
- 5. Manufacturers:
 - a. MicroMetl

3. PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install units level and plumb, maintaining manufacturer's recommended clearances.
- B. Isolation Curb Support: Install units on isolation curbs and install flexible duct connectors and the following vibration isolation and seismic-control devices. Flexible duct connectors are specified in Section "Duct Accessories."

3.2 CONNECTIONS

- A. Piping installation requirements are specified in other Division 23 Sections. Drawings indicate general arrangement of piping, fittings, and specialties.
- B. Install piping adjacent to machine to allow service and maintenance.
 - 1. Gas Piping: Comply with applicable requirements in "Plumbing Piping and Valves." Connect gas piping to burner, full size of gas train inlet, and connect with ground joint union and shutoff valve with sufficient clearance for burner removal and service.

- C. Duct installation requirements are specified in other Division 23 Sections. Drawings indicate the general arrangement of ducts. The following are specific connection requirements:
 - 1. Install ducts to termination in roof curb.
 - 2. Remove roof decking only as required for passage of ducts. Do not cut out decking under entire roof curb.
 - 3. Terminate return-air duct through roof structure and insulate space between roof and bottom of unit with 2-inch- thick, acoustic duct liner.
- D. Electrical System Connections: Coordinate with Division 26 Sections for power wiring, switches, and motor controls.

3.3 FIELD QUALITY CONTROL

- A. Perform the following field quality-control tests and inspections and prepare test reports:
 - 1. After installing rooftop air conditioners and after electrical circuitry has been energized, test units for compliance with requirements.
 - 2. Inspect for and remove shipping bolts, blocks, and tie-down straps.
 - 3. Operational Test: After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation.
 - 4. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
- B. Remove malfunctioning units, replace with new units, and retest as specified above.

3.4 ADJUSTING

- A. In accordance with 230593.

END OF SECTION 23 81 19

SECTION 26 01 00
BASIC ELECTRICAL REQUIREMENTS

1. PART 1 GENERAL

1.1 SCOPE

- A. This section supplements all sections of this division and shall apply to all phases of work hereinafter specified, shown on the drawings, or required to provide a complete installation of electrical systems for the Project. The work required under this division is not limited to the electrical specifications and drawings. Refer to all bid documents including Civil, Architectural, Structural, and Mechanical documents which may designate Work to be accomplished. The intent of the Specifications is to provide a complete and operable electrical system, which shall include all documents that are a part of the entire Project Contract.
1. Work included: Furnish all labor, material, tools, equipment, facilities, transportation, skilled supervision necessary for, and incidental to, performing operations in connection with furnishing, delivery, and installation of the work in this division complete as shown or noted on the Drawings and specified herein.
- B. Related Work Specified Elsewhere:
1. Refer to all sections in the general contract conditions, Contract Requirements and Division 1, General Requirements.
- C. Work Installed but Furnished by Others:
1. The electrical work includes the installation or connection of certain materials and equipment furnished by others. Verify installation details. Foundations for apparatus and equipment will be furnished by others unless otherwise noted or detailed.

1.2 GENERAL REQUIREMENTS

- A. Guarantee See General Conditions:
1. Except as may be specified under other Sections in the specification, guarantee equipment furnished under the specifications for a period of one year, except for equipment required to have a longer guarantee period, from date of final completion. Guarantee all work against defective workmanship, material, and improper installation. Upon notification of failure, correct deficiency immediately and without additional cost to the Owner.
2. Standard warranty of manufacturer shall apply for replacement of parts after expiration of the above period. Manufacturer shall furnish replacement parts to the Owner or his service agency as approved. Furnish to the Owner, through the Architect, printed manufacturer's warranties complete with material included and expiration dates, upon completion of project. Conform to Division 01.
- B. Equipment Safety: All electrical materials and equipment shall be new and shall be listed by Underwriter's Laboratories and bear their label, or listed and certified by a nationally recognized testing authority where UL does not have an approval. Custom made equipment must have complete test data submitted by the manufacturer attesting to its safety.

C. Codes and Regulations:

1. Design, manufacturer, testing and method of installation of all apparatus and materials furnished under the requirements of these specifications shall conform to the latest publications or standard rules of the following:
 - a. Institute of Electrical and Electronic Engineers - IEEE
 - b. National Electrical Manufacturers' Association - NEMA
 - c. Underwriters' Laboratories, Inc. - UL
 - d. National Fire Protection Association - NFPA
 - e. American Society for Testing and Materials - ASTM
 - f. American National Standards Institute - ANSI
 - g. California Electrical Code – CEC, Title 24, Part 3
 - h. California Code of Regulations, Title 8, Subchapter 5
 - i. California Building Code-CBC, Title 24 Parts 1 & 2
 - j. State & Municipal Codes in Force in the Specific Project Area
 - k. Occupational Safety & Health Administration – OSHA
 - l. California State Fire Marshal
 - m. California Fire Code- CFC, Title 24 Part 9
 - n. National Electrical Testing Association - NETA
2. The term "Code", when used within the specifications, shall refer to the Publications, Standards, ordinances and codes, listed above. In the case where the codes have different levels of requirements the most stringent rules shall apply.

D. Requirements of Regulatory Agencies:

1. Codes, Permits, and Fees: Where the Contract Documents exceed minimum requirements, the Contract Documents take precedence. Where code conflicts occur, the most stringent shall apply. The most stringent condition shall be as interpreted by the Engineer.
 - a. Comply with all requirements for permits, licenses, fees and Code. Permits, licenses, fees, inspections and arrangements required for the Contractor at his expense shall obtain the Work, unless otherwise specified.
 - b. Comply with the requirements of the applicable utility companies serving the Project. Make all arrangements with the utility companies for proper coordination of the Work.

E. Shop Drawings:

1. See Division 01 for additional requirements.
2. Time Schedules for Submission and Ordering: The Contractor shall prepare, review and coordinate his schedule of submissions carefully, determining the necessary lead time for preparing, submitting, checking, ordering and delivery of materials and equipment for timely arrival. The Contractor shall be responsible for conformance with the overall construction schedule.
3. Submittals will be checked for general compliance with specifications only. The Contractor shall be responsible for deviations from the drawings or specifications and for errors or omissions of any sort in submittals.
4. Submit a complete list of materials and equipment proposed for the job, including manufacturers names and catalog numbers.

5. Shop drawings shall be submitted in completed groups of materials (i.e., lighting fixtures or switchgear). The Contractor shall add and sign the following paragraph on equipment and materials submitted for review. "It is hereby certified that the (equipment) (material) shown and marked in this submittal is that proposed to be incorporated into the project; is in compliance with the Contract Drawings and specifications and can be installed in the allocated spaces". Failure to add the above written statement for compliance will result in return of submittals without review.
 - a. Bind catalog cuts, plate numbers, descriptive bulletins and drawings, 11" x 17" (275 mm x 435 mm) or smaller, in sets with covers neatly showing titles.
 - b. The Contractor shall verify dimensions of equipment and be satisfied as to Code compliance for fit prior to submitting shop drawings for approval.
 - c. Where current limiting devices are specified, submit technical data to substantiate adequate protection of equipment cascaded downstream. Submittals shall not be reviewed unless supporting calculations and data are submitted therewith.
 - d. Include complete catalog information such as construction, ratings, insulation systems, as applicable.
 - e. For any material specified to meet UL or trade standards, furnish the manufacturers or vendor's certification that the material furnished for the work does in fact equal or exceed such specifications.
 - f. Reference listings to the specifications' Sections and Article to which each is applicable.
 - g. Equipment Floor Plans: After approval of material is secured prepare a floor plan of each electrical and mechanical equipment space, room or yard, drawn to scale at 1/2 inch equals 1 foot and submit for approval in the same manner as for shop drawings. The layout drawings shall be exact scale.
 6. Contractor shall prepare coordinated drawings when required by Division 01 or where noted otherwise.
- F. Interpretations: The Contractor through the Architect must make Requests for interpretations of drawings and specifications. Any such requests made by equipment manufacturers or suppliers will be referred to the Contractor.
- G. Standard of Quality
1. The contract Drawings and Specifications establish the "MINIMUM STANDARD OF QUALITY" each product and/or system must meet to be considered acceptable. Products of other manufactures will be considered if the product and/or system meet or exceed the "MINIMUM STANDARD OF QUALITY" established by this Contract Document.
- H. Submit comprehensive material list, shop drawings and complete technical data for the following equipment and materials:
1. General Requirements:
 - a. Panelboards.
 - b. Switchboards.
 - c. Conduits
 - d. Conductors, include all selected insulation types.
 - e. Fuses
 - f. Disconnect switches and Starters.
 - g. Pullboxes, manholes and handholes.
 - h. Control devices, standard and special receptacles, switches, outlets and finish device plates.
 - i. Cabinets for signal and telephone system, special terminals and cabinets. Include all cabinet dimensions.
 - j. Dry Type Voltage Transformers.

- I. Record Drawings: Refer to Division 01, Contract Closeout.
- J. Work Responsibilities:
1. The drawings indicate diagrammatically the desired locations or arrangement of conduit runs, outlets, junction boxes and equipment and are to be followed. Execute the work so as to secure the best possible installation in the available space and to overcome local difficulties due to space limitations. The Contractor is responsible for the correct placing of his work. Where conflicts occur in plans and/or specifications, the most stringent application shall apply and shall be part of the base bid.
 2. Locations shown on architectural plan or on wall elevations shall take precedence over electrical plan locations, but where a major conflict is evident, notify the Architect.
 3. In the event minor changes in the indicated locations or arrangement are necessary due to developed conditions in the building construction or rearrangement of furnishings or equipment or due to interference with other trades, such changes shall be made without extra cost.
 4. Verify dimensions and the correct location of Owner-Furnished equipment before proceeding with the roughing-in of connections.
 5. All scaled and figured dimensions are approximate of typical equipment of the class indicated. Before proceeding with work carefully check and verify dimensions and sizes with the drawings to see that the furnished equipment will fit into the spaces provided without violation of applicable Codes.
 6. Should any changes to the work indicated on the drawings or described in the specifications be necessary in order to comply with the above requirements, notify the Architect.
 7. Contractor shall be responsible for coordination of coordinated drawings when required by the Architect.
 8. Replace or repair, without additional compensation any work which does not comply with or which is installed in violation of any of these requirements.
- K. Installation General: For special requirements, refer to specific equipment under these requirements.
1. Unless otherwise specified elsewhere in the specifications, do all excavating necessary for the proper installation of the electrical work.
 2. Locations of Openings: Locate chases, shafts and openings required for the installation of the electrical work during framing of the structure. Do any additional cutting and patching required. Cutting or drilling in any structural member is prohibited without approval of the Architect. Furnish all access panels to make all boxes, connections and devices accessible as required by CEC.
 3. Location of Sleeves: Where conduits pass through concrete walls, suspended slabs or metal deck floors, install sleeves of adequate size to permit installation of conduit. Sleeves shall be installed prior to pouring of concrete and shall have ends flush with the wall or extend 2 inches above floor surfaces. Verify locations.
 4. Type of Sleeves: Refer to Section 260500.
 5. Wherever conduit extends through roof, install flashings in accordance with drawings and details.
 6. Contractor shall be responsible for cutting and patching which may be required for the proper installation of the electrical work.
 7. Protect work, materials and equipment cause whatever and provide adequate and proper storage facilities during the progress of the work. Storage outdoors shall be weather protected and shall include space heaters to prevent condensation. Provide for the safety and good condition of all work until final acceptance of the work. Replace all damaged or defective work, materials and equipment before requesting final acceptance.
 8. Conduit and Equipment to be Installed: Clean thoroughly to remove plaster, spattered paint, cement and dirt on both exterior and interior. All underground conduits shall be mandrelled prior to pulling wire.
 9. Conduit and Equipment to be Painted: Clean conduit exposed to view in completed structure by removing plaster and dirt. Remove grease, oil and similar material from conduit and equipment by wiping with clean rags and suitable solvents in preparation for paint.

10. Items with Factory Finish: Remove cement, plaster, grease and oil, and leave surfaces, including cracks and corners, clean and polished. Touch up scratched or bare spots to match finish.
11. Site Cleaning: Remove from site all packing cartons, scrap materials and other rubbish on a weekly basis. Vacuum out all cabinets, switchgear and panels and junction boxes prior to pulling any conductors.
12. Electrical equipment and materials exposed to public and in finished areas shall be finish-painted after installation in accordance with the Painting Section. All exposed screw-type fasteners, exterior, or interior in restrooms, shall be vandal-resistant spanner type; include tool.

L. Excavation, Cutting and Patching:

1. Excavating, trenching and backfilling required for the work of this Division in accordance with the applicable requirements of Division 31. Excavating and backfilling connected with electrical work, repaving cuts and providing and maintaining protective measures for the electrical work excavation required by the governing authorities having jurisdiction shall be performed as a part of the work of this Division.
2. Verify openings indicated on the drawings. Provide all cutting, patching and reinforcement of the construction of the building as required to install electrical work.

M. Tests

1. Equipment and systems for which the National Electrical Testing Association (NETA) has an approved or recommended procedure, shall be tested in accordance with that procedure. Test values shall equal values recommended by NETA. Copies of test reports shall be submitted as required under shop drawing submittals.
2. Resistance to ground tests shall be accomplished by a qualified independent testing firm to measure resistance to ground at grounding electrodes. Make tests before slabs or affected areas are poured in order that corrective measures, if required, may be taken. Submit a report showing the results of these measurements. If the resistances exceed values specified elsewhere or NETA test procedure recommendations, perform corrective measures required to reduce resistance to acceptable values.
3. Prior to energizing any motor, measure the service voltage for phase balance and report if unbalance exceeds 1% from mean.
4. Measure the three-phase voltage at no load and at maximum load conditions and submit to the engineer a report showing the results of these measurements.
5. Upon completion of the work and adjustment of all equipment, conduct an operating test. Conduct the test in the presence of an authorized representative of the Architect. Demonstrate system and equipment to operate in accordance with requirements of the Contract Documents and to be free from electrical and mechanical defects. Provide systems free from short circuits and grounds and show an insulation resistance between phase conductors and ground not less than the requirements of the governing electric code. Test circuits for proper neutral connection.
6. Complete tests prior to final inspection of project, including corrective work based on the results of the tests.
7. Perform special tests on systems and equipment as specified herein using personnel qualified to perform such tests.

- N. Protection: Protect finish parts of the materials and equipment against damage during the progress of the work and until final completion and acceptance. Cover materials and equipment in storage and during construction in such a manner that no finished surfaces will be damaged or marred. Keep moving parts clean, dry and lubricated.

O. Cleaning Up:

1. Upon completion of the work and at various time during the progress of the work, remove from the building all surplus materials, rubbish and debris resulting from the work of this Division.

2. Thoroughly clean switchgear including busses, apparatus, exposed conduit, metal work including the exterior and interior, and accessories for the work of this Division, of cement, plaster and other deleterious materials; remove grease and oil spots with cleaning solvent; carefully wipe surfaces and scrape cracks and corners clean.
3. Thoroughly polish chromium or plated work. Remove dirt and stains from lighting fixtures.
4. Leave the entire installation in a clean condition.

P. Completion:

1. 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.
2. When the installation is complete and adjustments have been made, operate the system for a period of one week, during which time demonstrate that systems are completed and operating in conformance with the specifications.

Q. Operating and Maintenance Data: Submit complete and at one time, prior to acceptance of the installation, 4 copies of manufacturer's instructions for operation and maintenance of electrical equipment, including replacement parts lists. As specified in Division 01

R. Inspection and Acceptance Procedures: The Architect will submit observation reports periodically during the construction phase detailing Contract deficiencies. The Contractor is responsible for making corrections immediately. Notice of Completion of the project will not be made until all items have been corrected.

S. Final Completion of Electrical Systems:

1. Prior to Final Completion of operating electrical systems, the Contractor shall:
 - a. Provide materials of the type and quality specified and as necessary for proper operation, tested and ready for use.
 - b. Deliver to the Architect, the Record Documents per 1.3 of this section.
 - c. Furnish the required Operating and Maintenance Data/Manuals.
 - d. Clean up of the project pertaining to this Division of the work.
 - e. After installation has been completed and adjustments made, operate the system for a period of one week, during which time, demonstrate to the Architect that systems are complete and operating in conformance with Contract Documents.
 - f. Conduct tests required and as specified in this Division and submit test reports and corrective actions taken.
 - g. Submission of warranties and guarantees.
2. Final Completion of Work Shall be Contingent On:
 - a. Contractor replacing defective materials and workmanship.
 - b. Upon completion of work and adjustments made, Contractor shall conduct an operating test for each system for approval at such time as Architect directs. Conduct test in presence of authorized representative of Architect and demonstrate that systems and equipment do operate in accordance with requirements of the Contract Documents and are free from electrical and mechanical defects.
 - c. Contractor shall provide the necessary training programs and instructions to the Owner's representative. Number of hours shall be a minimum of four (4) hours for each system or days as required under separate Sections of these Specifications. Complete operation and maintenance manuals shall be provided at least two (2) weeks prior to training.
 - d. Submit copies of manufacturer's instructions and maintenance of electrical equipment including replacement parts lists. Each set shall include one set of shop drawings of equipment installed.

- T. Submittals for Change Orders: When changes are made during the construction phase, deletions and additions shall be presented in a manner that will indicate the cost of each item of material and corresponding labor. Markup shall be then added in accordance with the requirements of the General Conditions as modified by the Supplementary Conditions.
- U. The Contractor at a time convenient to the Owner shall provide instruction to the Owner's operating personnel in the proper operation and maintenance of all equipment and systems. The instructors shall have received factory training and shall be thoroughly familiar with the equipment installed. The operating personnel shall receive the number of days instruction as indicated in other sections.

1.3 PROJECT RECORD DOCUMENTS

- A. Record Drawings: CAD: Use a computer aided drafting (CAD) system in the preparation of record drawings for this Project. Acceptable CAD systems shall be capable of producing files in AutoCAD Version 2018 compatible DWG or DXF format. Owner's consultant will furnish CAD backgrounds for use by the Contractor after construction is 85% complete except where prohibited by Contract.
- B. At all times when the work is in progress, maintain at the workplace, fabrication shop or Project Site as applies, a complete separate, clean, undamaged set of the latest stamped, actioned submittals. As work progresses, maintain records of "as installed" conditions on this set in suitable ink or chemical fluid. Update the set daily. After successful completion of Project Site testing specified herein, and after completion of Punch List corrections, copy all records of "as installed" conditions on to originals.
- C. Quantity:
 - 1. Review sets: As for Shop and Field Drawings.
 - 2. Record set: Three (3) blackline.
- D. Format: Record Drawings:
 - 1. Disk copy of Record Drawings - 1 copy of each drawing file in format noted above, CD-ROM.
- E. Content: All drawings required under "Field and Shop Drawings". Show "as installed" condition. Where room designations according to Project permanent signage differ from construction designations in the Contract Documents, show both designations.
- F. Warranty Certificates: Comply with Division 01.

2. PART 2 PRODUCTS

Not Used

3. PART 3 EXECUTION

Not Used

END OF SECTION 26 01 00

SECTION 26 01 60

CABINETS AND ENCLOSURES

1. PART 1 GENERAL

1.1 WORK INCLUDED

- A. Hinged cover enclosures.
- B. Cabinets.
- C. Terminal blocks and accessories.

1.2 REFERENCES

- A. NEMA 250 - Enclosures for Electrical Equipment (1000 Volts Maximum).
- B. ANSI/NEMA ICS 1 - Industrial Control and Systems.
- C. ANSI/NEMA ICS 4 - Terminal Blocks for Industrial Control Equipment and Systems.
- D. ANSI/NEMA ICS 6 - Enclosures for Industrial Control Equipment and Systems.

1.3 SUBMITTALS

- A. Submit product data under provisions of Division 01.
- B. Shop Drawings for Equipment Panels: Include wiring schematic diagram, wiring diagram, outline drawing and construction diagram as described in ANSI/NEMA ICS 1.

2. PART 2 PRODUCTS

2.1 HINGED COVER ENCLOSURES

- A. Construction: NEMA 250; Type 1, 3R, steel.
- B. Finish: Manufacturer's standard enamel finish.
- C. Covers: Continuous hinge, held closed by flush latch operable by key.
- D. Panel for Mounting Terminal Blocks or Electrical Components: 14 gage steel, white enamel finish.

2.2 CABINETS

- A. Cabinet Boxes: Galvanized steel with removable endwalls. Provide 3/4 inch thick plywood backboard painted matte white, for mounting terminal blocks.
- B. Cabinet Fronts: Steel, flush surface type with concealed trim clamps, screw cover front, concealed hinge and flush lock keyed to match branch circuit panelboard; finish as approved by Architect.

2.3 TERMINAL BLOCKS AND ACCESSORIES

- A. Terminal Blocks: ANSI/NEMA ICS 4; UL listed.
- B. Power Terminals: Unit construction type, closed-back type, with tubular pressure screw connectors, rated 600 volts.

- C. Signal and Control Terminals: Modular construction type, channel mounted; tubular pressure screw connectors, rated 300 volts.

2.4 FABRICATION

- A. Shop assemble enclosures and cabinets housing terminal blocks or electrical components in accordance with ANSI/NEMA ICS 6.
- B. Provide conduit hubs knockouts on enclosures.
- C. Provide protective pocket inside front cover with schematic diagram, connection diagram, and layout drawing of control wiring and components within enclosure.

3. PART 3 EXECUTION

3.1 INSTALLATION

- A. Install cabinets and enclosures plumb; anchor securely to wall and structural supports at each corner, minimum.
- B. Provide accessory feet for free-standing equipment enclosures.
- C. Install trim plumb.
- D. Provide nameplate per Section 26 05 32.
- E. Ground and bond per Section 26 05 26.

END OF SECTION 26 01 60

SECTION 26 04 40

DISCONNECT SWITCHES

1. PART 1 GENERAL

1.1 WORK INCLUDED

- A. Disconnect switches.
- B. Fuses.
- C. Enclosures.

1.2 REFERENCES

- A. ANSI/UL 198C - High-Intensity Capacity Fuses; Current Limiting Types.
- B. ANSI/UL 198E - Class R Fuses.
- C. FS W-F-870 - Fuseholders (For Plug and Enclosed Cartridge Fuses).
- D. FS W-S-865 - Switch, Box, (Enclosed), Surface-Mounted.
- E. NEMA KS 1 - Enclosed Switches.
- F. C.E.C. California Electrical Code.

2. PART 2 PRODUCTS

2.1 MANUFACTURERS - DISCONNECT SWITCHES

- A. Square D
- B. Eaton Cutler-Hammer.
- C. GE.

2.2 DISCONNECT SWITCHES

- A. Fusible Switch Assemblies: NEMA KS 1; quick-make, quick-break, load interrupter enclosed knife switch with externally operable handle interlocked to prevent opening front cover with switch in ON position. Handle lockable in OFF position. Fuse Clips: FS W-F- 870.
- B. Enclosures: NEMA KS 1; Type 1, for interior dry locations; Type 3R for exterior or wet locations. Furnish 1 padlock and two keys for each disconnect, Master 611 or M-20.
- C. Switch Ratings: Number of poles, voltage, current and horsepower rating as required for particular installation.

2.3 ACCEPTABLE MANUFACTURERS - FUSES

- A. Littelfuse.
- B. Gould Shawmut.
- C. Bussman.

2.4 FUSES

- A Fuses 600 Amperes and Less: ANSI/UL 198E, Class RK1; current limiting, one-time fuse, 250 volt.
- B. Interrupting Rating: 200,000 rms amperes.
- C. Size fuses based on motor nameplate rating.

3. PART 3 EXECUTION

3.1 INSTALLATION

- A. Install disconnect switches where indicated on Drawings.
- B. Install fuses in fusible disconnect switches, otherwise required by Code.
- C. Properly align switches and support independent of the connecting raceway.

END OF SECTION 26 04 40

SECTION 26 05 00

COMMON WORK RESULTS FOR ELECTRICAL

1. PART 1 GENERAL

1.1 SUMMARY

A. Section Includes:

1. Electrical equipment coordination and installation.
2. Sleeves for raceways and cables.
3. Sleeve seals.
4. Grout.
5. Common electrical installation requirements.

1.2 DEFINITIONS

- A. EPDM: Ethylene-propylene-diene terpolymer rubber.
- B. NBR: Acrylonitrile-butadiene rubber.

1.3 SUBMITTALS

- A. Product Data: For sleeve seals.

1.4 COORDINATION

- A. Coordinate arrangement, mounting, and support of electrical equipment:
1. To allow maximum possible headroom unless specific mounting heights that reduce headroom are indicated.
 2. To provide for ease of disconnecting the equipment with minimum interference to other installations.
 3. To allow right of way for piping and conduit installed at required slope.
 4. So connecting raceways, cables, wireways, cable trays, and busways will be clear of obstructions and of the working and access space of other equipment.
- B. Coordinate installation of required supporting devices and set sleeves in cast-in-place concrete, masonry walls, and other structural components as they are constructed.
- C. Coordinate location of access panels and doors for electrical items that are behind finished surfaces or otherwise concealed. Access doors and panels are specified in Division 08 Section "Access Doors and Frames."
- D. Coordinate sleeve selection and application with selection and application of firestopping specified in Division 07 Section "Firestopping."

2. PART 2 PRODUCTS

2.1 SLEEVES FOR RACEWAYS AND CABLES

- A. Steel Pipe Sleeves: ASTM A 53/A 53M, Type E, Grade B, Schedule 40, galvanized steel, plain ends.

- B. Cast-Iron Pipe Sleeves: Cast or fabricated "wall pipe," equivalent to ductile-iron pressure pipe, with plain ends and integral waterstop, unless otherwise indicated.
- C. Sleeves for Rectangular Openings: Galvanized sheet steel.
 - 1. Minimum Metal Thickness:
 - a. For sleeve cross-section rectangle perimeter less than 50 inches and no side more than 16 inches, thickness shall be 0.052 inch.
 - b. For sleeve cross-section rectangle perimeter equal to, or more than, 50 inches and 1 or more sides equal to, or more than, 16 inches, thickness shall be 0.138 inch.

2.2 SLEEVE SEALS

- A. Description: Modular sealing device, designed for field assembly, to fill annular space between sleeve and raceway or cable.
 - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Advance Products & Systems, Inc.
 - b. Calpico, Inc.
 - c. Metraflex Co.
 - d. Pipeline Seal and Insulator, Inc.
 - 2. Sealing Elements: EPDM interlocking links shaped to fit surface of cable or conduit. Include type and number required for material and size of raceway or cable.
 - 3. Pressure Plates: Carbon steel. Include two for each sealing element.
 - 4. Connecting Bolts and Nuts: Carbon steel with corrosion-resistant coating of length required to secure pressure plates to sealing elements. Include one for each sealing element.

2.3 GROUT

- A. Nonmetallic, Shrinkage-Resistant Grout: ASTM C 1107, factory-packaged, nonmetallic aggregate grout, noncorrosive, nonstaining, mixed with water to consistency suitable for application and a 30-minute working time.

3. PART 3 EXECUTION

3.1 COMMON REQUIREMENTS FOR ELECTRICAL INSTALLATION

- A. Comply with NECA 1.
- B. Measure indicated mounting heights to bottom of unit for suspended items and to center of unit for wall-mounting items.
- C. Headroom Maintenance: If mounting heights or other location criteria is not indicated, arrange and install components and equipment to provide maximum possible headroom consistent with these requirements.
- D. Equipment: Install to facilitate service, maintenance, and repair or replacement of components of both electrical equipment and other nearby installations. Connect in such a way as to facilitate future disconnecting with minimum interference with other items in the vicinity.
- E. Right of Way: Give to piping systems installed at a required slope.

3.2 SLEEVE INSTALLATION FOR ELECTRICAL PENETRATIONS

- A. Electrical penetrations occur when raceways, cables, wireways, cable trays, or busways penetrate concrete slabs, concrete or masonry walls, or fire-rated floor and wall assemblies.
- B. Concrete Slabs and Walls: Install sleeves for penetrations unless core-drilled holes or formed openings are used. Install sleeves during erection of slabs and walls.
- C. Use pipe sleeves unless penetration arrangement requires rectangular sleeved opening.
- D. Fire-Rated Assemblies: Install sleeves for penetrations of fire-rated floor and wall assemblies unless openings compatible with firestop system used are fabricated during construction of floor or wall.
- E. Cut sleeves to length for mounting flush with both surfaces of walls.
- F. Extend sleeves installed in floors 2 inches above finished floor level.
- G. Size pipe sleeves to provide 1/4-inch annular clear space between sleeve and raceway or cable, unless indicated otherwise.
- H. Seal space outside of sleeves with grout for penetrations of concrete and masonry
 - 1. Promptly pack grout solidly between sleeve and wall so no voids remain. Tool exposed surfaces smooth; protect grout while curing.
- I. Interior Penetrations of Non-Fire-Rated Walls and Floors: Seal annular space between sleeve and raceway or cable, using joint sealant appropriate for size, depth, and location of joint. Comply with requirements in Division 07 Section "Joint Sealants."
- J. Fire-Rated-Assembly Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at raceway and cable penetrations. Install sleeves and seal raceway and cable penetration sleeves with firestop materials. Comply with requirements in Division 07 Section "Penetration Firestopping."
- K. Roof-Penetration Sleeves: Seal penetration of individual raceways and cables with flexible boot-type flashing units applied in coordination with roofing work.
- L. Aboveground, Exterior-Wall Penetrations: Seal penetrations using steel pipe sleeves and mechanical sleeve seals. Select sleeve size to allow for 1-inch annular clear space between pipe and sleeve for installing mechanical sleeve seals.
- M. Underground, Exterior-Wall Penetrations: Install cast-iron pipe sleeves. Size sleeves to allow for 1-inch annular clear space between raceway or cable and sleeve for installing mechanical sleeve seals.

3.3 SLEEVE-SEAL INSTALLATION

- A. Install to seal exterior wall penetrations.
- B. Use type and number of sealing elements recommended by manufacturer for raceway or cable material and size. Position raceway or cable in center of sleeve. Assemble mechanical sleeve seals and install in annular space between raceway or cable and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.

3.4 FIRESTOPPING

- A. Apply firestopping to penetrations of fire-rated floor and wall assemblies for electrical installations to restore original fire-resistance rating of assembly. Firestopping materials and installation requirements are specified in Division 07 Section "Penetration Firestopping."

END OF SECTION 26 05 00

SECTION 26 05 19

LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES

1. PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Building wire and cable.
- B. Wiring connectors and connections.

1.2 REFERENCES

- A. ANSI/NFPA 70 – California Electrical Code.
- B. C.E.C. – California Electrical Code.
- C. InterNational Electrical Testing Association.
- D. OSHA, Definition B, 29 CFR 1910.7.

1.3 QUALIFICATIONS

- A. Manufacturer: Company specializing in manufacturing products specified in this Section with minimum three years documented experience.

1.4 REGULATORY REQUIREMENTS

- A. Conform to requirements of C.E.C.
- B. Furnish products listed and classified by Underwriters Laboratories, Inc. as suitable for purpose specified and shown.

1.5 PROJECT CONDITIONS

- A. Verify that field measurements are as shown on Drawings.
- B. Wire and cable routing shown on Drawings is approximate unless dimensioned. Route wire and cable as required meeting Project Conditions.
- C. Where wire and cable routing is not shown, and destination only is indicated, determine exact routing and lengths required.

1.6 COORDINATION

- A. Determine required separation between cable and other work.
- B. Determine cable routing to avoid interference with other work.

2. PART 2 PRODUCTS

2.1 BUILDING WIRE AND CABLE

- A. Description: Single conductor insulated wire, new, manufactured not more than 6 months prior to installation, with size, type of insulation, voltage rating and manufacturer's name permanently marked on outer covering at regular intervals.
- B. Conductor: Copper.
- C. Insulation Voltage Rating: 600 volts.

3. PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify that interior of building has been protected from weather.
- B. Verify that mechanical work likely to damage wire and cable has been completed.

3.2 PREPARATION

- A. Completely and thoroughly swab raceway before installing wire.

3.3 WIRING METHOD

- A. Type THHN/THWN insulation for dry interior locations, in raceway.
- B. Type THWN for exterior or wet locations, in raceway.

3.4 INSTALLATION

- A. Provide conductors continuous from outlet to outlet and splice only at outlet or junction boxes.
- B. Circuit all feeders and branch circuits as shown on the drawings. Suggested deviation from the plans must be provided by the Architect.
- C. Install products in accordance with manufacturers instructions.
- D. Use solid conductor for feeders and branch circuits 10 AWG and smaller.
- E. Use stranded conductors for control circuits.
- F. Use conductor not smaller than 12 AWG for power and lighting circuits.
- G. Use conductor not smaller than 16 AWG for control circuits.
- H. Low voltage control wiring shall be No. 18 AWG minimum, insulated cable for each conductor. Voltage rating of cable shall be suitable for either Class I or Class II, remote control or signal circuit, as determined by the code and the actual installation.
- I. Use 10 AWG conductors for 20 ampere, 120 volt branch circuits longer than 75 feet (450-m).
- J. Use 10 AWG conductors for 20 ampere, 277 volt branch circuits longer than 200 feet (600-m).

- K. Install all conductors in a single raceway at one time, insuring that conductors do not cross one another while being pulled into raceway. Leave sufficient cable at all fittings or boxes and prevent conductor kinks. Keep all conductors within the allowable tension and exceeding the minimum-bending radius.
- L. Use suitable wire pulling lubricant for building wire 4 AWG and larger. Lubricants for wire pulling shall conform to UL requirements for the insulation and raceway material.
- M. Provide conductor supports as required by Code and recommended by the cable manufacturer. Where required, provide cable supports in vertical conduits similar to OZ Gedney Type CMT and provide the lower end of conduit with OZ Gedney Type KVF ventilators.
- N. No splicing or joints will be permitted in either feeder or branch circuits except at outlet or accessible junction boxes.
- O. Neatly train and lace wiring inside boxes, equipment, and panelboards.
- P. Clean conductor surfaces before installing lugs and connectors.
- Q. Make splices, taps, and terminations to carry full ampacity of conductors with no perceptible temperature rise. Keep splices in underground junction boxes, handholes, and manholes to an absolute minimum. Where splices are necessary, use resin pressure splices and resin splicing kits manufactured by the 3M Company to totally encapsulate the splice. Arrange the splicing kit to minimize the effects of moisture.
- R. Use split bolt connectors for copper conductor splices and taps, 6 AWG and larger. Tape uninsulated conductors and connector with electrical tape to 150 percent of insulation rating of conductor.
- S. Use solderless pressure connectors with insulating covers for copper conductor splices and taps, 8 AWG and smaller.
- T. Use insulated spring wire connectors with plastic caps for copper conductor splices and taps, 10 AWG and smaller.
- U. Provide all power and control conductors, that terminate on equipment or terminal strips, with solderless lugs or tork and flanged tongue terminals. Provide T & B "Sta-kon" tongue terminal. This type conductor termination is not required when the equipment is provided with solderless connectors.

3.5 INTERFACE WITH OTHER PRODUCTS

- A. Identify wire and cable under provisions of Division 26.
- B. Identify each conductor with its circuit number or other designation indicated on Drawings.
- C. Conductor Identification: All branch circuit conductors (No. 10 AWG and smaller) throughout the project shall be provided with color-coded insulation as follows:

208Y/120V	Phase	480Y/277
Black	A	Brown
Red	B	Orange
Blue	C	Yellow
White	Neutral	Gray
Green	Ground	Green

- D. Conductors No. 8 and larger shall be black with bands of colored nonaging, plastic tape to color code the conductors, utilizing the same scheme as for branch circuits. The bands shall occur within each enclosure where a tap, splice or termination is made.

- E. Color code all control wire insulation and label each termination.

3.6 FIELD QUALITY CONTROL

- A. Testing Agency: Engage a qualified testing agency to perform tests and inspections and prepare test reports.
- B. Perform tests and inspections and prepare test reports.
- C. Tests and Inspections:
 - 1. After installing conductors and cables and before electrical circuitry has been energized, test service entrance and feeder conductors for compliance with requirements.
 - 2. Perform each visual and mechanical inspection and electrical test stated in NETA Acceptance Testing Specification. Certify compliance with test parameters.
 - 3. Infrared Scanning: After Substantial Completion, but not more than 60 days after Final Acceptance, perform an infrared scan of each splice in cables and conductors No. 3 AWG and larger. Remove box and equipment covers so splices are accessible to portable scanner.
 - a. Follow-up Infrared Scanning: Perform an additional follow-up infrared scan of each splice 11 months after date of Substantial Completion.
 - b. Instrument: Use an infrared scanning device designed to measure temperature or to detect significant deviations from normal values. Provide calibration record for device.
 - c. Record of Infrared Scanning: Prepare a certified report that identifies splices checked and that describes scanning results. Include notation of deficiencies detected, remedial action taken, and observations after remedial action.
- D. Test Reports: Prepare a written report to record the following:
 - 1. Test procedures used.
 - 2. Test results that comply with requirements.
 - 3. Test results that do not comply with requirements and corrective action taken to achieve compliance with requirements.
- E. Remove and replace malfunctioning units and retest as specified above.

END OF SECTION 26 05 19

SECTION 26 05 26

GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS

1. PART 1 GENERAL

1.1 SUMMARY

- A. This Section includes methods and materials for grounding systems and equipment.

1.2 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Other Informational Submittals: Plans showing dimensioned as-built locations of grounding features specified in Part 3 "Field Quality Control" Article, including the following:
 - 1. Test wells.
 - 2. Ground rods.
 - 3. Ground rings.
 - 4. Grounding arrangements and connections for separately derived systems.
 - 5. Grounding for sensitive electronic equipment.
- C. Qualification Data: For testing agency and testing agency's field supervisor.
- D. Field quality-control test reports.
- E. Operation and Maintenance Data: For grounding to include the following in emergency, operation, and maintenance manuals:
 - 1. Instructions for periodic testing and inspection of grounding features at grounding connections for separately derived systems based on NETA MTS and CEC Article 250.
 - a. Tests shall be to determine if ground resistance or impedance values remain within specified maximums, and instructions shall recommend corrective action if they do not.
 - b. Include recommended testing intervals.

1.3 QUALITY ASSURANCE

- A. Testing Agency Qualifications: An independent agency, with the experience and capability to conduct the testing indicated, that is a member company of the International Electrical Testing Association or is a nationally recognized testing laboratory (NRTL) as defined by OSHA in 29 CFR 1910.7, and that is acceptable to authorities having jurisdiction.
 - 1. Testing Agency's Field Supervisor: Person currently certified by the International Electrical Testing Association to supervise on-site testing specified in Part 3.
- B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in CEC, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
- C. Comply with UL 467 for grounding and bonding materials and equipment.
- D. Comply with the California Electrical Code (CEC).

2. PART 2 PRODUCTS

2.1 CONDUCTORS

- A. Insulated Conductors: Copper wire or cable insulated for 600 V unless otherwise required by applicable Code or authorities having jurisdiction.
- B. Bare Copper Conductors:
 - 1. Solid Conductors: ASTM B 3.
 - 2. Stranded Conductors: ASTM B 8.
 - 3. Tinned Conductors: ASTM B 33.
 - 4. Bonding Cable: 28 kcmil, 14 strands of No. 17 AWG conductor, 1/4 inch (6 mm) in diameter.
 - 5. Bonding Conductor: No. 4 AWG, stranded conductor.
 - 6. Bonding Jumper: Copper tape, braided conductors, terminated with copper ferrules; 1-5/8 inches (41 mm) wide and 1/16 inch (1.6 mm) thick.
 - 7. Tinned Bonding Jumper: Tinned-copper tape, braided conductors, terminated with copper ferrules; 1-5/8 inches (41 mm) wide and 1/16 inch (1.6 mm) thick.

2.2 CONNECTORS

- A. Listed and labeled by a nationally recognized testing laboratory acceptable to authorities having jurisdiction for applications in which used, and for specific types, sizes, and combinations of conductors and other items connected.
- B. Bolted Connectors for Conductors and Pipes: Copper or copper alloy, bolted pressure-type, with at least two bolts.
 - 1. Pipe Connectors: Clamp type, sized for pipe.
- C. Welded Connectors: Exothermic-welding kits of types recommended by kit manufacturer for materials being joined and installation conditions.

2.3 GROUNDING ELECTRODES

- A. Ground Rods: Copper-clad steel; 3/4 inch by 10 feet (19 mm by 3 m) in diameter.
- B. Chemical-Enhanced Grounding Electrodes: Copper tube, straight or L-shaped, charged with nonhazardous electrolytic chemical salts.
 - 1. Termination: Factory-attached No. 4/0 AWG bare conductor at least 48 inches (1200 mm) long.
 - 2. Backfill Material: Electrode manufacturer's recommended material.

3. PART 3 EXECUTION

3.1 APPLICATIONS

- A. Conductors: Install solid conductor for No. 8 AWG and smaller, and stranded conductors for No. 6 AWG and larger, unless otherwise indicated.
- B. Underground Grounding Conductors: Install bare copper conductor, No. 4/0 AWG minimum.
 - 1. Bury at least 24 inches (600 mm) below grade.
 - 2. Duct-Bank Grounding Conductor: Bury 12 inches (300 mm) above duct bank when indicated as part of duct-bank installation.

- C. Isolated Grounding Conductors: Green-colored insulation with continuous yellow stripe. On feeders with isolated ground, identify grounding conductor where visible to normal inspection, with alternating bands of green and yellow tape, with at least three bands of green and two bands of yellow.
- D. Grounding Bus: Install in electrical and telephone equipment rooms, in rooms housing service equipment, and elsewhere as indicated.
 - 1. Install bus on insulated spacers 1 inch (25 mm), minimum, from wall 6 inches (150 mm) above finished floor, unless otherwise indicated.
 - 2. Where indicated on both sides of doorways, route bus up to top of door frame, across top of doorway, down to specified height above floor, and connect to horizontal bus.
- E. Conductor Terminations and Connections:
 - 1. Pipe and Equipment Grounding Conductor Terminations: Bolted connectors.
 - 2. Underground Connections: Welded connectors, except at test wells and as otherwise indicated.
 - 3. Connections to Ground Rods at Test Wells: Bolted connectors.
 - 4. Connections to Structural Steel: Welded connectors.

3.2 GROUNDING UNDERGROUND DISTRIBUTION SYSTEM COMPONENTS

- A. Comply with IEEE C2 grounding requirements and CEC Article 250.
- B. Grounding Manholes and Handholes: Install a driven ground rod through manhole or handhole floor, close to wall, and set rod depth so 4 inches (100 mm) will extend above finished floor. If necessary, install ground rod before manhole is placed and provide No. 1/0 AWG bare, tinned-copper conductor from ground rod into manhole through a waterproof sleeve in manhole wall. Protect ground rods passing through concrete floor with a double wrapping of pressure-sensitive insulating tape or heat-shrunk insulating sleeve from 2 inches (50 mm) above to 6 inches (150 mm) below concrete. Seal floor opening with waterproof, nonshrink grout.
- C. Grounding Connections to Manhole Components: Bond exposed-metal parts such as inserts, cable racks, pulling irons, ladders, and cable shields within each manhole or handhole, to ground rod or grounding conductor. Make connections with No. 4 AWG minimum, stranded, hard-drawn copper bonding conductor. Train conductors level or plumb around corners and fasten to manhole walls. Connect to cable armor and cable shields as recommended by manufacturer of splicing and termination kits.
- D. Pad-Mounted Transformers and Switches: Install two ground rods and ground ring around the pad. Ground pad-mounted equipment and noncurrent-carrying metal items associated with substations by connecting them to underground cable and grounding electrodes. Install tinned-copper conductor not less than No. 2 AWG for ground ring and for taps to equipment grounding terminals. Bury ground ring not less than 6 inches (150 mm) from the foundation.

3.3 EQUIPMENT GROUNDING

- A. Install insulated equipment grounding conductors with all feeders and branch circuits sized per C.E.C. Table 250-122.
- B. Install insulated equipment grounding conductors with the following items, in addition to those required by CEC:
 - 1. Feeders and branch circuits.
 - 2. Lighting circuits.
 - 3. Receptacle circuits.
 - 4. Single-phase motor and appliance branch circuits.
 - 5. Three-phase motor and appliance branch circuits.

6. Flexible raceway runs.
 7. Armored and metal-clad cable runs.
 8. Busway Supply Circuits: Install insulated equipment grounding conductor from grounding bus in the switchgear, switchboard, or distribution panel to equipment grounding bar terminal on busway.
 9. Computer and Rack-Mounted Electronic Equipment Circuits: Install insulated equipment grounding conductor in branch-circuit runs from equipment-area power panels and power-distribution units.
- C. Air-Duct Equipment Circuits: Install insulated equipment grounding conductor to duct-mounted electrical devices operating at 120 V and more, including air cleaners, heaters, dampers, humidifiers, and other duct electrical equipment. Bond conductor to each unit and to air duct and connected metallic piping.
 - D. Water Heater: Install a separate insulated equipment grounding conductor to each electric water heater. Bond conductor to heater units, piping, connected equipment, and components.
 - E. Isolated Grounding Receptacle Circuits: Install an insulated equipment grounding conductor connected to the receptacle grounding terminal. Isolate conductor from raceway and from panelboard grounding terminals. Terminate at equipment grounding conductor terminal of the applicable derived system or service, unless otherwise indicated.
 - F. Isolated Equipment Enclosure Circuits: For designated equipment supplied by a branch circuit or feeder, isolate equipment enclosure from supply circuit raceway with a nonmetallic raceway fitting listed for the purpose. Install fitting where raceway enters enclosure, and install a separate insulated equipment grounding conductor. Isolate conductor from raceway and from panelboard grounding terminals. Terminate at equipment grounding conductor terminal of the applicable derived system or service, unless otherwise indicated.
 - G. Signal and Communication Equipment: For telephone, alarm, voice and data, and other communication equipment, provide No. 4 AWG minimum insulated grounding conductor in ¾" (19mm) raceway from grounding electrode system to each service location, terminal cabinet, wiring closet, and central equipment location.
 1. Service and Central Equipment Locations and Wiring Closets: Terminate grounding conductor on a 1/4-by-2-by-12-inch (6-by-50-by-300-mm) grounding bus.
 2. Terminal Cabinets: Terminate grounding conductor on cabinet grounding terminal.
 - H. Metal Poles Supporting Outdoor Lighting Fixtures: Install grounding electrode and a separate insulated equipment grounding conductor in addition to grounding conductor installed with branch-circuit conductors.

3.4 INSTALLATION

- A. Grounding Conductors: Route along shortest and straightest paths possible, unless otherwise indicated or required by Code. Avoid obstructing access or placing conductors where they may be subjected to strain, impact, or damage.
- B. Common Ground Bonding with Lightning Protection System: Comply with NFPA 780 and UL 96 when interconnecting with lightning protection system. Bond electrical power system ground directly to lightning protection system grounding conductor at closest point to electrical service grounding electrode. Use bonding conductor sized same as system grounding electrode conductor, and install in conduit.
- C. Ground Rods: Drive rods until tops are 2 inches (50 mm) below finished floor or final grade, unless otherwise indicated.
 1. Interconnect ground rods with grounding electrode conductor below grade and as otherwise indicated. Make connections without exposing steel or damaging coating, if any.

2. For grounding electrode system, install at least three rods spaced at least one-rod length from each other and located at least the same distance from other grounding electrodes, and connect to the service grounding electrode conductor.
- D. Test Wells: Ground rod driven through drilled hole in bottom of handhole. Handholes are specified in Division 26 Section "Underground Ducts and Raceways for Electrical Systems," and shall be at least 12 inches (300 mm) deep, with cover.
1. Test Wells: Install at least one test well for each service, unless otherwise indicated. Install at the ground rod electrically closest to service entrance. Set top of test well flush with finished grade or floor.
- E. Bonding Straps and Jumpers: Install in locations accessible for inspection and maintenance, except where routed through short lengths of conduit.
1. Bonding to Structure: Bond straps directly to basic structure, taking care not to penetrate any adjacent parts.
 2. Bonding to Equipment Mounted on Vibration Isolation Hangers and Supports: Install so vibration is not transmitted to rigidly mounted equipment.
 3. Use exothermic-welded connectors for outdoor locations, but if a disconnect-type connection is required, use a bolted clamp.
- F. Grounding and Bonding for Piping:
1. Metal Water Service Pipe: Install insulated copper grounding conductors, in conduit, from building's main service equipment, or grounding bus, to main metal water service entrances to building. Connect grounding conductors to main metal water service pipes, using a bolted clamp connector or by bolting a lug-type connector to a pipe flange, using one of the lug bolts of the flange. Where a dielectric main water fitting is installed, connect grounding conductor on street side of fitting. Bond metal grounding conductor conduit or sleeve to conductor at each end.
 2. Water Meter Piping: Use braided-type bonding jumpers to electrically bypass water meters. Connect to pipe with a bolted connector.
 3. Bond each aboveground portion of gas piping system downstream from equipment shutoff valve.
- G. Bonding Interior Metal Ducts: Bond metal air ducts to equipment grounding conductors of associated fans, blowers, electric heaters, and air cleaners. Install bonding jumper to bond across flexible duct connections to achieve continuity.
- H. Grounding for Steel Building Structure: Install a driven ground rod at base of each corner column and at intermediate exterior columns at distances not more than 60 feet (18 m) apart.
- I. Ground Ring: Install a grounding conductor, electrically connected to each building structure ground rod and to each steel column and where indicated on the drawings.
1. Install tinned-copper conductor not less than No. 4/0 AWG for ground ring and for taps to building steel.
 2. Bury ground ring (where indicated) not less than 24 inches (600 mm) from building foundation.
- J. UFER Ground (Concrete-Encased Grounding Electrode): Fabricate according to CEC, using a minimum of 40 feet (12 meters) of bare copper conductor not smaller than No. 4/0 AWG.
1. If concrete foundation is less than 20 feet (6 m) long, coil excess conductor within base of foundation.
 2. Bond grounding conductor to reinforcing steel in at least four locations and to anchor bolts. Extend grounding conductor below grade and connect to building grounding grid or to grounding electrode external to concrete.

3.5 FIELD QUALITY CONTROL

- A. Testing Agency: Owner will engage a qualified testing and inspecting agency to perform field tests and inspections and prepare test reports.
- B. Testing Agency: Engage a qualified testing and inspecting agency to perform the following field tests and inspections and prepare test reports:
- C. Perform the following tests and inspections and prepare test reports:
 - 1. After installing grounding system but before permanent electrical circuits have been energized, test for compliance with requirements.
 - 2. Test completed grounding system at each location where a maximum ground-resistance level is specified, at service disconnect enclosure grounding terminal, at ground test wells, and at individual ground rods. Make tests at ground rods before any conductors are connected.
 - a. Measure ground resistance not less than two full days after last trace of precipitation and without soil being moistened by any means other than natural drainage or seepage and without chemical treatment or other artificial means of reducing natural ground resistance.
 - b. Perform tests by fall-of-potential method according to IEEE 81.
 - 3. Prepare dimensioned drawings locating each test well, ground rod and ground rod assembly, and other grounding electrodes. Identify each by letter in alphabetical order, and key to the record of tests and observations. Include the number of rods driven and their depth at each location, and include observations of weather and other phenomena that may affect test results. Describe measures taken to improve test results.
- D. Report measured ground resistances that exceed the following values:
 - 1. Power and Lighting Equipment or System with Capacity 500 kVA and Less: 10 ohms.
 - 2. Power and Lighting Equipment or System with Capacity 500 to 1000 kVA: 5 ohms.
 - 3. Power and Lighting Equipment or System with Capacity More Than 1000 kVA: 3 ohms.
 - 4. Power Distribution Units or Panelboards Serving Electronic Equipment: 3 ohms.
 - 5. Substations and Pad-Mounted Equipment: 5 ohms.
 - 6. Manhole Grounds: 10 ohms.
- E. Excessive Ground Resistance: If resistance to ground exceeds specified values, notify Architect promptly and include recommendations to reduce ground resistance.

END OF SECTION 26 05 26

SECTION 26 05 29

HANGERS AND SUPPORTS FOR ELECTRICAL SYSTEMS

1. PART 1 GENERAL

1.1 SUMMARY

A. This Section includes the following:

1. Hangers and supports for electrical equipment and systems.
2. Construction requirements for concrete bases.

B. Related Sections include the following:

1. Division 26 Section "Vibration And Seismic Controls For Electrical Systems" for products and installation requirements necessary for compliance with seismic criteria.

1.2 DEFINITIONS

A. EMT: Electrical metallic tubing.

B. IMC: Intermediate metal conduit.

C. RMC: Rigid metal conduit.

1.3 PERFORMANCE REQUIREMENTS

- A. Delegated Design: Design supports for multiple raceways, including comprehensive engineering analysis by a qualified professional engineer, using performance requirements and design criteria indicated.
- B. Design supports for multiple raceways capable of supporting combined weight of supported systems and its contents.
- C. Design equipment supports capable of supporting combined operating weight of supported equipment and connected systems and components.
- D. Rated Strength: Adequate in tension, shear, and pullout force to resist maximum loads calculated or imposed for this Project, with a minimum structural safety factor of five times the applied force.

1.4 SUBMITTALS

A. Product Data: For the following:

1. Steel slotted support systems.
2. Nonmetallic slotted support systems.

B. Shop Drawings: Show fabrication and installation details and include calculations for the following:

1. Trapeze hangers. Include Product Data for components.
2. Steel slotted channel systems. Include Product Data for components.
3. Nonmetallic slotted channel systems. Include Product Data for components.
4. Equipment supports.

C. Welding certificates.

1.5 QUALITY ASSURANCE

- A. Welding: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."
- B. Comply with California Electrical Code (CEC).

1.6 COORDINATION

- A. Coordinate size and location of concrete bases. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork requirements are specified in Division 03.
- B. Coordinate installation of roof curbs, equipment supports, and roof penetrations. These items are specified in Division 07 Section "Roof Accessories."

2. PART 2 PRODUCTS

2.1 SUPPORT, ANCHORAGE, AND ATTACHMENT COMPONENTS

- A. Steel Slotted Support Systems: Comply with MFMA-4, factory-fabricated components for field assembly.
 - 1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - 2. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Allied Tube & Conduit.
 - b. Cooper B-Line, Inc.; a division of Cooper Industries.
 - c. ERICO International Corporation.
 - d. GS Metals Corp.
 - e. Thomas & Betts Corporation.
 - f. Unistrut; Tyco International, Ltd.
 - g. Wesanco, Inc.
 - 3. Metallic Coatings: Hot-dip galvanized after fabrication and applied according to MFMA-4.
 - 4. Nonmetallic Coatings: Manufacturer's standard PVC, polyurethane, or polyester coating applied according to MFMA-4.
 - 5. Painted Coatings: Manufacturer's standard painted coating applied according to MFMA-4.
 - 6. Channel Dimensions: Selected for applicable load criteria.
- B. Nonmetallic Slotted Support Systems: Structural-grade, factory-formed, glass-fiber-resin channels and angles with 9/16-inch- (14-mm-) diameter holes at a maximum of 8 inches (200 mm) o.c., in at least 1 surface.
 - 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. Allied Tube & Conduit.
 - b. Cooper B-Line, Inc.; a division of Cooper Industries.
 - c. Fabco Plastics Wholesale Limited.
 - d. Seasafe, Inc.
 - 3. Fittings and Accessories: Products of channel and angle manufacturer and designed for use with those items.

4. Fitting and Accessory Materials: Same as channels and angles, except metal items may be stainless steel.
 5. Rated Strength: Selected to suit applicable load criteria.
- C. Raceway and Cable Supports: As described in NECA 1 and NECA 101.
- D. Conduit and Cable Support Devices: Steel and malleable-iron hangers, clamps, and associated fittings, designed for types and sizes of raceway or cable to be supported.
- E. Support for Conductors in Vertical Conduit: Factory-fabricated assembly consisting of threaded body and insulating wedging plug or plugs for non-armored electrical conductors or cables in riser conduits. Plugs shall have number, size, and shape of conductor gripping pieces as required to suit individual conductors or cables supported. Body shall be malleable iron.
- F. Structural Steel for Fabricated Supports and Restraints: ASTM A 36/A 36M, steel plates, shapes, and bars; black and galvanized.
- G. Mounting, Anchoring, and Attachment Components: Items for fastening electrical items or their supports to building surfaces include the following:
1. Powder-Actuated Fasteners: Threaded-steel stud, for use in hardened portland cement concrete, steel, or wood, with tension, shear, and pullout capacities appropriate for supported loads and building materials where used.
 - a. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - b. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1) Hilti Inc.
 - 2) ITW Ramset/Red Head; a division of Illinois Tool Works, Inc.
 - 3) MKT Fastening, LLC.
 - 4) Simpson Strong-Tie Co., Inc.; Masterset Fastening Systems Unit.
 2. Mechanical-Expansion Anchors: Insert-wedge-type, zinc-coated or stainless steel, for use in hardened portland cement concrete with tension, shear, and pullout capacities appropriate for supported loads and building materials in which used.
 - a. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - b. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1) Cooper B-Line, Inc.; a division of Cooper Industries.
 - 2) Empire Tool and Manufacturing Co., Inc.
 - 3) Hilti Inc.
 - 4) ITW Ramset/Red Head; a division of Illinois Tool Works, Inc.
 - 5) MKT Fastening, LLC.
 3. Concrete Inserts: Steel or malleable-iron, slotted support system units similar to MSS Type 18; complying with MFMA-4 or MSS SP-58.
 4. Clamps for Attachment to Steel Structural Elements: MSS SP-58, type suitable for attached structural element.
 5. Through Bolts: Structural type, hex head, and high strength. Comply with ASTM A 325.
 6. Toggle Bolts: All-steel springhead type.
 7. Hanger Rods: Threaded steel.

2.2 FABRICATED METAL EQUIPMENT SUPPORT ASSEMBLIES

- A. Description: Welded or bolted, structural-steel shapes, shop or field fabricated to fit dimensions of supported equipment.
- B. Materials: Comply with requirements in Division 05 Section "Metal Fabrications" for steel shapes and plates.

3. PART 3 EXECUTION

3.1 APPLICATION

- A. Comply with NECA 1 and NECA 101 for application of hangers and supports for electrical equipment and systems except if requirements in this Section are stricter.
- B. Maximum Support Spacing and Minimum Hanger Rod Size for Raceway: Space supports for EMT, IMC, and RMC as required by CEC. Minimum rod size shall be 1/4 inch (6 mm) in diameter.
- C. Multiple Raceways or Cables: Install trapeze-type supports fabricated with steel slotted support system, sized so capacity can be increased by at least 25 percent in future without exceeding specified design load limits.
 - 1. Secure raceways and cables to these supports with two-bolt conduit clamps.
- D. Spring-steel clamps designed for supporting single conduits without bolts may be used for 1-1/2-inch (38-mm) and smaller raceways serving branch circuits and communication systems above suspended ceilings and for fastening raceways to trapeze supports.

3.2 SUPPORT INSTALLATION

- A. Comply with NECA 1 and NECA 101 for installation requirements except as specified in this Article.
- B. Raceway Support Methods: In addition to methods described in NECA 1, EMT, IMC, and RMC may be supported by openings through structure members, as permitted in CEC.
- C. Strength of Support Assemblies: Where not indicated, select sizes of components so strength will be adequate to carry present and future static loads within specified loading limits. Minimum static design load used for strength determination shall be weight of supported components plus 200 lb (90 kg).
- D. Mounting and Anchorage of Surface-Mounted Equipment and Components: Anchor and fasten electrical items and their supports to building structural elements by the following methods unless otherwise indicated by code:
 - 1. To Wood: Fasten with lag screws or through bolts.
 - 2. To New Concrete: Bolt to concrete inserts.
 - 3. To Masonry: Approved toggle-type bolts on hollow masonry units and expansion anchor fasteners on solid masonry units.
 - 4. To Existing Concrete: Expansion anchor fasteners.
 - 5. Instead of expansion anchors, powder-actuated driven threaded studs provided with lock washers and nuts may be used in existing standard-weight concrete 4 inches (100 mm) thick or greater. Do not use for anchorage to lightweight-aggregate concrete or for slabs less than 4 inches (100 mm) thick.
 - 6. To Steel: Welded threaded studs complying with AWS D1.1/D1.1M, with lock washers and nuts or Beam clamps (MSS Type 19, 21, 23, 25, or 27) complying with MSS SP-69.
 - 7. To Light Steel: Sheet metal screws.

8. Items Mounted on Hollow Walls and Nonstructural Building Surfaces: Mount cabinets, panelboards, disconnect switches, control enclosures, pull and junction boxes, transformers, and other devices on slotted-channel racks attached to substrate by means that meet seismic-restraint strength and anchorage requirements.
- E. Drill holes for expansion anchors in concrete at locations and to depths that avoid reinforcing bars.

3.3 INSTALLATION OF FABRICATED METAL SUPPORTS

- A. Comply with installation requirements in Division 05 Section "Metal Fabrications" for site-fabricated metal supports.
- B. Cut, fit, and place miscellaneous metal supports accurately in location, alignment, and elevation to support and anchor electrical materials and equipment.
- C. Field Welding: Comply with AWS D1.1/D1.1M.

3.4 CONCRETE BASES

- A. Construct concrete bases of dimensions indicated but not less than 4 inches (100 mm) larger in both directions than supported unit, and so anchors will be a minimum of 10 bolt diameters from edge of the base.
- B. Use 3000-psi (20.7-MPa), 28-day compressive-strength concrete. Concrete materials, reinforcement, and placement requirements are specified in Division 03 Section "Cast-in-Place Concrete or Cast-in-Place Concrete (Limited Applications)" as applicable.
- C. Anchor equipment to concrete base.
 1. Place and secure anchorage devices. Use supported equipment manufacturer's setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
 2. Install anchor bolts to elevations required for proper attachment to supported equipment.
 3. Install anchor bolts according to anchor-bolt manufacturers written instructions.

3.5 PAINTING

- A. Touchup: Clean field welds and abraded areas of shop paint. Paint exposed areas immediately after erecting hangers and supports. Use same materials as used for shop painting. Comply with SSPC-PA 1 requirements for touching up field-painted surfaces.
 1. Apply paint by brush or spray to provide minimum dry film thickness of 2.0 mils (0.05 mm).
- B. Touchup: Comply with requirements in Division 09 for cleaning and touchup painting of field welds, bolted connections, and abraded areas of shop paint on miscellaneous metal.
- C. Galvanized Surfaces: Clean welds, bolted connections, and abraded areas and apply galvanizing-repair paint to comply with ASTM A 780.

END OF SECTION 26 05 29

SECTION 26 05 32

IDENTIFICATION FOR ELECTRICAL SYSTEMS

1. PART 1 GENERAL

1.1 WORK INCLUDED

- A. Nameplates.
- B. Wire and cable markers.

1.2 SUBMITTALS

- A. Submit shop drawings under provisions of Division 01.
- B. Include schedule for nameplates and tape labels.

2. PART 2 PRODUCTS

2.1 MATERIALS

- A. Nameplates: Engraved three-layer laminated plastic, white letters on a black background.
- B. Wire and Cable Markers: Cloth markers, split sleeve or tubing type.

3. PART 3 EXECUTION

3.1 INSTALLATION

- A. Degrease and clean surfaces to receive nameplates.
- B. Install nameplates and tape labels parallel to equipment lines.
- C. Secure nameplates to equipment fronts using screws, or rivets. Secure nameplate to inside face of recessed panelboard doors in finished locations.
- D. Embossed tape will not be permitted for any application.

3.2 WIRE IDENTIFICATION

- A. Provide wire markers on each conductor in panelboard gutters, pull boxes, outlet and junction boxes, and at load connection. Identify with panel and branch circuit or feeder number for power and lighting circuits, and with control wire number as indicated on schematic and interconnection diagrams equipment manufacturer's shop drawings for control wiring.

3.3 NAMEPLATE ENGRAVING

- A. Provide nameplates to identify all circuits in the service distribution and power distribution panelboards; branch circuit panelboards; separately mounted starting switches; disconnecting switches; motor control push-button stations; selector switches; terminal cabinets; telephone cabinets, etc. Clearly identify on the nameplate the equipment such as "Air Handling Unit AH-1" and "Hot Water Cir. Pump P-1" in lieu of abbreviated plan references such as "AH-1" or "P-1".
- B. Provide nameplates of minimum letter height as scheduled below.

- C. Panelboards and Switchboards: 1/4 inch; identify equipment designation, voltage rating, and source.
- D. Individual Circuit Breakers In Panelboards and Switchboards: 1/8 inch; identify circuit and load served, including location.
- E. Individual Circuit Breakers, Enclosed Switches and Motor Starters: 1/8 inch; identify voltage rating, ampere rating and load served including location.
- F. HVAC and Plumbing Control Equipment: 1/8 inch; identify equipment designation and equipment served including location.
- G. Communication Terminal Cabinets: 1/4 inch; identify cabinet designation and type of system.

END OF SECTION 26 05 32

SECTION 26 05 33

RACEWAY AND BOXES FOR ELECTRICAL SYSTEMS

1. PART 1 GENERAL

1.01 SUMMARY

- A. This Section includes raceways, fittings, boxes, enclosures, and cabinets for electrical wiring.
- B. Related Sections include the following:
 - 1. Division 26 Section "Underground Ducts and Raceways for Electrical Systems" for exterior ductbanks, manholes, and underground utility construction.

1.02 DEFINITIONS

- A. EMT: Electrical metallic tubing.
- B. ENT: Electrical nonmetallic tubing.
- C. EPDM: Ethylene-propylene-diene terpolymer rubber.
- D. FMC: Flexible metal conduit.
- E. IMC: Intermediate metal conduit.
- F. LFMC: Liquidtight flexible metal conduit.
- G. LFNC: Liquidtight flexible nonmetallic conduit.
- H. NBR: Acrylonitrile-butadiene rubber.
- I. RNC: Rigid nonmetallic conduit.

1.03 SUBMITTALS

- A. Product Data: For surface raceways, wireways and fittings, floor boxes, hinged-cover enclosures, and cabinets.
- B. Shop Drawings: For the following raceway components. Include plans, elevations, sections, details, and attachments to other work.
 - 1. Custom enclosures and cabinets.
 - 2. For handholes and boxes for underground wiring, including the following:
 - a. Duct entry provisions, including locations and duct sizes.
 - b. Frame and cover design.
 - c. Grounding details.
 - d. Dimensioned locations of cable rack inserts, and pulling-in and lifting irons.
 - e. Joint details.
- C. Samples for Initial Selection: For wireways and surface raceways with factory-applied texture and color finishes.
 - 1. Size: 12" (300mm).

- D. Samples for Verification: For each type of exposed finish required for wireways and surface raceway, prepared on Samples of size indicated below.
1. Size: 12" (300mm).
- E. Coordination Drawings: Conduit routing 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. Structural members in the paths of conduit groups with common supports.
 2. HVAC and plumbing items and architectural features in the paths of conduit groups with common supports.
- F. Manufacturer Seismic Qualification Certification: Submit certification that enclosures and cabinets and their mounting provisions, including those for internal components, will withstand seismic forces defined in Division 26 Section "Vibration and Seismic Controls for Electrical Systems." Include the following:
1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.
 - a. The term "withstand" means "the cabinet or enclosure will remain in place without separation of any parts when subjected to the seismic forces specified and the unit will retain its enclosure characteristics, including its interior accessibility, after the seismic event.
 2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.
 3. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.
- G. Qualification Data: For professional engineer and testing agency.
- H. Source quality-control test reports.

1.04 QUALITY ASSURANCE

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in CEC, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

2. PART 2 PRODUCTS

2.01 METAL CONDUIT AND TUBING

- A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
- B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. AFC Cable Systems, Inc.
 2. Alfex Inc.
 3. Allied Tube & Conduit; a Tyco International Ltd. Co.
 4. Anamet Electrical, Inc.; Anaconda Metal Hose.
 5. Electri-Flex Co.
 6. Manhattan/CDT/Cole-Flex.
 7. Maverick Tube Corporation.
 8. O-Z Gedney; a unit of General Signal.
 9. Wheatland Tube Company.

- C. Rigid Steel Conduit: ANSI C80.1.
- D. Aluminum Rigid Conduit: ANSI C80.5.
- E. IMC: ANSI C80.6.
- F. PVC-Coated Steel Conduit: PVC-coated rigid steel conduit.
 - 1. Comply with NEMA RN 1.
 - 2. Coating Thickness: 0.040 inch (1 mm), minimum.
- G. EMT: ANSI C80.3.
- H. FMC: Zinc-coated steel.
- I. LFMC: Flexible steel conduit with PVC jacket.
- J. Fittings for Conduit (Including all Types and Flexible and Liquidtight), EMT, and Cable: NEMA FB 1; listed for type and size raceway with which used, and for application and environment in which installed.
 - 1. Conduit Fittings for Hazardous (Classified) Locations: Comply with UL 886.
 - 2. Fittings for EMT: Steel, raintight compression with integral insulated throat.
 - 3. Coating for Fittings for PVC-Coated Conduit: Minimum thickness, 0.040 inch (1 mm), with overlapping sleeves protecting threaded joints.
- K. Joint Compound for Rigid Steel Conduit or IMC: Listed for use in cable connector assemblies, and compounded for use to lubricate and protect threaded raceway joints from corrosion and enhance their conductivity.

2.02 NONMETALLIC CONDUIT AND TUBING

- A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
- B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. AFC Cable Systems, Inc.
 - 2. Anamet Electrical, Inc.; Anaconda Metal Hose.
 - 3. Arnco Corporation.
 - 4. CANTEX Inc.
 - 5. CertainTeed Corp.; Pipe & Plastics Group.
 - 6. Condux International, Inc.
 - 7. ElecSYS, Inc.
 - 8. Electri-Flex Co.
 - 9. Lamson & Sessions; Carlon Electrical Products.
 - 10. Manhattan/CDT/Cole-Flex.
 - 11. RACO; a Hubbell Company.
 - 12. Thomas & Betts Corporation.
- C. ENT: NEMA TC 13.
- D. RNC: NEMA TC 2, Type EPC-80-PVC, unless otherwise indicated.
- E. LFNC: UL 1660.
- F. Fittings for ENT and RNC: NEMA TC 3; match to conduit or tubing type and material.
- G. Fittings for LFNC: UL 514B.

2.03 OPTICAL FIBER/COMMUNICATIONS CABLE RACEWAY AND FITTINGS

- A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
- B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Arnco Corporation.
 - 2. Endot Industries Inc.
 - 3. IPEX Inc.
 - 4. Lamson & Sessions; Carlon Electrical Products.
- C. Description: Comply with UL 2024; flexible type, approved for riser installation.

2.04 METAL WIREWAYS

- A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
- B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Cooper B-Line, Inc.
 - 2. Hoffman.
 - 3. Square D; Schneider Electric.
- C. Description: Sheet metal sized and shaped as indicated, NEMA 250, Type 1 or 3R, unless otherwise indicated on drawings or as required for specific installation.
- D. Fittings and Accessories: Include couplings, offsets, elbows, expansion joints, adapters, hold-down straps, end caps, and other fittings to match and mate with wireways as required for complete system.
- E. Wireway Covers: Screw-cover type or Flanged-and-gasketed type for specific installation to maintain NEMA rating.
- F. Finish: Manufacturer's standard enamel finish.

2.05 NONMETALLIC WIREWAYS

- A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
- B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Hoffman.
 - 2. Lamson & Sessions; Carlon Electrical Products.
 - 3. Or approved equal.
- C. Description: Fiberglass polyester, extruded and fabricated to size and shape indicated, with no holes or knockouts. Cover is gasketed with oil-resistant gasket material and fastened with captive screws treated for corrosion resistance. Connections are flanged, with stainless-steel screws and oil-resistant gaskets.
- D. Description: PVC plastic, extruded and fabricated to size and shape indicated, with snap-on cover and mechanically coupled connections with plastic fasteners.
- E. Fittings and Accessories: Include couplings, offsets, elbows, expansion joints, adapters, hold-down straps, end caps, and other fittings to match and mate with wireways as required for complete system.

2.06 SURFACE RACEWAYS

- A. Surface Metal Raceways: Galvanized steel with snap-on covers. Manufacturer's standard enamel finish in color selected by Architect in areas not exposed to public view or Prime coating, ready for field painting where exposed to public view.
 - 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. Thomas & Betts Corporation.
 - b. Walker Systems, Inc.; Wiremold Company (The).
 - c. Wiremold Company (The); Electrical Sales Division.
- B. Surface Nonmetallic Raceways: Not permitted on project.

2.07 BOXES, ENCLOSURES, AND CABINETS

- A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
- B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Cooper Crouse-Hinds; Div. of Cooper Industries, Inc.
 - 2. EGS/Appleton Electric.
 - 3. Erickson Electrical Equipment Company.
 - 4. Hoffman.
 - 5. Hubbell Incorporated; Killark Electric Manufacturing Co. Division.
 - 6. O-Z/Gedney; a unit of General Signal.
 - 7. RACO; a Hubbell Company.
 - 8. Robroy Industries, Inc.; Enclosure Division.
 - 9. Scott Fetzer Co.; Adalet Division.
 - 10. Spring City Electrical Manufacturing Company.
 - 11. Thomas & Betts Corporation.
 - 12. Walker Systems, Inc.; Wiremold Company (The).
 - 13. Woodhead, Daniel Company; Woodhead Industries, Inc. Subsidiary.
- C. Sheet Metal Outlet and Device Boxes: NEMA OS 1.
- D. Cast-Metal Outlet and Device Boxes: NEMA FB 1, ferrous alloy, Type FD, with gasketed cover.
- E. Nonmetallic Outlet and Device Boxes: NEMA OS 2.
- F. Metal Floor Boxes: Cast or sheet metal, semi-adjustable, rectangular.
- G. Nonmetallic Floor Boxes: Not permitted on project.
- H. Small Sheet Metal Pull and Junction Boxes: NEMA OS 1.
- I. Cast-Metal Access, Pull, and Junction Boxes: NEMA FB 1, cast aluminum with gasketed cover.
- J. Hinged-Cover Enclosures: NEMA 250, Type 1, with continuous-hinge cover with flush latch, unless otherwise indicated.
 - 1. Metal Enclosures: Steel, finished inside and out with manufacturer's standard enamel.

K. Cabinets:

1. NEMA 250, Type 1, galvanized-steel box with removable interior panel and removable front, finished inside and out with manufacturer's standard enamel.
2. Hinged door in front cover with flush latch and concealed hinge.
3. Key latch to match panelboards.
4. Metal barriers to separate wiring of different systems and voltage.
5. Accessory feet where required for freestanding equipment.

2.08 HANDHOLES AND BOXES FOR EXTERIOR UNDERGROUND WIRING

A. Description: Comply with SCTE 77.

1. Color of Frame and Cover: Gray.
2. Configuration: Units shall be designed for flush burial and have integral closed bottom, unless otherwise indicated.
3. Cover: Weatherproof, secured by tamper-resistant locking devices and having structural load rating consistent with enclosure.
4. Cover Finish: Nonskid finish shall have a minimum coefficient of friction of 0.50.
5. Cover Legend: Molded lettering, as indicated for each service.
6. Conduit Entrance Provisions: Conduit-terminating fittings shall mate with entering ducts for secure, fixed installation in enclosure wall.
7. Handholes 12 inches wide by 24 inches long (300 mm wide by 600 mm long) and larger shall have inserts for cable racks and pulling-in irons installed before concrete is poured.

B. Polymer-Concrete Handholes and Boxes with Polymer-Concrete Cover: Molded of sand and aggregate, bound together with polymer resin, and reinforced with steel or fiberglass or a combination of the two.

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:
3. Basis-of-Design Product: Subject to compliance with requirements, provide the product indicated on Drawings or a comparable product by one of the following:
 - a. Armorcast Products Company.
 - b. Carson Industries LLC.
 - c. CDR Systems Corporation.
 - d. NewBasis.
 - e. Brooks.

C. Fiberglass Handholes and Boxes with Polymer-Concrete Frame and Cover: Sheet-molded, fiberglass-reinforced, polyester-resin enclosure joined to polymer-concrete top ring or frame.

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:
3. Basis-of-Design Product: Subject to compliance with requirements, provide the product indicated on Drawings.

D. Fiberglass Handholes and Boxes: Molded of fiberglass-reinforced polyester resin, with covers of reinforced concrete.

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:

3. Basis-of-Design Product: Subject to compliance with requirements, provide the product indicated on Drawings.

2.09 SLEEVES FOR RACEWAYS

- A. Steel Pipe Sleeves: ASTM A 53/A 53M, Type E, Grade B, Schedule 40, galvanized steel, plain ends.
- B. Cast-Iron Pipe Sleeves: Cast or fabricated "wall pipe," equivalent to ductile-iron pressure pipe, with plain ends and integral waterstop, unless otherwise indicated.
- C. Sleeves for Rectangular Openings: Galvanized sheet steel with minimum 0.052- or 0.138-inch (1.3- or 3.5-mm) thickness as indicated and of length to suit application.
- D. Coordinate sleeve selection and application with selection and application of firestopping specified in Division 07 Section "Firestopping."

2.10 SLEEVE SEALS

- A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
- B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
- C. 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. Advance Products & Systems, Inc.
 2. Calpico, Inc.
 3. Metraflex Co.
 4. Pipeline Seal and Insulator, Inc.
- D. Description: Modular sealing device, designed for field assembly, to fill annular space between sleeve and cable.
 1. Sealing Elements: EPDM interlocking links shaped to fit surface of cable or conduit. Include type and number required for material and size of raceway or cable.
 2. Pressure Plates: Carbon steel. Include two for each sealing element.
 3. Connecting Bolts and Nuts: Carbon steel with corrosion-resistant coating of length required to secure pressure plates to sealing elements. Include one for each sealing element.

2.11 SOURCE QUALITY CONTROL FOR UNDERGROUND ENCLOSURES

- A. Handhole and Pull-Box Prototype Test: Test prototypes of handholes and boxes for compliance with SCTE 77. Strength tests shall be for specified tier ratings of products supplied.
 1. Tests of materials shall be performed by a independent testing agency.
 2. Strength tests of complete boxes and covers shall be by either an independent testing agency or manufacturer. A qualified registered professional engineer shall certify tests by manufacturer.
 3. Testing machine pressure gages shall have current calibration certification complying with ISO 9000 and ISO 10012, and traceable to NIST standards.

3. PART 3 EXECUTION

3.01 RACEWAY APPLICATION

- A. Outdoors: Apply raceway products as specified below, unless otherwise indicated:
1. Exposed Conduit: Rigid steel conduit.
 2. Concealed Conduit, Aboveground: EMT.
 3. Underground Conduit: RNC, Type EPC-Schedule 40-PVC, direct buried.
 4. Connection to Vibrating Equipment (Including Transformers and Hydraulic, Pneumatic, Electric Solenoid, or Motor-Driven Equipment): LFMC.
 5. Boxes and Enclosures, Aboveground: NEMA 250, Type 3R.
 6. Application of Handholes and Boxes for Underground Wiring:
 - a. Handholes and Pull Boxes in Driveway, Parking Lot, and Off-Roadway Locations, Subject to Occasional, Nondeliberate Loading by Heavy Vehicles: Traffic rated steel.
 - b. Handholes and Pull Boxes in Sidewalk and Similar Applications with a Safety Factor for Nondeliberate Loading by Vehicles: Traffic rated steel.
 - c. Handholes and Pull Boxes Subject to Light-Duty Pedestrian Traffic Only: Traffic rated steel.
- B. Comply with the following indoor applications, unless otherwise indicated:
1. Exposed, Not Subject to Physical Damage: EMT.
 2. Exposed, Not Subject to Severe Physical Damage: EMT.
 3. Exposed and Subject to Physical Damage: IMC. Includes but not limited to, raceways in the following locations:
 - a. Shop Areas.
 - b. Corridors used for traffic of mechanized carts, forklifts, and pallet-handling units.
 - c. Mechanical rooms.
 - d. Kitchen Areas.
 4. Concealed in Ceilings and Interior Walls and Partitions: EMT.
 5. Connection to Vibrating Equipment (Including Transformers and Hydraulic, Pneumatic, Electric Solenoid, or Motor-Driven Equipment): LFMC.
 6. Damp or Wet Locations: IMC.
 7. Raceways for Optical Fiber or Communications Cable in Spaces Used for Environmental Air: EMT unless otherwise noted on drawings.
 8. Raceways for Optical Fiber or Communications Cable Risers in Vertical Shafts: EMT.
 9. Raceways for Concealed General Purpose Distribution of Optical Fiber or Communications Cable: EMT.
 10. Boxes and Enclosures: NEMA 250, Type 1, except use NEMA 250, Type 4, stainless steel in damp or wet locations.
- C. Minimum Raceway Size: 3/4-inch trade size for above ground and 1 inch trade size for below grade.
- D. Raceway Fittings: Compatible with raceways and suitable for use and location.
1. Rigid and Intermediate Steel Conduit: Use threaded rigid steel conduit fittings, unless otherwise indicated.
 2. PVC Externally Coated, Rigid Steel Conduits: Use only fittings listed for use with that material. Patch and seal all joints, nicks, and scrapes in PVC coating after installing conduits and fittings. Use sealant recommended by fitting manufacturer.
- E. Install nonferrous conduit or tubing for circuits operating above 60 Hz. Where aluminum raceways are installed for such circuits and pass through concrete, install in nonmetallic sleeve.

- F. Do not install aluminum conduits in contact with concrete.

3.02 INSTALLATION

- A. Comply with NECA 1 for installation requirements applicable to products specified in Part 2 except where requirements on Drawings or in this Article are stricter.
- B. Keep raceways at least 6 inches (150 mm) away from parallel runs of flues and steam or hot-water pipes. Install horizontal raceway runs above water and steam piping.
- C. Complete raceway installation before starting conductor installation.
- D. Support raceways as specified in Division 26 Section "Hangers and Supports for Electrical Systems."
- E. Arrange stub-ups so curved portions of bends are not visible above the finished slab.
- F. Install no more than the equivalent of three 90-degree bends in any conduit run except for communications conduits, for which fewer bends are allowed.
- G. Conceal conduit and EMT within finished walls, ceilings, and floors, unless otherwise indicated.
- H. Raceways Embedded in Slabs:
 - 1. Not Allowed
 - 2. Change from RNC, Type EPC-80-PVC to PVC coated rigid steel conduit, or IMC before rising above the floor through slab.
- I. Threaded Conduit Joints, Exposed to Wet, Damp, Corrosive, or Outdoor Conditions: Apply listed compound to threads of raceway and fittings before making up joints. Follow compound manufacturer's written instructions.
- J. Raceway Terminations at Locations Subject to Moisture or Vibration: Use insulating bushings to protect conductors, including conductors smaller than No. 4 AWG.
- K. Install pull wires in empty raceways. Use polypropylene or monofilament plastic line with not less than 200-lb (90-kg) tensile strength. Leave at least 12 inches (300 mm) of slack at each end of pull wire. Provide permanent nameplate tags identifying location of other end of raceway.
- L. Raceways for Optical Fiber and Communications Cable: Install raceways, metallic and nonmetallic, rigid and flexible, as follows:
 - 1. 1-Inch (25-mm) Trade Size and Larger: Install raceways in maximum lengths of 75 feet (23 m).
 - 2. Install with a maximum of two 90-degree bends or equivalent for each length of raceway unless Drawings show stricter requirements. Separate lengths with pull or junction boxes or terminations at distribution frames or cabinets where necessary to comply with these requirements.
- M. Install raceway sealing fittings at suitable, approved, and accessible locations and fill them with listed sealing compound. For concealed raceways, install each fitting in a flush steel box with a blank cover plate having a finish similar to that of adjacent plates or surfaces. Install raceway sealing fittings at the following points:
 - 1. Where conduits pass from warm to cold locations, such as boundaries of refrigerated spaces.
 - 2. Where otherwise required by CEC.
- N. Expansion-Joint Fittings for RNC: Not permitted on project.

- O. Flexible Conduit Connections: Use maximum of 72 inches (1830 mm) of flexible conduit for recessed and semi-recessed lighting fixtures, equipment subject to vibration, noise transmission, or movement; and for transformers and motors.
- P. Recessed Boxes in Masonry Walls: Saw-cut opening for box in center of cell of masonry block, and install box flush with surface of wall.
- Q. Set metal floor boxes level and flush with finished floor surface.
- R. Set metallic floor boxes level. Trim after installation to fit flush with finished floor surface.
- S. Coordinate with Architectural drawings for tackable wallboards and install box rings so that no space exists between device and wall plate.
- T. No non-metallic conduit is allowed above grade.

3.03 INSTALLATION OF UNDERGROUND CONDUIT

A. INSTALLATION OF UNDERGROUND CONDUIT

1. Install top of duct bank minimum 24 inches (600mm) below finished grade. Adjust depth to avoid interference with gravity flow systems of any kind. Maintain minimum 12 inches (300mm) clearance between duct bank and any gravity flow system.
2. Duct lines shall have a continuous slope downward toward manholes and away from buildings with a pitch of not less than 4 inches (100mm) in 100 feet (300m). Changes in direction of runs exceeding a total of 10 degrees, either vertical or horizontal, shall be accomplished by long sweep bends having a minimum radius of curvature of 25 feet (50m), except that manufactured bends may be used at ends of short runs of 100 feet (300mm) or less, and then only at or close to the end of run.
3. Terminate conduit in end bell at manhole and pullbox entries.
4. Use suitable separators and chairs installed not greater than 4 feet (25m) on centers. Band conduit together with suitable banding devices. Securely anchor conduit to prevent movement during concrete or slurry placement.
5. Provide minimum 3 inches (75mm) concrete 2 sack slurry cover at bottom, top, and sides of duct bank. Refer to Division 3 section for additional information.
6. Provide two No. 4 steel reinforcing bars in top of bank under paved driving areas.
7. Encase non-metallic primary and secondary feeders, telephone, fire alarm communications and data conduit installed underground 2 inches (50-mm) or larger in a concrete or slurry duct bank unless noted otherwise in the Contract Documents. Space the external surfaces of conduit within a bank a minimum of 3 inches (75-mm) apart except that sound, telephone, data and intercommunication circuits contained within non-metallic conduit shall have a minimum separation of 12 inches (300-mm) from any light or power circuits that parallel them within a bank. Use appropriate manufactured plastic spacers to insure the minimum required concrete or slurry coverage. All concrete or slurry duct conduit banks shall contain a warning tape 12 inches (300-mm) above ductbank.
8. Numbers and sizes of ducts shall be as indicated. Depending on the contour of the finished grade, the high-point may be at a terminal, a manhole, a handhole, or between manholes or handholes. Manufactured steel 90-degree duct bends shall be used only for pole or equipment risers, unless specifically indicated as acceptable. The minimum manufactured bend radius shall be 18 inches (450-mm) for ducts of less than 3-inch (75-mm) diameter, and 36 inches (900-mm) for ducts 3 inches (75mm) in diameter 48 inches (1.2-m) for ducts or greater in diameter unless noted otherwise in the Contract Documents. Long sweep bends having a minimum radius of 25 feet (75-m) shall be used for a change of direction of more than 5 degrees, horizontally or vertically. Both curved and straight sections shall be used to form long sweep bends as required, but the maximum curve used shall be 30 degrees and manufactured bends shall be used. Ducts shall be provided with end bells whenever duct lines terminate in manholes, pullboxes or handholes. Duct line markers shall be provided at the ends of long duct line stubouts or for other ducts whose locations are indeterminate because of duct curvature or terminations at completely below-grade structures. In lieu of markers, a 5-mil brightly colored plastic tape not less than 3 inches (75-mm) in width and suitably inscribed at not more than 10 feet on centers with a continuous metallic backing and

a corrosion resistant 1-mil metallic foil core to permit easy location of the duct line, shall be placed approximately 12 inches (300mm) below finished grade levels of such lines.

9. Ducts shall be kept clean of concrete or slurry, dirt or foreign substances during construction. Field cuts requiring tapers shall be made with proper tools and match factory tapers. After a duct line is completed, a standard flexible mandrel shall be used for cleaning followed by a brush with stiff bristles. Mandrels shall be at least 12 inches (300-mm) long and have diameters 1/4 inch (6.2-mm) less than the inside diameter of the duct being cleaned. Pneumatic rodding may be used to draw in lead wires. A coupling recommended by the duct manufacturer shall be used whenever an existing duct is connected to a duct of different material or shape. Ducts shall be stored to avoid warping and deterioration with ends sufficiently plugged to prevent entry of any water or solid substances. Ducts shall be thoroughly cleaned before being laid. Plastic ducts shall be stored on a flat surface and protected from the direct rays of the sun.

3.04 INSTALLATION OF UNDERGROUND HANDHOLES AND BOXES

- A. Install handholes and boxes level and plumb and with orientation and depth coordinated with connecting conduits to minimize bends and deflections required for proper entrances.
- B. Unless otherwise indicated, support units on a level bed of crushed stone or gravel, graded from 1/2-inch (12.5-mm) sieve to No. 4 (4.75-mm) sieve and compacted to same density as adjacent undisturbed earth.
- C. Elevation: In paved areas, set so cover surface will be flush with finished grade. Set covers of other enclosures 1 inch (25 mm) above finished grade in unpaved areas.
- D. Install handholes and boxes with bottom depth as required to meet elevation of incoming conduits.
- E. Install removable hardware, including pulling eyes, cable stanchions, cable arms, and insulators, as required for installation and support of cables and conductors and as indicated. Select arm lengths to be long enough to provide spare space for future cables, but short enough to preserve adequate working clearances in the enclosure.
- F. Field-cut openings for conduits according to enclosure manufacturer's written instructions. Cut wall of enclosure with a tool designed for material to be cut. Size holes for terminating fittings to be used, and seal around penetrations after fittings are installed.

3.05 SLEEVE INSTALLATION FOR ELECTRICAL PENETRATIONS

- A. Coordinate sleeve selection and application with selection and application of firestopping specified in Division 7 Section "Penetration Firestopping."
- B. Concrete Slabs and Walls: Install sleeves for penetrations unless core-drilled holes or formed openings are used. Install sleeves during erection of slabs and walls.
- C. Use pipe sleeves unless penetration arrangement requires rectangular sleeved opening.
- D. Rectangular Sleeve Minimum Metal Thickness:
 1. For sleeve cross-section rectangle perimeter less than 50 inches (1270 mm) and no side greater than 16 inches (400 mm), thickness shall be 0.052 inch (1.3 mm).
 2. For sleeve cross-section rectangle perimeter equal to, or greater than, 50 inches (1270 mm) and 1 or more sides equal to, or greater than, 16 inches (400 mm), thickness shall be 0.138 inch (3.5 mm).
- E. Fire-Rated Assemblies: Install sleeves for penetrations of fire-rated floor and wall assemblies unless openings compatible with firestop system used are fabricated during construction of floor or wall.
- F. Cut sleeves to length for mounting flush with both surfaces of walls.

- G. Extend sleeves installed in floors 2 inches (50 mm) above finished floor level.
- H. Size pipe sleeves to provide 1/4-inch (6.4-mm) annular clear space between sleeve and raceway unless sleeve seal is to be installed or unless seismic criteria require different clearance.
- I. Seal space outside of sleeves with grout for penetrations of concrete and masonry and with approved joint compound for gypsum board assemblies.
- J. Interior Penetrations of Non-Fire-Rated Walls and Floors: Seal annular space between sleeve and raceway, using joint sealant appropriate for size, depth, and location of joint. Refer to Division 07 Section "Joint Sealants" for materials and installation.
- K. Fire-Rated-Assembly Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at raceway penetrations. Install sleeves and seal with firestop materials. Comply with Division 07 Section "Penetration Firestopping."
- L. Roof-Penetration Sleeves: Seal penetration of individual raceways with flexible, boot-type flashing units applied in coordination with roofing work.
- M. Aboveground, Exterior-Wall Penetrations: Seal penetrations using sleeves and mechanical sleeve seals. Select sleeve size to allow for 1-inch (25-mm) annular clear space between pipe and sleeve for installing mechanical sleeve seals.
- N. Underground, Exterior-Wall Penetrations: Install cast-iron "wall pipes" for sleeves. Size sleeves to allow for 1-inch (25-mm) annular clear space between raceway and sleeve for installing mechanical sleeve seals.

3.06 SLEEVE-SEAL INSTALLATION

- A. Install to seal underground, exterior wall penetrations.
- B. Use type and number of sealing elements recommended by manufacturer for raceway material and size. Position raceway in center of sleeve. Assemble mechanical sleeve seals and install in annular space between raceway and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.

3.07 FIRESTOPPING

- A. Apply firestopping to electrical penetrations of fire-rated floor and wall assemblies to restore original fire-resistance rating of assembly. Firestopping materials and installation requirements are specified in Division 7 Section "Penetration Firestopping."

3.08 PROTECTION

- A. Provide final protection and maintain conditions that ensure coatings, finishes, and cabinets are without damage or deterioration at time of Substantial Completion.
 - 1. Repair damage to galvanized finishes with zinc-rich paint recommended by manufacturer.
 - 2. Repair damage to PVC or paint finishes with matching touchup coating recommended by manufacturer.

END OF SECTION 26 05 33

SECTION 26 05 72

ACCEPTANCE TESTING

1. PART 1 GENERAL

- 1.1 IT IS THE INTENT OF THESE ACCEPTANCE TESTS TO ASSURE THAT ALL CONTRACTOR SUPPLIED EQUIPMENT IS OPERATIONAL AND WITHIN INDUSTRY AND MANUFACTURER'S TOLERANCES AND IS INSTALLED IN ACCORDANCE WITH DESIGNED SPECIFICATIONS.

- A. The acceptance tests and inspections shall determine suitability for energization of switchgear and cables.
- B. Items that shall be checked, inspected, and tested include, but are not limited to, the following:
1. Relays.
 2. Power/Lighting panelboards.
 3. 600V rated cable.
 4. Lighting System

1.2 APPLICABLE CODES

- A. All inspections and tests shall be in accordance with the following applicable codes and standards except as provided otherwise herein.
1. California Electrical Code - CEC 2022 Edition.
 2. National Electrical Manufacturer's Association - NEMA.
 3. American Society for Testing and Materials - ASTM.
 4. Institute of Electrical and Electronic Engineers - IEEE.
 5. National Electrical Testing Association - NETA.
 6. American National Standards Institute - ANSI:
 - a. C2, National Electrical Safety Code
 - b. Z244-1, American National Standard for Personnel Protection
 7. State Codes and Ordinances.
 8. Insulated Cable Engineers Association - ICEA.
 9. Association of Edison Illuminating Companies - AEIC.
 10. Occupational Safety and Health Administration:
 - a. Part 1910, Subpart S, 1910.308
 - b. Part 1926, Subpart V, 1926.950 through 1926.960
 11. National Fire Protection Association - NFPA:
 - a. CEC, Electrical Equipment Maintenance
 - b. CEC, Electrical Safety Requirements for Employee Workplaces
 - c. ANSI/NFPA 70, California Electrical Code 2022 Edition
 - d. ANSI/NFPA 78, Lightning Protection Code
 - e. ANSI/NFPA 101, Life Safety Code
 - f. 2022 Title 24 Energy Guidelines, Chapter 8
 12. All inspections and tests shall utilize the following references:
 - a. Project Design Specification.
 - b. Project Design Drawings.

- c. Manufacturer's instruction manuals applicable to each particular apparatus.

1.3 QUALIFICATIONS OF TESTING AGENCY

- A. The testing firm shall be an independent testing organization, which can function as an unbiased testing authority, professionally independent of the manufacturers, suppliers, and installers of equipment or systems evaluated by the testing firm.
- B. The testing firm shall be regularly engaged in the testing of electrical equipment devices, installations, and systems.
- C. The testing firm and all the testing personnel shall have been engaged in such practices for a minimum of ten years.
- D. The testing firm shall meet federal OSHA criteria for accreditation of testing laboratories, Title 29, Parts 1907, 1910, and 1936. Full membership in the National Electrical Testing Association constitutes proof of such criteria.
- E. The lead, on site, technical person shall be currently certified by the National Electrical Testing Associate (NETA) in Electrical Power Distribution System Testing.
- F. Testing firm shall utilize only full-time technicians who are regularly employed by the firm for testing services. Electrically unskilled employees are not permitted to perform testing or assistance of any kind. Electricians may assist, but may not perform testing and/or inspection services.
- G. The testing firm shall submit proof of the above qualifications.
- H. The testing firm shall be an independent organization as defined by OSHA Title 29, Part 1936 and the National Electrical Testing Association.
- I. All instruments used by the testing firm to evaluate electrical performance shall meet NETA's Specifications for Test Instruments. (See Section 1.7 of this specification).
- J. The terms used herewith such as Test Agency, Testing Laboratory, or Contractor Test Company, shall be construed to mean testing firm.

1.4 RESPONSIBILITIES

- A. The Contractor shall notify the Owners Representative prior to commencement of any testing.
- B. Any system, material or workmanship, which is found defective on the basis of acceptance tests, shall be reported.
- C. The testing firm shall maintain a written record of all tests and upon completion of project, assemble and certify a final test report.
- D. A stable source of 60 hertz power shall be provided for testing purposes by the Contractor. Owners Representative shall witness all tests and a minimum of 14 days notice shall be provided.

1.5 TEST EQUIPMENT

- A. Test Instrument Calibration
 - 1. The testing firm shall have a calibration program that assures that all applicable test instrumentation is maintained within rated accuracy.
 - 2. The accuracy shall be directly traceable to the National Bureau of Standards.

3. Instruments shall be calibrated in accordance with the following frequency schedule:
 - a. Field instruments: Analog - 6 months maximum
Digital - 12 months maximum
 - b. Laboratory Instruments – 2 months
 - c. Leased specialty equipment - 12 months (where accuracy is guaranteed by lessor)
4. Dated calibration labels shall be visible on all test equipment.
5. Records must be kept up-to-date which show date and results of instruments calibrated or tested.
6. An up-to-date instrument calibration instruction and procedure will be maintained for each test instrument.
7. Calibrating standard shall be of higher accuracy than that of the instrument tested.

1.6 TEST REPORTS

- A. The test report shall include the following:
 1. Summary of project.
 2. Description of equipment/device tested.
 3. Description of test, including date, time, and duration of test.
 4. Test results.
 5. Conclusions and recommendations.
 6. Appendix, including appropriate test forms.
 7. Identification of test equipment used.
 8. Signature of responsible test organization authority.
 9. Signature of the person witnessing the tests.
 10. Furnish five copies of the complete report to the Owners Representative no later than thirty (30) days after completion of project unless otherwise directed.

1.7 SAFETY AND PRECAUTIONS

- A. Safety practices shall include, but are not limited to, the following requirements:
 1. Occupational Safety and Health Act of 1970 - OSHA.
 2. Accident Prevention Manual for Industrial Operations, National Safety Council, Chapter 4.
 3. Applicable State safety operating procedures.
 4. NETA Safety/Accident Prevention Program.
 5. District's safety practices.
 6. National Fire Protection Association - NFPA 70E.
 7. ANSI Z244.1 American National Standards for Personnel Protection.
- B. All tests shall be performed with apparatus de-energized except where otherwise specifically required.
- C. The testing firm shall have a designated safety representative on the project to supervise operations with respect to safety.

2. PART 2 PRODUCTS

- NOT USED

3. PART 3 EXECUTION

3.1 GENERAL

- A. As part of the contract, the Contractor shall perform tests of installed work as herein specified and specified in other Sections of these Specifications.
- B. The Contractor shall provide all materials, equipment, labor and technical supervision to perform such tests and inspections.
- C. All tests shall be performed in compliance with the recommendations and requirements of the National Electrical Testing Association, Inc. (NETA), and applicable codes and standards.
- D. Upon completion of the tests and inspections noted in these Specifications, a label shall be attached to all serviced devices. These labels shall indicate date serviced and the service company responsible.
- C. The test and inspections shall determine suitability for continued reliable operation.
- D. All tests shall be conducted in the presence of the Owners Representative. Provide a minimum of two weeks notice to the Owners Representative.
- E. Furnish the necessary equipment and personnel to perform all required tests of all wiring and connections for continuity, short circuit, and improper grounds. Included, but not limited to, the following systems: substations, air interrupting switches, low voltage main and feeder circuit breakers, interlocking controls, panelboards, distribution transformers, branch circuits.

3.2 LOW VOLTAGE CIRCUIT BREAKERS

- A. Visual and mechanical inspection:
 - 1. Inspect for physical condition.
 - 2. Inspect alignment and grounding.
 - 3. Perform mechanical operator and contact alignment tests on the breaker and its operating mechanism in accordance with manufacturer's instructions.
 - 4. Perform insulation resistance test on control wiring.
 - 5. Clean mechanism, insulating surfaces and contacts.
- B. Electrical tests:
 - 1. Measure contact resistance.
 - 2. Trip overcurrent protective device by operation of each protective device.
 - 3. Perform an insulation resistance test phase-to-ground, phase-to-phase and across open contacts.
 - 4. Perform insulation resistance test in accordance with Doble procedure.
 - 5. Perform timing test with Travel Analyzer to insure proper contact overtravel and pressure.

3.3 CABLES, LOW VOLTAGE (600 VOLTS AND LESS)

- A. Visual and mechanical inspections:
 - 1. Inspect cables for physical damage and proper connection.
 - 2. Torque test cable connection. Tighten connections in accordance with industry standards.
 - 3. Perform infrared scan of all connections under loaded conditions.
- B. Electrical tests:
 - 1. Perform insulation resistance test of each cable with respect to ground and adjacent cables.

3.4 GROUNDING SYSTEMS

A. Visual and mechanical inspection:

1. Inspect ground system connections for completeness and adequacy.

B. Electrical tests:

1. Perform fall-of-the-potential test per IEEE No. 81, Section 9.03 to determine the ground resistance between the main grounding system and all major electrical equipment frames, system neutral and/or derived neutral points.

END OF SECTION 26 05 72

SECTION 26 27 26

WIRING DEVICES

1. PART 1 GENERAL

1.1 WORK INCLUDED

- A. Wall switches.
- B. Receptacles.
- C. Device plates and decorative box covers.
- D. Time switches.

1.2 REFERENCES

- A. NEMA WD 1 - General-Purpose Wiring Devices.
- B. NEMA WD 6 - Wiring Device Configurations.

1.3 QUALIFICATIONS

- A. Manufacturer: Company specializing in manufacturing products specified in this Section with minimum three years documented experience.

2. PART 2 PRODUCTS

2.1 WALL SWITCHES

A. Single Pole Switch:

- 1. Hubbell, Model 2121-W.
- 2. Leviton, Model 5621-2W.
- 3. Equal by Arrow Hart or Bryant.

B. Double Pole Switch:

- 1. Hubbell, Model 2122-W.
- 2. Leviton, Model 5622-2W.
- 3. Equal by Arrow Hart or Bryant.

C. Three-way Switch:

- 1. Hubbell, Model 2123-W.
- 2. Leviton, Model 5623-3W.
- 3. Equal by Arrow Hart or Bryant.

D. Substitutions: Under provisions of Division 01.

- E. Description: NEMA WD 1, heavy-duty specification grade, AC only general-use quiet type rocker switch, UL approved for tungsten lamp loads or inductive loads without derating.

- F. Device Body: White plastic with rocker handle.
- G. Ratings: 20A., 120-277V A.C. or as required to match with specific branch circuit and load characteristics.
- H. Keyed switches shall be Leviton only per District standards.

2.2 RECEPTACLES

A. Duplex Convenience Receptacle:

- 1. Hubbell
- 2. Leviton
- 3. Arrow Hart
- 4. Bryant.

B. GFCI Receptacle:

- 1. Hubbell
- 2. Leviton
- 3. Arrow Hart
- 4. Bryant.

C. Surge Protected Outlets:

- 1. Hubbell
- 2. Leviton
- 3. Arrow Hart
- 4. Bryant.

D. Substitutions: Under provisions of Division 01.

E. Description: NEMA WD 1; heavy-duty general-use receptacle. 20 Amp, 125V, 2-pole, 3-wire style line series.

F. Device Body: Plastic.

G. Configuration: NEMA WD 6; type as specified and indicated.

H. Convenience Receptacle: Type 5-20R

I. GFCI Receptacle: Convenience receptacle with integral ground fault circuit interrupter to meet regulatory requirements.

2.3 WALL PLATES

A. Plates shall be brushed stainless steel and supplied for every local switch, receptacle, telephone and data outlet, wall speaker outlet, etc.

B. Weatherproof Cover Plate: Gasketed cast metal with hinged gasketed device cover.

C. Locking Weatherproof Cover Plate: Pass & Seymour #WP26-L or equal at locations Indicated on drawings.

- D. Plates shall be engraved and filled, when used for:
 - 1. More than two gangs.
 - 2. Equipment that cannot be seen from the locations.
 - 3. All lock type switches.
 - 4. All receptacles other than 120 volts.
 - 5. All pilot switches.
 - 6. Switches in locations from which the equipment or circuits controlled cannot be readily seen.
 - 7. Manual motor starting switches.
 - 8. Where so indicated on the drawings.
 - 9. As required on all control circuit switches, such as heater controls, etc.

2.4 TIME SWITCHES

- A. Manufacturers:
 - 1. Tork.
 - 2. Paragon.
 - 3. Intermatic.
- B. Description: AC electronic time clock, 7-day.
- C. Input voltage: 120V.
- D. Poles: 40A, 120V, number as indicated. (4 pole minimum)
- E. Enclosure: Type as required to meet installation.
- F. Configuration: 365 Day Astronomic, electronic, programmable.
- G. Accessories: Photocell control as indicated.

3. PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify outlet boxes are installed at proper height.
- B. Verify wall openings are neatly cut and will be completely covered by wall plates.
- C. Verify branch circuit wiring installation is completed, tested, and ready for connection to wiring devices.

3.2 PREPARATION

- A. Provide extension rings to bring outlet boxes flush with finished surface.
- B. Clean debris from outlet boxes.

3.3 INSTALLATION

- A. Install products in accordance with manufacturer's instructions.
- B. Install devices plumb and level.

- C. Install switches with OFF position down.
- D. Install receptacles with grounding pole on top
- E. Connect wiring device grounding terminal to branch circuit equipment grounding conductor.
- F. Install decorative plates on switches, receptacles, etc., and blank outlets in finished areas.
- G. Connect wiring devices by wrapping conductor around screw terminal.
- H. Use jumbo size plates for outlets installed in masonry walls.
- I. Install galvanized steel plates on outlet boxes and junction boxes in unfinished area, above accessible ceilings, and on surface mounted outlets.

3.4 INTERFACE WITH OTHER PRODUCTS

- A. Coordinate locations of outlet boxes provided under Section 260533 to obtain mounting heights specified and indicated on drawings.
- B. Install wall switches as indicated on drawings.
- C. Install convenience receptacles 18 inches above finished floor.
- D. Install convenience receptacle 6 inches above backsplash of counter.

3.5 FIELD QUALITY CONTROL

- A. Inspect each wiring device for defects.
- B. Operate each wall switch with circuit energized and verify proper operation.
- C. Verify that each receptacle device is energized.
- D. Test each receptacle device for proper polarity.
- E. Test each GFCI receptacle device for proper operation.

3.6 ADJUSTING

- A. Adjust devices and wall plates to be flush and level.

END OF SECTION 26 27 26